FORM-14159 R000*

Periodic Safety Review - Final Document Review Traveler

Bruce Power

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Bruce Power Document Title:
Safety Factor 8 – Safety Performance

Bruce Power Contract/Purchase Order:	Bruce Power Project #:
00193829	38180

Supplier's Name:	Supplier Document #:	Revision:
CANDESCO	K-421231-00018	R00

Supplier Document Title:
Safety Factor 8 – Safety Performance

Accepted for use at Bruce Power by:	**Signature:**	**Date**
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Acceptance of this document does not relieve the Supplier of responsibility for any errors or omissions

*Associated with BP-PROC-01024, Periodic Safety Reviews

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Title: Safety Factor 8 - Safety Performance

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NK21-SFR-09701-00008

A Report Submitted to Bruce Power

June 30, 2015

Issue	Reason for Issue:				
R00D0	For first internal Candesco review				
	Author: J. Sobolewski	Verifier:	Reviewer: G. Archinoff T. Kapaklili D. Rennick	Approver:	Date: Dec 23, 2014
Issue	**Reason for Issue:**				
R00D1	For harmonization, which incorporates internal Candesco review comments				
	Author: J. Sobolewski	Verifier:	Reviewer: G. Archinoff T. Kapaklili D. Rennick	Approver:	Date: Jan 29, 2015
Issue	**Reason for Issue:**				
R00D2	For final internal Candesco review				
	Author: J. Sobolewski	Verifier:	Reviewer: G. Archinoff L. Watt	Approver:	Date: Feb 20, 2015
Issue	**Reason for Issue:**				
R00D3	Issued to Bruce Power for review				
	Author: J. Sobolewski	Verifier: G. Buckley	Reviewer: G. Archinoff L. Watt	Approver:	Date: March 6, 2015

	Rev Date: June 30, 2015	Status: Issued
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<table>
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R00D4</td><td colspan="5">Reason for Issue:
Incorporates changes from Bruce Power review</td></tr>
<tr><td>Author:
J. Sobolewski</td><td>Verifier:
G. Aldev</td><td>Reviewer:
G. Archinoff
L. Watt</td><td>Approver:</td><td>Date:
June 19, 2015</td></tr>
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R00</td><td colspan="5">Reason for Issue:
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<tr><td>Author:
J. Sobolewski</td><td>Verifier:
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C. Stallman</td><td>Reviewer:
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</table>

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Acronyms and Abbreviations

ACE	Apparent Cause Evaluation
ACR	Annual Compliance Report
AHP	Authorized Health Physicist
ALARA	As Low As Reasonably Achievable
AR	Action Request
BP	Bruce Power
CANDU	Canada Deuterium Uranium
CCA	Contamination Control Area
CHRs	Component Health Reports
CPMP	Component Performance Monitoring Plan
CMLF	Central Maintenance and Laundry Facility
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DCN	Design Change Notice
DCP	Design Change Package
DRL	Derived Release Limit
DRP	Discrete Radioactive Particles
EA	Environmental Assessment
EACE	Equipment Apparent Cause Evaluation
EFPH	Equivalent Full Power Hours
EMS	Environmental Management System
ER	Equipment Reliability
ERCOE	Equipment Reliability Centre of Excellence
ERCI	Equipment Root Cause Investigation
FASA	Focus Area Self-Assessment
FCN	Field Change Notice
HU	Human Performance
IAEA	International Atomic Energy Agency
ISO	International Organization for Standardization

INPO	Institute of Nuclear Power Operations
ISR	Integrated Safety Review
JHSC	Joint Health and Safety Committee
KPIs	Key Human Performance (HU) Indicators
LBLOCA	Large Break Loss of Coolant Accident
LCH	Licence Conditions Handbook
LTEP	Long Term Energy Plan
M&TE	Maintenance and Test Equipment
MCR	Major Component Replacement
MOE	Ministry of the Environment
MRM	Management Review Meeting
NIEP	Nuclear Industry Evaluation Program
NORA	Nuclear Oversight and Regulatory Affairs
NPP	Nuclear Power Plant
NSCA	Nuclear Safety and Control Act
NSRD	Nuclear Substance and Radiation Device
OFIs	Opportunities for Improvement
OPEX	Operating Experience
OPG	Ontario Power Generation
OP&Ps	Operating Policies and Principles
PDS	Problem Development Sheets
PIs	Performance Indicators
PM	Preventative Maintenance
PMP	Performance Monitoring Plan
PMOG	Preventative Maintenance Oversight Group
POC	Performance Objectives and Criteria
PORC	Plant Operational Review Committee
PPE	Personal Protective Equipment
PROL	Power Reactor Operating Licence
PSAs	Probabilistic Safety Assessments
PSR	Periodic Safety Review

QORs	Quarterly Operations Reports
QRPI	Quarterly Reports of Performance Indicators
RCEs	Responsible Component Engineers
RCI	Root Cause Investigation
RIDM	Risk Informed Decision Making
RP	Radiation Protection
RSEs	Responsible System Engineers
SAT	Systematic Approach to Training
SBR	Safety Basis Report
SCA	Safety and Control Areas
SCR	Station Condition Record
SFR	Safety Factor Report
SHRs	System Health Reports
SIS	Systems Important to Safety
SOE	Safe Operating Envelope
SOER	Significant Operating Experience Report
SPHC	Station Plant Health Committee
SSC	Structures, Systems, and Components
WANO	World Association of Nuclear Operators
WIS	Workplace Inspections System
WNSL	Waste Nuclear Substance Licence

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 plant's safety performance indicators and records of operating experience, including the evaluation of root causes of plant events, indicate the need for safety improvements.

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. The review of safety performance will evaluate whether the plant has in place appropriate processes for the routine recording and evaluation of safety related operating experience, including:
    a. Safety related incidents, low level events and near misses;
    b. Safety related operational data;
    c. Maintenance, inspection and testing;
    d. Replacements of Structures, Systems and Components (SSCs) important to safety owing to failure or obsolescence;
    e. Modifications, either temporary or permanent, to SSCs important to safety;
    f. Unavailability of safety systems;
    g. Radiation doses (to workers, including contractors);
    h. Off-site contamination and radiation levels;
    i. Discharges of radioactive effluents;
    j. Generation of radioactive waste;
    k. Compliance with regulatory requirements.
2. Where safety performance indicators are used, the review considers their adequacy and effectiveness, applying trend analysis and comparing performance levels with those for other plants in Canada;
3. The review considers the effectiveness of the processes and methodology used to evaluate and assess operating experience and trends. The findings of the reviews of other Safety Factors is taken into account when undertaking this task;
4. Records of radiation doses and radioactive effluents are reviewed to determine whether these are within prescribed limits, as low as reasonably achievable and adequately managed. Although radiation risks is considered in all Safety Factors, the review of this Safety Factor examines specifically data on radiation doses and radioactive effluents and the effectiveness of the radiation protection measures in place. The review takes into account the types of activity being undertaken at the plant, which may not be directly comparable with those at other nuclear power plants in Canada; and
5. Data on the generation of radioactive waste will be reviewed to determine whether operation of the plant is being optimized to minimize the quantities of waste being generated and accumulated, taking into account the national policy on radioactive discharges and international treaties, standards and criteria.

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. Acts 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. Operating Licence

The list of codes and standards related to safety performance that are referenced in the Bruce Power Reactor Operating Licence (PROL) [15] and Licence Conditions Handbook (LCH) [16] [17], and confirmed as relevant against Table C-1 of the ISR Basis Document [1] are identified in Table 1.[2] The edition dates referenced in the third column of the table are the modern versions used for comparison. The following licence conditions have been re-affirmed as applicable for Safety Performance:

- Licence Condition 1.7: S-99: Reporting Requirements for Operating Nuclear Power Plants.
- Licence Condition 3.1: Maintaining Operating Policies and Principles (OP&Ps).
- Licence Condition 3.3: Comply with the reactor power limits specified.

[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.

- Licence Condition 3.4: Not Restart the Reactor after a Serious or Potential Serious Process Failure, without consent.
- Licence Condition 5.2: Not make any change to the design of the facility, facility operation, equipment or procedure that would change the operational limits in condition 3.1, or introduce hazards different in nature or greater in probability than those considered by the Final Safety Analysis Report and Probabilistic Safety Assessment, without consent.
- Licence Condition 8.2: Control, monitor and record releases of nuclear substances to the environment from the nuclear facility so the releases do not exceed the derived release limits of the PROL.
- Licence Condition 8.3: Notify, within 7 days of becoming aware that an action level has been reached.
- Licence Condition 9.1: Implement and maintain a radiation protection program for the nuclear facility.
- Licence Condition 9.2: Notify, within 7 days of becoming aware that an action level has been reached.

These clauses are considered in this sub-section of Section 3 to determine where additional code and standard reviews are necessary.

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 S-99 (2003) [20]	Reporting Requirements for Operating Nuclear Power Plants	CNSC REGDOC-3.1.1 (2014) [21]	NR
CNSC RD/GD-99.3 [22]	Public Information and Disclosure	CNSC RD/GD-99.3 (2012) [22]	NR
CNSC RD-204 [23]	Certification of Persons Working at Nuclear Power Plants	CNSC RD-204 [23]	NR
CNSC S-210 [24]	Maintenance Programs for Nuclear Power Plants	CNSC RD/GD-210 [25]	NR
CNSC RD-360 [4]	Life Extension of Nuclear Power Plants	CNSC RD-360 [4]	NR

Document Number	Document Title	Modern Version Used for ISR Comparison	Type of Review
CNSC Internal Guide, 2010/08	CNSC Expectations for Licensee Hours of Work Limits - Objectives and Criteria	CNSC Internal Guide, 2010/08 [26]	NR
CNSC Internal Guide, 2009/05	Requirements for the Requalification Testing of Certified Shift Personnel at Nuclear Power Plants	CNSC Internal Guide, 2009/05 [27]	NR
Examination Guide EG-1	Requirements and Guidelines for Written and Oral Certification Examinations for Shift Personnel at Nuclear Power Plants	Examination Guide EG-1 (2005) [28]	NR
Examination Guide EG-2	Requirements and Guidelines for Simulator-Based Certification Examinations for Shift Personnel at Nuclear Power Plants	Examination Guide EG-2 (2004) [29]	NR
CSA N286-05 (R2011) [30]	Management System Requirements for Nuclear Power Plants	CSA N286-12 [31]	NR
CSA N290.15 [32]	Requirements for the safe operating envelope of nuclear power plants	CSA N290.15 [32]	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-3.1.1: Table C-1 of the ISR Basis Document [1] calls for a code-to-code assessment of CNSC REGDOC-3.1.1 to CNSC S-99. CNSC S-99 (2003) [20], "Reporting Requirements for Operating Nuclear Power Plants", was included in PROL 15.00/2015 and was the basis document the CNSC used to assess past refurbishments at Bruce A, as Bruce Power has had an obligation to meet this Regulatory Document since before 2008. CNSC REGDOC-3.1.1 [21], Reporting Requirements for Nuclear Power Plants, which replaced S-99 [20] in May 2014, is listed as condition 1.7 in PROL 18.00/2020 [18] and sets reporting requirements for nuclear power plants. Bruce Power switched over to CNSC REGDOC-3.1.1 at the beginning of 2015[3], as committed in a letter submitted to the CNSC [33]. Line-by-line

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

compliance with this regulatory document is verified on an ongoing basis to ensure compliance with the PROL, and therefore it was not assessed as part of this Safety Factor.

CNSC RD/GD-99.3: Table C-1 of the ISR Basis Document [1] calls for a clause-by-clause assessment of CNSC RD/GD-99.3 [22], Public Information and Disclosure, which establishes regulatory requirements for public information and disclosure for licensees. CNSC RD/GD-99.3 replaces Regulatory Guide G-217, Licensee Public Information Programs. Bruce Power has established an effective public information, disclosure and communication program ([34] Appendix G), and RD/GD-99.3 is already included in Bruce Power's Management System Manual [35]. Neither RD/GD-99.3 nor its predecessor G-217 were included in the Safety and Control Areas (SCAs) and they are not applicable to safety. 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-204: CNSC RD-204 [23] defines requirements regarding certification of persons who work at Canadian Nuclear Power Plants (NPPs) in positions that have a direct impact on nuclear safety. The document specifies the requirements to be met by persons working, or seeking to work, in positions where certification by the Canadian Nuclear Safety Commission is required. It specifies the requirements regarding the programs and processes supporting certification of the workers that NPP licensees must implement to train and examine persons seeking or holding a certification delivered by the CNSC.

Consistent with the CNSC's regulatory philosophy and with international practice, licensees are first and foremost responsible for the safe operation of their respective NPPs. Consequently, NPP licensees are held responsible for training and testing their workers to ensure that they are fully qualified to perform the duties of their position, in accordance with current regulatory requirements. The CNSC obtains assurances that each person it certifies is qualified to perform the duties of the applicable position by means of a regulatory oversight regime of the licensees' training programs and certification examinations based on a combination of appropriate regulatory guidance and compliance activities.

Training and Human Performance aspects are considered in Safety Factor 12. From the Safety Factor 8 perspective, there simply needs to be an assurance workers are qualified. Safety Factor 12 performs an in-depth review of whether workers are qualified and the means to qualify them, and the processes and results are audited regularly by the CNSC as part of their inspection programmes. RD-204 is not reviewed in Safety Factor 8.

CNSC RD/GD-210: Regulatory document RD/GD-210 [25], Maintenance Programs for Nuclear Power Plants, sets out the requirements of the CNSC with regard to maintenance programs for nuclear power plants. It specifies that a maintenance program consists of policies, processes and procedures that provide direction for maintaining SSCs of the plant. RD/GD-210 [25] replaces regulatory standard S-210 (published in 2007). RD/GD-210 will be listed in the PROL line-by-line compliance with this regulatory document is verified on an ongoing basis to ensure compliance with the PROL. Therefore assessment of RD/GD-210 is not included in this Safety Factor.

CNSC RD-360 (2008): 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.

CNSC Internal Guidance: Table C-1 of the ISR Basis Document [1] identifies CNSC internal Guidance regarding the “CNSC Expectation for Licensee Hours of Work Limits – Objectives and Criteria” and “Requirements for the Requalification Testing of Certified Shift Personnel at Nuclear Power Plants”. The ISR Basis Document states that these internal guidance documents will not be assessed as a part of this ISR.

CNSC Examination Guide EG-1: Table C-1 of the ISR Basis Document [1] identifies Examination Guide EG-1, “Requirements and Guidelines for Written and Oral Certification Examinations for Shift Personnel at Nuclear Power Plants”. The ISR Basis Document states that EG-1 will not be assessed as a part of this ISR.

CNSC Examination Guide EG-2: Table C-1 of the ISR Basis Document [1] identifies Examination Guide EG-1, “Requirements and Guidelines for Simulator-Based Certification Examinations for Shift Personnel at Nuclear Power Plants”. The ISR Basis Document states that EG-2 will not be assessed as a part of this ISR.

CSA N286-05: Table C-1 of the ISR Basis [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” [36].

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 [37]. 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 [38]. 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.

CSA N290.15: CSA N290.15 [32] is referenced in the PROL. Bruce Power has procedures to ensure compliance with it [39] under the auspices of the Safe Operating Envelope (SOE). As part of the SOE, consistent with the deterministic safety analyses, Bruce Power has comprehensively identified the operating limits and conditions for safety-related systems where operator actions are effective in keeping the systems within the analyzed envelope. Some limits are included directly in the licence, including the fuel bundle power and reactor power limits. Recognizing further support has been discussed with the Regulator to enhance the SOE has extended its full implementation [40]. Therefore, there is no further discussion on this standard in this Safety Factor Report.

3.3. Regulatory Documents

In addition to those Regulatory Documents identified in the Bruce Power PROL [15] and LCH [16], the Regulatory Documents identified in Table C-1 of the ISR Basis Document [1] considered for application to review tasks of this Safety Factor are included in Table 2.

Table 2: Regulatory Documents

Document Number	Document Title	Reference	Type of Review
CNSC R-10 (1977)	The Use of Two Shutdown Systems in Reactors	[41]	NR
CNSC REGDOC-2.2.2 (2014)	Personnel Training	[42]	CBC
Assessment type: Clause-by-Clause (CBC); Code-to-Code (CTC); High Level (HL); No Assessment Required (NR); Confirm Validity of Previous Assessments (CV)			

CNSC R-10: CNSC R-10 [41] provides requirements for the shutdown systems in reactors. Section 3 of this regulatory document identifies the design requirements for the use of two shutdown systems for reactors and thus is relevant to design. The CNSC has recently reviewed and reorganized its regulatory framework program in order to develop a more robust, manageable and up-to-date regulatory requirements framework. A key objective of the review was ensuring that CNSC regulatory requirements are well defined and supported by additional guidance, as necessary. CNSC staff has been working with the CSA Group to develop amendments to CSA N290.1 Requirements for the Shutdown Systems of Canada Deuterium Uranium (CANDU) Nuclear Plants to incorporate all necessary existing requirements currently available in R-10. With the publication of this standard, R-10 is no longer reflecting the current regulatory environment and as such during FY 2012-13 [43] it was identified that it is not necessary to maintain R-10 and it can be withdrawn and archived. Table C-1 of the ISR Basis Document [1] calls for the confirmation of validity of previous assessments of this code to be performed. However, since a clause-by-clause assessment of the latest edition (i.e., 2013) of CSA N290.1 standard is performed and documented in Safety Factor 1, review against CNSC R-10 is not necessary.

In the Bruce 3 and 4 ISR, the requirements of CNSC R-10 were noted as applicable to Safety Factors 1, 5 and 7, rather than Safety Factor 8 [10] [11] [12]. Reference [44] refers to the earlier reviews, e.g., Reference [9] and [8], but none of these referred to Safety Factor 8. Therefore, R-10 was re-reviewed recognizing that it has not changed since 1977. Clauses Part II 3.6), 3.7) of R-10 on testing and reliability were considered to be applicable to Safety Factor 8, as they were written to ensure testing and reliability are completed to confirm the shutdown system safety performance. These are activities are routinely reported on in response to the requirements of S-99 (see the discussion in Section 3.2).

CNSC REGDOC-2.2.2: CNSC REGDOC-2.2.2 [42] sets out the CNSC's requirements for the development of a training system at nuclear facilities, and provides guidance on how these requirements should be met. Specifically, it defines the requirements and guidance for the analysis, design, development, implementation, evaluation, documentation, and management of training for workers at nuclear facilities in Canada, including the principles and elements essential to an effective training system. The requirements and guidance contained in CNSC REGDOC-2.2.2 align with the IAEA's recommendations on the use of the Systematic Approach to Training (SAT) methodology, as set forth in Technical Report Series 380, Nuclear Power Plant Personnel Training and its Evaluation: A Guidebook. CNSC REGDOC-2.2.2 formalizes the CNSC's existing oversight program for training in nuclear facilities, and provides the basis for assessing the acceptability of licensee training programs.

The majority of CNSC REGDOC-2.2.2 is applicable to Safety Factor 12, rather than Safety Factor 8. There is a minor relevance to Safety Factor 8 in clauses 5.4 and 5.5, which respectively discuss continual monitoring to ensure learning is occurring on a routine basis and incident reports and rework statistics are raised when shortcoming arise. As it is identified in Table 2, CNSC REGDOC-2.2.2 is to be further assessed, but given its limited relevance to Safety Factor 8, the comprehensive clause-by-clause assessment is provided in Safety Factor 12. Safety Factor 12 is used as the basis for confirming the qualification of workers, discussed in Section 5. Bruce Power and the CNSC initial reviews show there are few if any gaps in Bruce Power's ability to comply with CNSC REGDOC-2.2.2 [45].

3.4. CSA Standards

There were no additional CSA standards were identified in Table C-1 of the ISR Basis Document [1] considered for application to review tasks of this Safety Factor beyond those identified in the PROL [15] and LCH [16].

3.5. International Standards

As applicable international guidance considered for application to review tasks of this Safety Factor are included in Table 3.

Table 3: International Standards

Document Number	Document Title	Reference	Type of Review
IAEA SSG-25 (2013)	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. Bruce Power routinely considers external industry standards such as those from the International Atomic Energy Agency (IAEA), Institute of Nuclear Power Operations (INPO) and World Association of Nuclear Operators (WANO) when developing their procedures.

4. Overview of Applicable Bruce A Station Programs and Processes

Sections 4.1through 4.6 provide an overview of Bruce Power programs, procedures and practices related to this Safety Factor.

4.1. Key Implementing Documents

The key Bruce Power documents related to implementation of the elements related to Safety Performance are indicated in Table 4.[4]

[4] Table 4 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 4: Key Implementing Documents

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
BP-MSM-1: Management System Manual [46]	BP-PROG-00.02: Environmental Safety Management [47]		
	BP-PROG-00.06: Health and Safety Management [48]	BP-PROC-00651: Safety Performance Metric and Monitoring, [64]	
	BP-PROG-00.07: Human Performance Program [49]	BP-PROC-00271: Observation and Coaching [65]	
		BP-PROC-00617: Human Performance Tools for Workers [66]	
		BP-PROC-00794: Monitoring Human Performance [67]	
		BP-PROC-00811: Procedure Alterations [68]	
		BP-PROC-00795: Human Performance Tools for Knowledge Workers [69]	
	BP-PROG-01.01: Business Planning Program [50]	BP-PROC-00936: Asset Management Planning [70]	
	BP-PROG-01.06: Operating Experience Program [51]	BP-PROC-00062: Processing External and Internal Operating Experience [71]	

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
		BP-PROC-00137: Focus Area Self-Assessment [72]	
		BP-PROC-00147: Benchmarking and Conference Activities [73]	
		BP-PROC-00892: Nuclear Safety Culture Monitoring [74]	
	BP-PROG-01.07: Corrective Action [52]	BP-PROC-00019: Action Tracking [75]	
		BP-PROC-00059: Event Response and Reporting [76]	
		BP-PROC-00060: Station Condition Record Process [77]	
		BP-PROC-00252: Control of Nonconforming Items [78]	
		BP-PROC-00412: Trend identification and Reporting of SCRs [79]	
		BP-PROC-00506: Effectiveness Reviews [80]	

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
		BP-PROC-00518: Root Cause Investigation [81]	
		BP-PROC-00519: Apparent Cause Evaluation (ACE) [82]	
		BP-PROC-00644: Common Cause Analysis [83]	
	BP-PROG-06.01: CNSC Licence Acquisition [53]	BP-PROC-00114: Power Reactor Operating Licence Amendment or Renewal [84]	
	BP-PROG-06.03: CNSC Interface Management [54]	BP-PROC-00064: Formal Correspondence with the CNSC [85]	
		BP-PROC-00833: Reporting to the CNSC [86]	BP-PROC-00165: Reporting to CNSC – Power Reactor Operating Licences [111]
			BP-PROC-00139: Bruce A and B Quarterly Operations and CMLF Quarterly Technical Reports [112]
			BP-PROC-00509: Bruce A and B Quarterly Report of Performance Indicators [113]

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
			BP-PROC-00836: Reporting to CNSC – WNSL and NSRD Licences [114]
			BP-PROC-00837: Reporting to CNSC – Class II Nuclear Facilities Licences [115]
			BP-PROC-00839: Reporting to CNSC/IAEA – Safeguards [116]
	BP-PROG-10.01: Plant Design Basis Management [55]	BP-PROC-00335: Design Management [87]	DPT-PE-00008: System and Component Performance Monitoring Plans [117]
			SEC-EQD-00035[5]: Environmental Qualification Sustainability Monitoring [118]
		BP-PROC-00363: Nuclear Safety Assessment [88]	DPT-NSAS-00003: Guidelines for Evaluating and Prioritizing Safety Report Issues [119]

[5] SEC-EQD-00035 is a Fifth Tier Document, taking its guidance from BP-PROC-00261, Environmental Qualification.

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
			DPT-NSAS-00007: Processing of S-99 Reportable Conditions Arising from Safety Analysis [120]
			DPT-NSAS-00012: Preparation and Maintenance of Operational Safety Requirements [39]
			DPT-NSAS-00016: Integrated Aging Management for Safety Assessment [121]
			DPT-RS-00012: Systems Important to Safety (SIS) Decision Methodology [122]
	BP-PROG-10.02: Engineering Change Control [56]	BP-PROC-00539: Design Change Package [89]	
		BP-PROC-00542: Configuration Information Change [90]	
	BP-PROG-11.01: Equipment Reliability [57]	BP-PROC-00268: Safety System Testing (SST) Program Procedures [91]	

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
		BP-PROC-00778: Scoping and Identification of Critical SSCs [92]	
		BP-PROC-00779: Continuing Equipment Reliability Improvement [93]	BP-PROC-00498[6] Condition Assessment of Generating Units in Support of Life Extension [123]
		BP-PROC-00781: Performance Monitoring [94]	DPT-PE-00005: Performance Requirements for Contamination Exhaust Control Filters [125]
			DPT-PE-00009: System and Component Performance Monitoring Walkdowns [126]
			DPT-PE-00010: System Health Reporting [127]
			DPT-PE-00011: Component Health Reporting [128]
		BP-PROC-00782: Equipment Reliability Problem Identification and Resolution [95]	BP-PROC-00559: Station Plant Health Committee [129]

[6] BP-PROC-00498 Section 5.2 says it is affiliated with BP-Policy-14, which no longer exists, so it would have naturally fallen within BP-PROG-14.01: Project Management and Construction [124]; however it was transferred to BP-PROG-11.01 per Figure 1 of that program document.

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
		BP-PROC-00783: Long Term Planning & Life Cycle Management [96]	BP-PROC-00533: Obsolescence Management [130]
		BP-PROC-00849: Aggregate Risk Assessment and Monitoring [97]	
	BP-PROG-11.02: On-Line Work Management Program [58]	BP-PROC-00329: On-Line Work Management Process [98]	BP-PROC-00439: Seasonal Readiness [131]
	BP-PROG-11.03: Outage Work Management [59]		
	BP-PROG-11.04: Plant Maintenance [60]		
	BP-PROG-12.01: Conduct of Plant Operations [61]	GRP-OPS-00047: Operator Routines and Inspections - Bruce A and Bruce B [99]	
		BP-PROC-00260: Material Condition and Housekeeping [100]	
	BP-PROG-12.05: Radiation Protection Program [62]	BP-RPP-00001: Radiation Protection Policies and Principles [101]	
		BP-RPP-00008: Access Control [102]	

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
		BP-RPP-00010: Segregation and Handling of Radioactive Waste [103]	
		BP-RPP-00015: Zoning [104]	
		BP-RPP-00020: Dosimetry and Dose Reporting [105]	
		BP-RPP-00022: Contamination Control [106]	
		BP-PROC-00714: Level Radioactive Waste Minimization [107]	
		BP-PROC-00878: Radioactive Waste Management [108]	
	BP-PROG-13.01: Corporate Governance and Legal Services [63]		
		BP-PROC-00136: Plant Operational Review Committee[7] (PORC) [109]	
		BP-PROC-00169: Safety Related System List[7] [110]	

[7] BP-PROC-00136 and BP-PROC-00169 Section 5.2 do not identify the PROG where it takes its authority. This is identified as gap SF8-10 in Section 8.

4.2. Overview Discussion

Bruce Power's Management model contains the company's vision, mission, values, behaviours, policies, key results areas, summary of the Board structure and a statement of commitment from the Chief Executive to the management system. It includes Sheets covering a summary of the complete list of Programs, a listing of Program owners and approvers, as well as functional area (process) groupings, the responsibilities and authorities of all section manager and above positions at Bruce Power and a summary of regulatory, legal and business requirements [46]. Central to this is fostering a healthy Safety Culture and being recognized for excellence in all aspects of nuclear safety including reactor safety, radiation safety, personnel safety and environmental safety management. More details on the MSM can be found in Safety Factor 10.

From a Safety Performance perspective the key implementing documents are those covering the availability of SSCs to perform their safety functions when called upon during an abnormal operational occurrence, a design basis event, design extension condition or beyond design basis event involve those covering the programmatic and process aspects of condition assessment and performance monitoring. During normal operation the more relevant programmatic and process aspects involve day-to-day monitoring, prevention, mitigation and accommodation of radiation doses to workers and the public and similarly control or containment of radioactive materials and radioactive effluents to the environment.

The prevention aspects are covered by ensuring operations stays within the envelope established by the design and licensing basis. The design basis and design requirements, with a particular focus on nuclear safety, are discussed in greater detail in Safety Factors 1 and 2.

The next subsections discuss the programs and processes key in identifying when there is a possibility the design and operation may be diverging from the envelope agreed in the licensing and design basis. The effectiveness of these management processes is discussed in Section 5. The observations from Section 5 are supported by reviews (self-assessments, audits and inspections) of the implementation of these programs and processes. The reviews are discussed in Section 7.

Bruce Power maintains a comprehensive set of processes and procedures to perform continuous, daily and weekly SSC surveillance and testing. Daily maintenance reviews and activities are undertaken and accomplished commensurate with the safety and production significance to ensure continued safe operation. S-99 and CNSC REGDOC 3.1.1 event notification occurs immediately or within 5 days depending on the safety significance and event reporting based on the timing requirements specified in the Regulatory Documents (e.g., preliminary and detailed within 5 and 60 days, respectively). Similarly the International Atomic Energy Agency is notified of events via the CNSC Safeguards Section.

Additionally Bruce Power maintains a comprehensive set of indicators that allow on-going monitoring of safety performance. These indicators are reported during each shift, daily or over a longer term depending on the purpose of the indicator. The less frequent indicators are captured in Quarterly Performance Assessment reports, Quarterly Reports of Performance Indicators for the CNSC, Annual Environmental Compliance Reports (e.g., Water), and Quarterly Operations Reports. Furthermore, Bruce Power invites Industry Experts to provide insight on areas for improvement and continuing strengths through the Institute of Nuclear

Power Operations (INPO) and the World Association of Nuclear Operators (WANO). These discussions are privileged/confidential but corrective actions from many of these reports are discussed with staff and the CNSC as they are logged through the Station Condition Record (SCR) process.

Similarly Bruce Power ensures each employee, augmented staff consultants and long-term contractors attend monthly Safety and Business Performance Meetings focusing on the four pillars of Nuclear Safety - Reactor Safety, Industrial Safety, Radiation Safety, Environmental Safety, where employees are continually indoctrinated on the importance of safety. On a weekly and even daily basis meetings such as the Morning Leadership Meetings are held to review emergency or emergent safety issues, including Radiation Physics, and System, Structure and Equipment performance. Visual Management Boards, BP-PROC-00965 [132] are used to ensure staff are up-to-date on activities and safety performance in their area, including issues to be stressed due to recent events and conditions, to promote team engagement and performance. Visual Management Boards provide a method for leaders to establish regular communication and visible field presence to foster an environment that promotes effective feedback and continual improvement in worker performance.

4.3. Performance Measurement

BP-PROG-11.01[57], Equipment Reliability, defines the fundamental engineering operational performance needs, requirements, implementing approaches, and responsibilities of the plant equipment reliability integration process. The objective of the Equipment Reliability Program is to “ensure:

- The process is efficient, incorporates human factor considerations, and ensures effective performance during all phases of plant operations.
- A uniform process is used among all plants in the organization.
- Applicable in house and industry lessons learned are incorporated into the process to improve adequacy and efficiency.
- Changes to the process are timely, responsive to user feedback, and implemented at all affected plants."

BP-PROG-11.02 [58], the On-Line Work Management Program, defines the performance needs, requirements, implementing approaches and responsibilities of On-Line Work. Its objective is to provide timely identification, selection, prioritization, approval, scheduling and coordination to allow execution of work necessary to ensure safety and to maximize the availability and reliability of SSCs. It accounts for the risks associated with conducting work and identifies the impact of work to the station and to work groups; protects the station from unanticipated transients due to the execution of work; and supports nuclear safety and fosters a nuclear safety culture through the incorporation of the following guiding principles and values:

- Provide timely identification, screening, scoping, planning, scheduling, preparation and execution of work necessary to maximize the availability and reliability of station equipment and systems;

- Manage the risk associated with work through the proactive identification of situations or activities that could jeopardize or adversely impact safety margins and enable the development of mitigation strategies;
- Identify the impact of work to the station and work groups, and protect the station from unanticipated transients that result from work; and
- Maximize the efficiency and effectiveness of station staff and material resources while sustaining safe, reliable and competitive plant operation at optimum cost to Bruce Power.

BP-PROG-11.03 [59], the Outage Work Management program defines the performance needs, requirements, implementing approaches, and responsibilities of Outage Work Management. It identifies the controls associated with planning, implementation, and control of work performed on a reactor unit when the unit is shut down so maintenance, inspections, and modifications are performed safely and on the basis of value to maintaining safe, reliable and cost effective operation. This includes selecting and controlling the scope of work, planning, scheduling, coordinating work execution, and completing the outage.

BP-PROG-11.04 [60], Plant Maintenance defines the performance needs, requirements, implementing approaches and responsibilities of the management of the plant maintenance process. It covers the hands-on maintenances of plant SSCs based on the approved maintenance strategies, schedules, procedures and practices in a cost effective manner that maximizes the availability and reliability of safety-related and production sensitive equipment while maintaining the commitment to Nuclear Safety: Reactor, Radiation, Environmental and Industrial Safety. Predictive and preventative maintenance supports enhanced equipment reliability and improved operational safety performance. Maintenance strategies are continually refined using improved technologies, Operating Experience (OPEX) and equipment reliability feedback. Work selection, prioritization and response are guided by risk informed decision making. The aforementioned information addresses Section 1.2 Review Task 3.

DPT-PE-00008 [117], System and Component Performance Monitoring Plans (PMPs) states Responsible System Engineers (RSEs) and Responsible Component Engineers (RCEs) develop and establish PMPs to monitor the performance of their systems/components on a continual basis to determine the health of their equipment.

- The trended PMP information is used to capture degradation in performance and initiate investigation and maintenance activities before there is an adverse impact on the system/component performance and reliability.
- Documentation of performance monitoring activities includes the record of the completed data collected and the results of the applicable analyses, assessments.

DPT-PE-00009 [126], System and Component Performance Monitoring Walkdowns, explains Field Walk-downs are an essential component of performance and condition monitoring. Walk-downs provide: an opportunity for first hand direct observation of physical performance and are the basis to allow an assessment of the state of the SSCs; the means for detection of adverse trends; and the Plant Engineer with the opportunity to detect nominal changes and a recognition of abnormal or degrading situations which in turn provides the basis for implementation of mitigating actions.

A field walk-down is the mechanism used for performing a field evaluation of the SSC performance. The Plant Engineer looks for signs of degradation or changes from previous (normal) operation. The Engineer recognizes and improves the awareness of general conditions such as housekeeping deficiencies, safety deficiencies, and radiological protection deficiencies. The focus is on areas which have the greatest degree of uncertainty with regard to the state of equipment degradation. Field walk-downs provide information and data through sensory observation (sight, sound, smell, touch), and opportunities for conversation with plant staff and provide means of manually collecting equipment data from field monitors and sensors.

DPT-PE-00010 [127], System Health Reporting, provides the basis and expectations related to the development and generation of System Health Reports (SHRs) to meet the Equipment Reliability (ER) goals and continuous improvement. SHRs are developed for those systems and associated equipment that are deemed critical to ensure safe and reliable plant operation.

Responsible System Engineers (RSEs) SHRs assess and document the overall system health and condition of the associated critical equipment for their assigned systems as identified in BP-PROC-00781 [94].

SHRs are issued as follows:

- Overall Colour Rating[8] YELLOW or RED: SHR are issued bi-annually (i.e., once every 6 months).
- Overall Colour Rating WHITE or GREEN: SHR are issued annually (i.e., once every 12 months).

The RSE may justify to the Section Manager for an adjustment to the SHR schedule approval. If a Health Report changes colour in the adverse direction a Station Condition Record is raised requiring a review of the situation at a Management Review Meeting (MRM) and the change is presented to the Station Plant Health Committee (SPHC) within 60 days of the colour change.

SHR requires that work-arounds and operator work burdens be considered in the calculation of system health. A work-around coordinator has been used to identify Operator Challenges to the System Health Committee.

DPT-PE-00011 [128], Component Health Reporting, provides the basis and expectations related to the development and generation of Component Health Reports (CHRs) to meet the Equipment Reliability (ER) goals and continuous improvement. Health Reports are developed for those Components that are deemed critical to ensure safe and reliable plant operation.

Component Engineers establish Component Health Reports to assess and document the overall Component health and condition of the associated critical equipment.

Specifically, the scope and content of Component Health Reports is defined as follows:

[8] Red means unacceptable as degradation requires near term attention to minimize operational challenges, while Yellow means the degradation presents challenges to long term reliability and possibly safe and efficient operation. White is acceptable with some challenges to long term reliability, while Green is excellent with no additional action necessary beyond routine maintenance and evaluation.

- It provides directions for compiling and evaluating specific Component information such as operating status, performance monitoring results, ageing and obsolescence issues, and reliability concerns, to determine a graded Component health status.
- It assesses Component condition by measuring the Component Performance Monitoring Plan (CPMP) Performance Indicators (PIs) against a predefined set of criteria.
- It provides for trending of Component health and PIs over time to discern the direction of Component performance and proactively identify changes needed to improve equipment reliability and Component health.
- It defines the Health Report document and communication requirements to capture and convey the graded Component health and identified issues/action plans to Plant Management.

Component Health Reports are issued bi-annually if the overall Colour Rating is YELLOW or RED or issued annually if the rating is WHITE or GREEN.

Department Manager approval and justification is needed for an extension to a CHR due date.

SCRs are raised if a Health Report changes colour in the negative direction and it is reviewed by the MRM. A corrective action plan includes an action to present to the SPHC within 60 days of the colour change.

BP-PROC-00268 [91], Safety System Testing (SST)[9] Program Procedures defines the Safety-Related System Testing program and lists the roles and responsibilities of stakeholders in relation to the testing requirements of Safety Related Systems. The SST program is intended to test Safety-Related SSCs to determine if they are available and directly links to equipment reliability. Routine SST is performed to ensure the continued availability of Safety-Related Systems. Testing requirements and frequencies are determined by considering design manuals, safety analysis, reliability models, and probabilistic risk assessments.

SST frequency is selected to ensure that Systems Important to Safety and Safety-Related Systems meet their availability targets, while considering the impact of repeated testing on equipment life cycle.

The aforementioned information addresses Section 1.2 Review Task 3.

4.4. Performance Monitoring

BP-PROG-00.02 [47], Environmental Safety Management Program provides the overall framework to manage the environmental aspects of the Station operations, consistent with its Management System Manual, safety, environment, quality, economic and other requirements putting safety as the overriding priority. Bruce Power's nuclear safety incorporates the four pillars of; reactor safety, industrial safety, radiological safety and environmental safety.

[9] BP-PROC-00268 uses Safety-Related System Testing and Safety System Testing interchangeably, and each has the acronym SST.

The Bruce Power Environmental Safety Management Program is structured to address the Environmental Management System (EMS) requirements of the International Organization for Standardization (ISO) 14001 standard. The Program defines the requirements and elements of environmental protection and oversees the planning, implementation and control of activities to minimize potential adverse impacts of operations on the natural environment. It conforms to S-296, CSA N286-05 clauses 6.28 and 6.29 as well as the ISO 14001. Programs, processes, and procedures, at a minimum, assure compliance with regulatory and statutory requirements and facilitate continual improvement in environmental performance, and provide a system based approach to managing environmental aspects.

Bruce Power Department Procedure, DPT-PE-00005 [125], Performance Requirements for Contamination Exhaust Control Filters specifies the requirements for the testing and remediation of contaminated exhaust ventilation control filters used under emergency and normal operating conditions.

BP-PROG-00.07 [48], Human Performance Program, ensures personnel particularly line management are trained to be knowledgeable in Human Performance (HU) processes and the proper use of HU tools, so they are role models and reinforce the use of HU tools to their peers and teams. As such, they search for and eliminate, wherever it is possible to do so, conditions that lead to human error. Where the conditions for human error may not be eliminated and may impact the performance of critical steps, line management ensures staff is trained to take defensive action to detect and to correct against human error, and to ensure known measures are implemented to mitigate event consequences if they occur.

Staff and contractors adhere to leadership and worker behaviours that contribute to excellence in human performance by their adherence to the use of HU tools and identification and reporting to line management of conditions that might lead to human error.

The Performance Improvement Department monitors the status of HU indicators and generates site-wide HU reports, manages HU initiatives and makes HU recommendations based on industry best practices, benchmarking, self-assessments, and operating experience.

BP-PROC-00794 [67], Monitoring Human Performance provides guidance in practices for tracking and trending Human Performance. It describes the practices for monitoring and promoting high standards of Human Performance and the practices employed in monitoring HU.

The key HU indicators (KPIs) are common measurements used to determine site Human Performance program effectiveness in the prevention of events. The KPIs provide the capability to compare HU across the stations and with all NPP sites that have adopted similar practices per INPO 08-004 (Human Performance Key Performance Indicators).

BP-PROC-00795 [69], Human Performance Tools for Knowledge Workers describes these tools for workers which are used to anticipate, prevent and detect errors before they cause harm to people, plant, property or the environment. Although these tools can be used by any employee in a wide range of situations, they are particularly useful for knowledge workers, especially engineers, who are capable of making “in-process” errors that cause latent defects in plant equipment and supporting documentation.

Human Performance Tools for Knowledge Workers help the engineer or knowledge worker maintain positive control of a work situation, especially during critical tasks or activities – that is, what is intended to happen is what happens, and nothing else happens.

BP-PROC-00811 [68], Procedure Alterations provides direction on how to proceed when a problem is encountered that threatens procedure adherence. BP-PROC-00617 [66], Human Performance Tools for Workers, describes the requirements for the Procedure Use and Procedure Adherence tools. When procedure adherence is challenged, work stops and does not proceed until the problem has been assessed and resolved.

Examples of Problems Threatening Procedure Adherence:

- Unexpected results could occur or have occurred.
- Procedure step sequencing problems.
- Procedure is incorrect, unclear or inconsistent.
- Procedure requirements, entry conditions, or step(s) are not applicable in the current circumstances.
- Performer is uncertain as to how to proceed.
- Partial performance for corrective maintenance or post-maintenance testing is required.
- Parallel performance of steps or sections of a maintenance procedure is desirable, where the sequencing does not affect risk or the outcome.

GRP-OPS-00047 [99], Operator Routines and Inspections ensures Operator Field Inspections and Routines are monitoring the process systems and components to determine they are operating properly, parameter values are within limits, poised systems are available to operate properly, and overall unit conditions are maintained. Inspection sheets help ensure that inspections are done consistently and to a high standard. GRP-OPS-00047 defines what Routines and Operator Field Inspections are, how they are initiated, changed, scheduled, conducted, and documents the process, standards and requirements for their completion.

Operator routines are a set of regularly performed tasks such as recording data, testing equipment, changes to equipment duty, and inspections. They are scheduled, viewed, printed, and updated in station routines programs. The Operator accesses them at the beginning of each shift to obtain a list of routines assigned for the duty unit and area. Assigned tasks are noted, and performed during the shift. Prior to the end of shift, they update the completion status of assigned routines in the program. Routines are reviewed to ensure they are completed and recorded by the end of each shift. Scheduled routines that are not completed are reported to ensure follow-up so safety related Operator Routines comply with regulatory expectations.

BP-PROC-00260 [100], Material Condition and Housekeeping Facilities recognizes Safety Performance and relies on the separation of equipment and components as a defence to mitigate the effects from common mode events e.g., the spread of fires, which may cause multiple failures of components and adversely affect the station/facility safety. The existence of combustible and flammable materials between systems, components or buildings, degrades this design feature impacting both the ability to fight fires and to operate facilities in a safe manner.

To assure the design intent, high housekeeping standards are maintained. Also, the potential impact of severe weather is taken into account when inspecting storage and staging areas external to permanent, enclosed facilities (unapproved outside storage areas are not permitted). Airborne objects and flooding can impact safe operation.

Each facility is subdivided into inspection and ownership areas. Each area is assigned an accountable line manager Area Owner and an independent, line manager Area Inspector. Inspection areas and associated, accountable Inspectors and Owners, are designated by the facility Department/Section Managers. These areas are grouped into larger housekeeping areas, such as Station Units or Site Buildings and are in turn, assigned an accountable, Management Unit Owner, by the facility Senior Management.

A Planned Inspections Coordinator is assigned for each of the major facilities on site as the Single Point of Contact for administration of the database and monitoring of facility specific trends. The Operations Department ensures material and equipment deficiencies are identified to the Maintenance Department, who maintain and restore equipment to function as designed.

It is recognized that excellent Material/Equipment condition and high Housekeeping standards are fundamental to safe and efficient Operation. Staff are to ensure areas are left in a better condition than before the work/task/activity was started (Better Than As Found).

The Workplace Inspections System (WIS) provides Management and the Joint Health and Safety Committee (JHSC) an oversight tool for the program and is designed to assign accountability for areas in each facility and ensure that these standards are being met on a continuous basis.

Housekeeping Inspections help to ensure Contamination Control Areas (CCAs) are established and maintained according to the BP-RPP-00022 [106], Contamination Control (Interface Document).

Inspections of a CCA confirm:

- CCA boundaries are clearly marked and boundaries are intact.
- CCA Identification Tag is completed and up to date.
- The area within the CCA is generally tidy with no additional hazards present, i.e., obvious leaks or materials stored inappropriately.
- Any concerns associated with the CCA are communicated to the CCA Owner.

Incidences of non-compliance are reported including: the condition or behaviour observed; the location; and the individuals knowledgeable of the incident. The WIS allows entry into the WIS database for tracking and the initiation of action by the Area Owner.

Types of inspections include:

- Housekeeping Inspections are those conducted as part of a normal work routine or those assigned by Facility Management (e.g., Manager in the Field Day, Housekeeping Days and outages).

- Planned inspections are Area Inspectors where Owners complete an inspection of their assigned area once per calendar month. Joint Inspections with the Area Owner should be performed whenever possible.
- Manager Unit Inspections are those inspections completed by Unit Owners, at a frequency determined by facility Senior Management.
- The JHSC completes an inspection of their assigned area/facility once per calendar month.
- Operator Field Inspections and Rounds per GRP-OPS-00047 [99] are Inspection Tours/Rounds in any area of the facility while completing assigned tasks.

Substandard conditions classified as Class A or B (i.e., likely to cause permanent or excessive losses and serious injury) are immediately made safe and brought to the attention of the Duty Shift Manager/Boiler and System Supervisor. Class A or B conditions are eliminated or reduced to a Class C rating (may cause minor injury and non-disruptive property damage).

BP-PROC-00439 [131], Seasonal Readiness, aligns with the Long Range Cycle Planning Process and BP-PROC-00329 [98], On-Line Work Management Process to provide guidance for the planning and scheduling of preventative maintenance activities and select component deficiencies which may impact the station operation in the upcoming season.

Regulatory requirements outlined in S-210, Maintenance Programs for Nuclear Power Plants are satisfied by ensuring work group interfaces are established to direct the planning and scheduling of the seasons' maintenance work.

Efforts combine to promote optimum equipment reliability, system health and safe, reliable plant operation through a broad range of seasonal changes in temperatures, weather patterns and grid operating conditions. The response to the Seasonal Readiness process ensures enhanced management, monitoring, and nuclear risk assessment of Safety Related work activities through to completion.

4.5. Operating Experience

Safety performance is determined from an assessment of operating experience, including safety related events, and records of unavailability of safety systems, radiation doses and the generation of radioactive waste and discharges of radioactive effluents.

Safety Factor 8 includes several objectives and criteria that tie into Bruce Power's program for Internal and External Operating Experience. Safety Factor 8 restricts the review of safety performance to operating experience internal to the Station. Other plants and research findings external to the Station are addressed in Safety Factor 9.

BP-PROG-01.06 [51], Operating Experience Program, defines processes to meet the requirements of the CSA Standard N286-05 (e.g., Sections 5.4, 5.11 and 5.14), by making improvements via: Processing Internal and External Operating Experience information; conducting Focus Area Self-Assessments; Benchmarking others; and by attending industry Conferences and Workshops.

Bruce Power's processes governing Operating Experience are described in its implementing procedure "Processing External and Internal Operating Experience". The Operating Experience program and Corrective Action Program are closely inter-connected.

BP-PROC-00062 [71], Processing External and Internal Operating Experience identifies the processes used to identify, evaluate and take action based on internal and external lessons learned to improve nuclear safety including reactor safety, radiation safety, industrial safety and environmental safety management. This is achieved by using the lessons learned information to improve processes, procedures, training, and system and equipment design. Bruce Power communicates internal experience from the Bruce Site to others in the Nuclear Industry to improve nuclear plant safety, reliability and commercial performance around the world.

BP-PROC-00137 [72], Focus Area Self Assessment provides support in identifying and documenting lessons learned from internal sources to continuously improve performance by identifying weakness, strengths, threats and opportunities to make improvements to Processes/ Procedures, Training, or System/Equipment Design. It specifies the requirements and describes the process for collecting business intelligence through Comprehensive Focus Area and Quick Hit Focus Area Self- Assessments.

The Focus Area Self-Assessment (FASA) process is a tool that focuses on specific areas of a Functional Area's activities, processes or performance. It is used by Functional Areas to assess the adequacy and effective implementation of their programs. The results of the assessment are then compared with business needs, the management system, industry standards of excellence and regulatory/statutory or other legal requirements. This procedure describes the planning, preparation, execution, and reporting of performance improvement opportunities identified during Self Assessments. The FASA process provides the capability to review the effectiveness of the processes utilized to support the identification of degraded performance and effectively track, trend, prioritize, and correct subtle problems.

BP-PROC-00147 [73], Benchmarking and Conference Activities provides guidance in identifying and documenting lessons learned from external sources to continuously improve performance by making improvements to processes/procedures, training or system/equipment design. Benchmarking and conference activities foster the use of diverse information sources to understand performance gaps and implement corrective actions to improve performance. This is discussed further in Safety Factor 9.

BP-PROC-00892 [74], Nuclear Safety Culture Monitoring provides the framework to monitor nuclear safety culture between formal assessment activities, in particular to have mechanisms to identify and correct potential gaps in nuclear safety culture. The approach is collegial and supports the development of a common understanding of safety culture within senior and middle levels of leadership at the nuclear power stations and describing the traits and attributes of the desired safety culture. This monitoring and adjustment process facilitates the desired behaviours of a learning organization – one that places nuclear safety as its overriding priority and relentlessly seeks ways to continuously improve itself.

This process provides an approach for monitoring nuclear safety culture using the framework described in INPO 12-012, Traits of a Healthy Nuclear Safety Culture and based on the approach described in NEI 09-07, Rev 1, Fostering a Healthy Nuclear Safety Culture (March 2014). See Safety Factor 10 for more information. This supports assuring that Bruce

Power meets the WANO Performance Objective for Nuclear Safety Culture (SC.1) and associated criteria: The organization's core values and behaviours reflect a collective commitment by all nuclear professionals to make nuclear safety the overriding priority.

This process attempts to characterize the health of nuclear safety culture rather than trying to directly measure culture. Judgment and subjectivity by experienced leaders are applied to derive insights from this process using data elements (e.g., aspects of plant conditions, human resource issues, behavioural observations, process weaknesses, etc.) which, when considered against a framework such as the Ten Traits of a Healthy Nuclear Safety Culture, reveal cultural issues that require to be addressed.

The aforementioned information addresses Section 1.2 Review Task 3.

4.6. Corrective Action

Bruce Power processes related to Corrective Action are governed by the Corrective Action program and related implementing procedures. A Corrective Action Review Board, consisting of senior management, performs a review of all significant events.

BP-PROG-01.07 [52], Corrective Action identifies and eliminates or mitigates adverse conditions that could negatively impact nuclear safety (including reactor safety, radiation safety, industrial safety and environmental safety), business loss or corporate reputation. Adverse conditions and nonconformances are to be promptly identified, documented and reported. For most events, significant events and significant conditions adverse to quality, the causes are determined and corrective action is taken to correct, and where appropriate, prevent their recurrence. Corrective actions taken to address identified causes are tracked to completion. Effectiveness is verified for actions taken to prevent recurrence. Adverse conditions are trended and periodically analyzed for adverse trends. Corrective actions are implemented to address adverse trends where warranted. Periodic assessment of the effectiveness of the program is done based on the results and recommendations obtained from verifications and audits.

BP-PROC-00019 [75], Action Tracking provides an integrated online means of tracking actionable events and ensuring actions are taken to respond to each action item. An Action Request (AR) may be initiated as a result of a reported problem, a licensing requirement, an internal procedure or any other event that requires a response in a timely manner. This procedure governs how Action Tracking is used at Bruce Power to ensure accountability, data integrity and audit requirements. Different AR types have different process owners. These owners specify requirements in their area of responsibility such as requests for due date extensions and actions to provide oversight for completion of those assignments and the type of action they wish completed.

BP-PROC-00059 [76], Event Response and Reporting, defines the process for preliminary response and reporting to internal contacts and external agencies, to ensure compliance with both Bruce Power and Regulatory requirements.

This procedure describes the process of Incident Response and Reporting which consists of the following major steps:

- Immediate response.

- Rapid Learning.
- Internal and external notifications.
- Initiation of an investigation to determine the cause of the incident.

External agency reporting is discussed further under BP-PROG-06.03, in Section 4.7 under Compliance Reporting.

BP-PROC-00060 [77], the Station Condition Record (SCR) Process is used to document adverse conditions, investigation results and corrective actions related to people, plant, environment and process. The SCR process is used by staff, including contractors, to document adverse conditions, investigation results and corrective actions related to people, plant, environment and process. Investigations into events where there is the likelihood of regulatory charges or commercial litigation where legal privilege needs to be maintained are handled separately.

A consistent reporting and evaluation process for identified adverse conditions, including but not limited to nonconformances, minimizes undesirable impacts on nuclear safety, business loss, and corporate reputation. This is accomplished by ensuring the following:

- Events, incidents, and error-likely situations are documented.
- Cause(s) are determined.
- Corrective action(s) are implemented.
- Lessons learned are identified for communication to internal and external organizations.

For nonconformances (typically a documentation deficiency) which could but have not yet resulted in a nonconforming item (typically a deficiency in an SSC), BP-PROC-00060, Station Condition Records applies rather than BP-PROC-00252, Control of Nonconforming Items. An SCR is required, but the Tagging and Segregation steps do not apply. In this case, it is very important to control the nonconformance to ensure that no nonconforming item is produced. This might include actions like quarantining a procedure, ceasing work using faulty equipment or process, ensuring that non-qualified staff do not work on tasks requiring qualification. The means taken to control the nonconformance should be described in the SCR.

BP-PROC-00252 [78], Control of Nonconforming Items describes the process used to identify, document, segregate, evaluate and disposition nonconforming items. BP-PROC-00252 is used only when acceptance of the problem disposition by an external inspection/oversight agency needs to be documented (e.g., pressure vessel issues preventing recertification of the vessel). Adherence to this procedure ensures items that do not conform to specified quality requirements are controlled to prevent further processing, use or installation, pending disposition by the authorized personnel. Personnel involved in this process are adequately free of cost and schedule considerations. This procedure describes the generic corporate process for identifying, controlling and evaluating nonconforming items.

BP-PROC-00412 [79], Trend Identification and Reporting of SCRs determines whether performance is improving, declining or stagnant; and corrective actions are initiated to address adverse performance before a break-through event occurs. Trend identification entails reviewing and analyzing the data in SCRs to identify these trends and assigning and recommending corrective actions and investigations to mitigate adverse trends.

BP-PROC-00506 [80], Effectiveness Reviews defines the process for performing effectiveness reviews of corrective actions and the corrective action management effectiveness oversight. The effectiveness review process is used to determine whether or not a corrective action was effective.

The depth of the review may entail the collection of information and assist in conducting a Root Cause Investigation, Apparent Cause Evaluation or Common Cause Analysis. Other types of reviews may include reviews of the functional line response to WANO and INPO directives and recommendations, for example, Significant Operating Experience Reports.

BP-PROC-00518 [81], the Root Cause Investigation process is used to identify the root cause of an event (which includes accidents) and incidents so proper corrective action is initiated to prevent the future reoccurrence of similar events and incidents. It defines the process for performing a Root Cause Investigation (RCI) and an Equipment Root Cause Investigation (ERCI).

BP-PROC-00519 [82], Apparent Cause Evaluation (ACE) defines the process for performing an ACE and an Equipment Apparent Cause Evaluation (EACE). The ACE/EACE processes are used to identify the likely cause of an event and propose corrective actions that strengthen barriers or reduce the frequency or reduce the severity of similar events. The ACE/EACE processes may not prevent recurrence.

BP-PROC-00644 [83], Common Cause Analysis is used on adverse trends so corrective action can be taken to reduce the probability of the adverse trend continuing. It provides instructions for performing Common Cause Analysis. Conducting a Common Cause Analysis is not an exact science. Although intended for analyzing adverse trends linked to the Corrective Action Program, the methodology described can be used to analyze data from other sources as well.

4.7. Compliance Reporting

Several objectives and criteria listed for “Safety Performance” relate to information that Bruce Power is required by its operating licence to report at specified frequencies and in specific detail to the CNSC. Compliance reporting requirements are described in CNSC Regulatory Standard S-99 (CNSC REGDOC-3.1.1). Internal Bruce Power processes that support these reporting requirements are described in this section.

BP-PROG-06.03 [54], CNSC Interface Management defines the overall business need, functional requirements, constituent elements and key responsibilities associated with managing the interface between Bruce Power and the CNSC. This is achieved by establishing and implementing standards and processes that meet the expectations of both parties and facilitate conformance to the NSCA, applicable regulations and other CNSC requirements and expectations.

The program supports the achievement of excellence in nuclear safety as the overriding priority and a healthy nuclear safety culture by assuring that processes and practices are defined and managed to ensure that the requirements arising in the PROL are understood, implemented and reported on in a controlled manner throughout the management system. The program was recently updated to confirm the need for compliance against CNSC REGDOC-3.1.1. ([84] Clause 4.5 item 3).

The CNSC regulatory framework consists of a mix of requirements and guidance. Requirements are set out in legislation, regulations, licences and CNSC regulatory documents invoked in licences. Guidance on how applicants and licensees can meet regulatory requirements is provided in CNSC guidance documents. CNSC INFO-documents provide more general information on the regulatory regime and processes for the broader public. CNSC interface management processes are structured to facilitate compliance with CNSC requirement and to conform, where practicable, to CNSC guidance or expectations with the understanding compliance to a CNSC Regulatory Document is mandatory when the document is referred to in a CNSC licence. Deviations from a licence-referenced regulatory document and transitional arrangements, where necessary, are addressed on a case by case basis in accordance with the applicable Licence and/or LCH.

BP-PROC-00165 [111], Reporting to CNSC – Power Reactor Operating Licences describes from Bruce Power's perspective the information that the CNSC requires of a licensee who operates a nuclear power plant, and how, when and to whom the information is to be provided. It establishes standardized practices, format and content for unscheduled and scheduled formal reporting to the CNSC per Regulatory Standard S-99 [20].

S-99 specifies four types of unscheduled reports:

a) Situations and events that require both preliminary and detailed reports.
b) The reaching of an action level.
c) Reports on the performance and status of certified personnel.
d) Reports of problems identified by research findings or revised.

Similarly for S-99 scheduled reports include:

a) Updates to facility descriptions and final safety analysis reports.
b) Reports of environmental monitoring information.
c) Reports on the progress of research and development activities.
d) Reports on the degradation of pressure boundary components.

BP-PROC-00139 [112], Bruce A and B Quarterly Operations Reports (QORs) and Central Maintenance Laundry Facility Quarterly Technical Reports establishes standardized practices, format and content for the Quarterly Operations Reports to the CNSC, made pursuant to Regulatory Standard S-99, and Central Maintenance and Laundry Facility (CMLF) Quarterly Technical Reports to the CNSC, made pursuant to the Waste Nuclear Substance Licence (WNSL) for the CMLF. The procedure describes the process for preparation, review, approval, transmittal, handling, distribution and filing of these reports (per S-99, Section 6.4.1 and CMLF WNSL, Condition 6).

BP-PROC-00509 [113], Bruce A and B Quarterly Report of Performance Indicators establishes standardized practices, format and content for Quarterly Reports of Performance Indicators (QRPI), and describes the process for preparation, review, approval, transmittal, handling, distribution and filing of the reports including the timing and content of the QRPI (per S-99, Subsection 6.4.2).

Initiation, preparation, and issue of the QORs and QRPIs are in accordance with the general requirements of BP-PROC-00833 [86], Reporting to the CNSC.

BP-PROC-00833 [86] expands upon requirements established in BP-PROG-06.03, and establishes in more detail in the Bruce Power Management System, additional functional requirements, constituent elements and key responsibilities that are required for managing formal reporting to the CNSC and to facilitate conformance to the Nuclear Safety and Control Act (NSCA), applicable regulations and other CNSC requirements and expectations.

BP-PROC-00837 [115], Reporting to CNSC – Class II Nuclear Facilities Licences is an implementing procedure of BP-PROC-00833 and assigns responsibility for reporting to the CNSC for the Class II Nuclear Facilities Licences to the Class II Radiation Safety Officer.

This procedure defines the responsibilities and provides instructions to complete formal reports to the CNSC including Unscheduled Reports, Scheduled Reports, and Sealed Source Tracking Reports with a focus on Radiation Protection Regulations, Prescribed Equipment Regulations and Licences, Annual Compliance Reports, and Sealed Sources.

BP-PROC-00839 [116], Reporting to CNSC/IAEA – Safeguards establishes standardized practices, format and content of formal reports to the CNSC on information on the inventory and transfer of fissionable and fertile substances pursuant to S-99 and on the Design Information Questionnaire, Additional Protocol and Operational Program to comply with the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons. Also it establishes standardized practices, format and content of non-formal reports and information transfer to the CNSC/IAEA on the internal transfer of fissionable and fertile substances, on Core Discharge Monitors, Bundle Counters and any additional reports as requested by the CNSC/IAEA made pursuant to Article 72 of the Agreement between Canada and the IAEA for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons.

DPT-NSAS-00007 [120], Processing of S-99 Reportable Conditions Arising from Safety Analysis describes the process to follow in processing S-99 reports made pursuant to Section 6.3.2.3 of S-99 when nuclear safety related issues are discovered from new research findings, review of operating experience and review of submitted safety analysis.

BP-PROC-00836 [114], Reporting to CNSC – WNSL and NSRD Licences, is an implementing document of BP-PROC-00833 and the reporting is managed by the Corporate Radiation Safety Officer. Standardized practices, format and content for unscheduled formal reports, Sealed Source Tracking, and the Annual Compliance Report (ACR) to the CNSC made pursuant to the Waste Nuclear Substance (WNSL) and Nuclear Substances and Radiation Device (NSRD) licences are covered by this procedure.

The aforementioned information addresses Section 1.2 Review Task 2.

4.8. Radiation Protection and Waste Management

Bruce Power has a mature Radiation Protection program that provides radiation protection services to staff and contractors. The program requirements are described in “Radiation Protection Policies and Principles” [101]. Waste management activities are described in the

"Environmental Safety Management" program [47]. Final processing and storage of solid radioactive waste is performed by Ontario Power Generation (OPG)'s Western Waste Management Facility located at the Bruce site. Wastes are packaged and delivered to the OPG Western Waste Management Facility according to specified waste acceptance criteria.

BP-RPP-00001 [101], the Radiation Protection Policies and Principles procedure assists workers in finding the location of instructions as BP-PROG-12.05 R001, Radiation Protection Program and its associated suite of procedures are replacing BP-RPP-00001. Each line of BP-RPP-00001 R000 has been mapped (Appendix A) in this revision (R001) to the appropriate location within BP-PROG-12.05 R001 and/or sub-tier procedures. BP-RPP-00001 remains active until the Radiation Protection Program requirements have been confirmed as complete and correct.

BP-RPP-00008 [102], Access Control is an implementing document to BP-PROG-12.05, Radiation Protection Program, and outlines the requirements to access areas of the plant where high radiation fields may exist. Hazardous radiation and conventional safety hazards exist as the result of both normal and abnormal reactor operation and irradiated fuel transfer. The access control system controls the movement of personnel into and out of potentially hazardous areas to prevent accidental high exposure to radiological hazards. Also, the access control system prevents significant increases in radiological hazards for people in or about to enter an Access Control Area. The access control system reduces the risk to personnel from the conventional safety hazards associated with the operation and fuelling of reactors.

BP-RPP-00010 [103], Segregation and Handling of Radioactive Waste details how staff shall segregate and dispose of routine solid waste and disposition contaminated liquid wastes as per governing document BP-PROC-00878, Radioactive Waste Management. Staff ensures that equipment and materials do not become radioactive waste unnecessarily and minimizes radioactive waste produced. To minimize radioactive waste, the following is applied when performing radiological work:

- Do not take items that will not be used into radiological zones or contaminated areas.
- Wrap or bag material/equipment taken into contaminated areas.
- Use reusable Personal Protective Equipment (PPE) where there is a choice between it and disposable PPE.
- Only take the required amount of liquids into radiological zones or contaminated areas and use dispensers to prevent liquids becoming contaminated.
- Do not generate liquid mixed radiological wastes containing hazardous components.

Waste reduction, segregation and handling is considered in work plans involving radioactive work as per BP-PROC-00714, Low Level Radioactive Waste Minimization [107]. When a job is expected to produce significant waste quantities, Waste Management Section is contacted in advance to arrange for a waste can, bin or pick-up of active waste. Bins delivered to Waste Management include a detailed log with dose rates and description of material.

BP-RPP-00015 [104], Zoning details the requirements for movement of personnel and equipment around the Zoned Areas of Station facilities, and specifies the requirements for the transfer of radioactive material outside the zoned areas but within the site boundary fence.

BP-RPP-00020 [105], Dosimetry and Dose Reporting documents the processes for use of radiation dosimetry devices per Regulatory Standard S-106 Revision 1, Technical and Quality Assurance Requirements for Dosimetry Services.

BP-RPP-00022 [106], Contamination Control is an implementing document of BP-RPP-00041, Executing Radiological Work and describes the Radiation Protection (RP) work practices, measures, and techniques used to control radioactive contamination at the source, including Discrete Radioactive Particles (DRPs) to prevent contamination spreading to workers, equipment and areas between work locations and to maintain exposures As Low as Reasonably Achievable (ALARA).

BP-PROC-00714 [107], Low Level Radioactive Waste Minimization is an implementing document of BP-PROC-00878, Radioactive Waste Management, and defines the principles to be applied by personnel who influence or control the selection, procurement, usage and subsequent management of materials that may become low level radioactive waste.

BP-PROC-00878 [108], Radioactive Waste Management defines the fundamental business needs, constituent elements, functional requirements, implementing approaches and key responsibilities associated with implementing the Radiation Protection Waste Management Program, for radioactive waste.

This is achieved by establishing and implementing standards and processes for the conduct of radioactive waste activities to ensure the following objectives are met:

1. Radioactive waste activities are controlled in a safe and environmentally, financially and socially responsible way to ensure full compliance with regulatory requirements.
2. Public and occupational exposures to ionizing radiation during radioactive waste activities are controlled such that individual and collective doses are maintained at levels As Low as Reasonably Achievable (ALARA), social and economic factors being taken into account.
3. Ensure decisions on management of radioactive waste are based on minimizing risk to the environment, public and staff and minimizing total life cycle costs for radioactive waste storage and disposal.
4. Ensure compliance with CNSC Regulations, Licences and Standards and CSA requirements pertaining to radioactive waste management.
5. The achievement of high standards of radiation protection performance in accordance with industry best practices and the World Association of Nuclear Operators (WANO) Guidelines for Radiological Protection at Nuclear Power Plants, WANO GL 2004-01.

The aforementioned information addresses Section 1.2 Review Tasks 4 and 5.

5. Results of the Review Tasks

The review of safety performance evaluated whether the plant has in place appropriate processes for the routine recording and evaluation of safety related operating experience. The review tasks assessed in this section have not changed from those listed in Section 1.2. In addition to the assessment of the review tasks listed in Section 1.2, Section 5.1 provides an overview of safety performance assessments and Section 5.14 augments the discussion, and addresses overall safety performance.

This review is complementary to and does not replace the routine and non-routine Bruce Power and regulatory reviews, inspections, mid-term reports, event reporting and investigations, or other CNSC compliance and verification activities.

5.1. Overview Safety Performance Assessments

Safety performance is defined as an area of continual focus and improvement across the site; Bruce Power strives to achieve world-class performance levels by embracing a philosophy of continuous improvement. In 2013 the Bruce site reached over 14 million hours without a lost time injury. Likewise, diligent application of Bruce Power's RP Program has been effective at identifying and controlling radiological hazards. During the 2009-2013 licensing period Bruce Power consistently maintained worker radiological exposures below regulatory limits and enhancements to the RP Program were implemented and are yielding positive results. These are discussed further in this Section with further details in the Performance Report ([133] Section 3.7).

Environmental performance remained strong over the past licence period with no major events. The 2012 dose to public demonstrates the maximum dose received by a member of the public due to Bruce Power site operations continues to be a very small percentage of the annual legal limit of 1000 μSv/Year; less than 0.12% for 2012 ([133] Section 3.7.3). Bruce Power is continuing to adopt best industry standards as a framework for achieving continuous improvement and sustainable performance excellence, while minimizing environmental impact and preventing pollution. The progress made in achieving these is discussed further in Section 7, and Bruce Power plans to implement Canadian Standards Association N288.4-10 on environmental monitoring programs and its companion standards, CSA N288.5-11 and CSA N288.6-12 on effluent monitoring programs and environmental risk assessments. These are discussed further in Safety Factor 14.

Bruce Power provides an annual Environmental Monitoring Program update describing its effluent monitoring program related to Operations in compliance with PROL Licence Condition 1.7 [134]. The report stated for the 22nd consecutive year Bruce Power's calculated dose to a member of the public is less than 10 microSv/year regarded as the lower threshold for significance (the de minimus).

Bruce Power adopts applicable best industry standards as a framework for achieving continual improvement and sustainable performance excellence, while minimizing environmental impact and preventing pollution. Bruce Power complies with the Environmental Compliance Approvals and Permits issued by the Ontario Ministry of Environment. Bruce Power continues to monitor site/offsite groundwater. Bruce Power complies with the Federal Regulations and programs which protect human health and the environment under the Canadian Environmental Protection Act [134]. Specific data on effluent emissions (airborne, iodine, carbon, water), radiological dose and waste are provided yearly in the annual reports including figures on trending over a 10-year period.

The CNSC performs an annual review of each Station [135] [136]. The review for 2013 showed Bruce A's performance was satisfactory, unchanged from the 2012 review. The Security and Conventional Health and Safety, Safety and Control areas were fully satisfactory, while all others were satisfactory. The Environmental Assessment (EA) monitoring program related to the Unit 1 and 2 refurbishment continued to verify the conclusion of the EA there were no significant adverse environmental effects due to the project ([136] Section 3.1). The CNSC highlighted that Bruce Power continued to make gains in the area of human performance. No significant operations-related compliance issues were identified during CNSC inspections ([136] Section 3.1.3). These inspections are detailed in Section 7.3.

Similarly Bruce Power performed a Performance Review of the Stations as part of a supplemental submission in support of the Licence Renewal, in October 2013 [133]. It highlighted over the past 10 years, Unit 4 has consistently been one of the top Canada Deuterium Uranium (CANDU) units in the world. It states as Bruce Power moves forward to renew and modernize its nuclear fleet it plans to build on the lessons learned and the experience gained over the last decade to ensure greater certainty and predictability in its refurbishment and asset management projects. The report [133] discusses numerous SCAs applicable to this Safety Factor report, including the complete discussion in Sections:

- 3.2.1 on SCA 2, on the Human Performance Program (continuous improvement);
- 3.2.2 on Personnel Training,
- 3.2.3 on Personnel Certification;
- 3.2.4 on Certification and Requalification Tests;
- 3.2.5 on Work Organization and Job Design, including specialized staffing;
- 3.3 on SCA 3, Operating Experience;
- 3.4.5 on Management of Safety Issues;
- 3.5 on SCA 5, on Physical Design which covers Configuration Management;
- 3.6 on SCA 6, on Work Management;
- 3.7 on SCA 7, on Radiation Protection;
- 3.8 on SCA 8, on Conventional Health and Safety;
- 3.11 on SCA 11, on Waste Management.

Each of these sections provides information on the relevance and management of the SCA, past performance, future plans, challenges (if any) and requests (if any). Overall the report shows Bruce Power has moved forward to renew and modernize its nuclear fleet and is building on the lessons learned and the experience gained over the last decade to ensure greater certainty and predictability in future projects.

5.2. Safety Performance Indicators

This section addresses Section 1.2 Review Task 2.

Bruce Power has defined a set of Operational Safety Performance Indicators designed to monitor the safety of plant operation. Integrated, these indicators give Management an enhanced perspective on the condition of the plant, while the instantaneous numerical value of an individual indicator may be of little significance if treated in an isolated manner. Indicators are trended over a period of time to provide early warning to investigate the causes of the observed changes. The indicators are compared to set goals to identify strengths, and drive improvement recognizing an indicator is selected based on the importance to the plants unique situation and are dynamic, not static indicators as the plant environment changes.

The list of performance indicators used at Bruce A is identified in Reference [137]. A number are relevant to the Safety Performance of the station including, Chemistry, Health and Safety [64], Plant Status, Audits and Assessments, Corrective Action, Human Performance, Reactivity Management, Operator Experience, Radiation, Staff Qualification, Security, Maintenance and Reliability, and Emergency Preparedness. Quarterly Reports of Performance Indicators have been provided to the CNSC since before 2009 [138] [139], including ones covering industrial accidents, chemistry, change control, emergency preparedness, non-compliances, preventative maintenance, radiation, SSTs, unplanned transients, unplanned capability loss factor and power history.

In addition to the Bruce A Station performance indicators, for comparative purposes the CANDU industry shares information through the CANDU Owners Group so Bruce A management can compare the station safety performance with other stations and review trends against comparably designed reactors [140] [141]. Also, CANDU Station Performance Annual reports are assembled [142]. These provide overviews of outage and unplanned loss of production events for CANDU stations.

These reports show Bruce Power is recording and evaluating Safety Performance continually since the previous Integrated Safety Reviews were conducted in 2008 and the data is being trended against the performance of other stations. Trends are reviewed and as appropriate are captured through the Station Condition and Corrective Action processes to deal with adverse conditions or to share positive performance so as to reinforce the learning.

5.3. Safety-Related Incidents, Low Level Events and Near Misses

This section addresses Section 1.2 Review Task 1a.

Bruce Power has defined processes for routine recording and evaluation of safety-related incidents, low level events and near misses. These include:

- Event Response and Reporting, BP-PROC-00059 [76]; and

- CNSC Interface Management, BP-PROG-06.03 [54].

These procedures define the steps on how events which need to be reported are reported and to whom they are reported. As part of the CNSC interface, compliance reporting processes elaborate on reporting to the CNSC [86] [111] [114] [115] [116] in compliance with the reporting requirements of CNSC Standard S-99, and identify when scheduled and unscheduled reports of incidents, events and near misses are due [86][120]. Quarterly Operations Reports [112] list the reportable events and identify inconsistencies between the safety analysis and licensing documents.

On a daily basis as events arise they are recorded for all staff via the Station Condition Record process [77]. These SCRs are reviewed by Management at the daily Morning Review Meetings, and addressed through the Corrective Action Program [52].

Separately, Safety Factor 9 covers the processes in place for Bruce Power to factor in experience from events and incidents at other plants and from research findings.

Based on the Quarterly Operations Reports about 20 events are reported quarterly, but over the last operating licence period they identify less significant items. These reports identify a significance level[10] with the events. Since 2011 over 14 quarters, zero Level 1, 67 Level 2, and 176 Level 3 events have been recorded. The maximum number of Level 2 and 3 events in a quarter has been 10 and 18 respectively, and an average number of 4.8 and 12.6, respectively over the four year period.

A more important trend of events has recently been flagged with respect to unanticipated SDS2 Trips in Units 1 and 2 on Steam Generator Low Level [143].

The Large Loss of Coolant Accident Safety Margin Restoration Project was established in 2008 to explore design changes that can provide improvements to safety margins during large break loss of coolant accidents [34] [144] while discussions with the CNSC have been held to consider the reclassification of large break loss of coolant accidents from design basis to beyond design basis events similar to the practices of similar type of events in other jurisdictions [145]. Previously a generic action item GAI 95G04 had existed to review positive void reactivity uncertainty and its treatment in Large Loss of Coolant Accidents and another GAI 99G02 reviewed the replacement of reactor physics codes used in Safety Analysis (INFO-0745 [146] Sections E.9 and E.15). In the interim, since the last ISR was completed, additional reactor core physics findings impacting the core void reactivity and uncertainty in the analysis have arisen, thus the available margin continues to be challenged [147]. Bruce Power considered whether a trend has arisen with these adverse events in the area of reactor physics and/or thermal-hydraulics based on the discovery issues. It evaluates and prioritizes these events on a quarterly basis following Reference [119] DPT-NSAS-00003-R004, Guidelines for Evaluating and Prioritizing Safety Report Issues, Bruce Power. Bruce Power has concluded the Large Break Loss of Coolant Accident (LBLOCA) analysis continues to have sufficient margin [148]. For completeness, this issue is flagged as a gap as the Safety Report Improvement project will

[10] Level 3: Potential reduction in margin to the health and safety of persons, security or the environment; Level 2: Some reduction in margin to the health and safety of persons, security or the environment; Level 1: Major reduction in margin to the health and safety of persons, security or the environment.

need to capture changing LBLOCA analysis in future Safety Report updates. This is identified as gap SF8-3 in Table 7.

With the exception noted as gap SF8-3, Bruce Power programs and processes meet the requirements of this review task.

5.4. Safety-Related Operational Data

This section addresses Section Review Task 1b.

Bruce Power has a wide range of processes in place for routine recording and evaluation of safety-related operational data under the Equipment Reliability Program, BP-PROG-11.01 [57]. These include:

- Operations inspections and monitoring, GRP-OPS-00047 [99];
- Safety System Testing, BP-PROC-00268, [91];
- Routine System, Structure, and Component performance and health monitoring by System Engineers, DPT-PE-00008 [117], DPT-PE-00009 [126], DPT-PE-00010, [127] DPT-PE-00011 [128];
- Fault Data Collection for Probabilistic Risk Assessment, BP-PROC-00943 [149]; and
- In-Service Inspection Programs for Safety-Related Structures NK21-PIP-20000-00001 [151].

These processes provide detailed information on the Safety-Related System, Structures and Components condition and performance on a shift, daily, weekly and less frequent basis. This data is feedback to capture the reliability and unavailability data used in the Bruce A Annual Reliability Report [172] as part of the Reliability Program input which complies with the CNSC Regulatory Standard S-98 and used in the Safety Analyses to ensuring ageing is appropriately modeled [126]. For example, the Operational Data captured in the Annual Reliability Report includes Human Performance data covering human error events observed involving the systems important to safety, inputs from the SSTs, Safety Related Operator Routines, and the System Health Reports.

On a daily basis routine SSC and equipment-related issues found through plant monitoring, maintenance, walk-downs and operator routines are more widely identified via the Station Condition Record process [77]. The SCRs are reviewed by Management at the daily Morning Review Meetings, and addressed through the Corrective Action program [52]. Similarly the Station Plant Health Committee, BP-PROC-00559 [129] meets regularly to determine the actions in response to the inspection, walk-downs and maintenance findings.

Safety-Related Operational Data is collected, reviewed and trended by Bruce Power in compliance with CNSC Standard S-99 and consistent with WANO expectations, guidance provided in IAEA-TECDOC-1141, Operational Safety Performance Indicators for Nuclear Power Plants [154] was considered in deriving the operational performance indicators.

Bruce Power has an extensive program of monitoring and recording safety-related operational data consistent with Canadian requirements and international best practices. Specific performance indicators are discussed later in this Section.

Bruce Power programs and processes meet the requirements of this review task.

5.5. Maintenance, Inspection and Testing

This section addresses Section 1.2 Review Task 1c.

Bruce Power has processes in place for routine recording and evaluation of maintenance, inspection and testing under the Equipment Reliability program [57]. Appendix C of that program maps the regulatory requirements to the program implementing procedures. Numerous SSC specific items are documented specific to the SSCs (e.g., Infrared Inspection of Indoor Electrical Equipment BP-PROC-00764 and Inspection and Monitoring of Once-Through Service Water Systems SEC-ME-00010). Others cover multiple SSCs including:

- Operations inspections and monitoring, GRP-OPS-00047 [99];
- In-Service Inspection Programs for Safety-Related Structures, NK21-PIP-20000-00001 [151];
- Safety System Testing Program Procedures, BP-PROC-00268 [91]; and
- Maintenance information comes from Routine System, Structure, and Component performance and health monitoring by System Engineers DPT-PE-00008 [117], DPT-PE-00009 [126], DPT-PE-00010 [127], DPT-PE-00011, [128].

Each of these is also a source of Operational Data so were already discussed in Section 5.4.

In addition to the testing programs, Bruce Power tracks incomplete Safety System Testing Program testing in Section 9.0 of the Quarterly Report of Performance Indicators [152].

The assessments of Safety Factor 2 have discussed the progress on the maintenance backlogs as well so specific technical details are not reviewed in this Safety Factor, however from a trending and completeness perspective this Safety Factor review noted the completion of this item has been slow. This trend is flagged as gap SF8-8 in Table 7 and also highlighted through the review of CNSC inspections reported in Sections 7.3.1 and 7.3.2. The status and importance of this gap are discussed next.

Bruce Power and the CNSC have had long standing discussion of the Maintenance Backlogs under Action Item 080707. This issue was flagged in the 2008 ISR and the parties have been tracking it fully with some 15 correspondences on the topic. Bruce Power provided a detailed summary of the status and identified the numerous procedures and processes in place and identified future courses of action [153]. Bruce Power followed up with a status report which shows significant improvement on this issue as supplemental information to the PROL renewal application. The update shows extensive gains in reducing maintenance backlogs through 2014 [148].

Bruce Power is complying with the requirements of this review task recognizing the progress on maintenance backlogs has been less effective than originally desired, but improvement actions have been taken. The station is now in line with or exceeds target backlog goals [148].

5.6. Replacements of SSCs Important to Safety Owing to Failure or Obsolescence

This section addresses Section 1.2 Review Task 1d.

Bruce Power has processes in place for routine recording and evaluation of replacements of SSCs Important to Safety Owing to Failure or Obsolescence. These include:

- Equipment Reliability, On-Line Work Management, Outage Work Management and Plant Maintenance Programs [57] [58] [59] [60];
- Aggregate Risk Assessment and Monitoring, BP-PROC-00849 [97];
- Integrated Aging Management for Safety Assessment, DPT-NSAS-00016 [121];
- Long Term Planning & Life Cycle Management, BP-PROC-00783 [96];
- Assessment Management Planning, BP-PROC-00936 [70];
- Scoping and Identification of Critical SSCs, BP-PROC-00778 [92];
- Obsolescence Management, BP-PROC-00533 [130];
- Environmental Qualification Sustainability Monitoring, SEC-EQD-00035 [118];
- Station Plant Health Committee, BP-PROC-00559 [129]; and
- Margin Management BP-PROC-00786 [155].

As discussed in Sections 4.3 and 4.4, Equipment Reliability defines the fundamental needs, requirements, implementing approaches, and responsibilities of the plant equipment reliability integration process. The objective of equipment reliability is to develop, implement and revise the approaches required for anticipating, identifying, preventing and resolving performance and condition problems with SSCs on the basis of risk, to support safe, reliable plant operation at optimum cost. A review of single point vulnerabilities and obsolescence are important aspects of Equipment Reliability.

The Aggregate Risk Assessment and Monitoring process reviews the risk of degraded performance during normal and abnormal operation including plant transients to ensure continuing reliable operation [97]. If an important SSC fails or becomes obsolete Plant and Station Engineering personnel take the appropriate actions based on an understanding of the risk. Results of assessments are provided to the Station Plant Health Committee, BP-PROC-00559 via a risk ranking sub-committee report for their awareness and review to ensure a safe, integrated focus on aggregate risk. Factors considered include findings of degraded margin, safety system impairments, loss of redundancy, condition single point vulnerabilities, backlogs, operator work-arounds, bill of material obsolescence, and Abnormal Incidents Manual equipment health.

The Integrated Aging Management for Safety Assessment process [121] links to ageing management as it requires that the condition of the plant be monitored and inspected so the results can be used to ensure that safety margins remain adequate. The dominant ageing mechanisms in the Heat Transport System are associated with pressure tubes, steam generators and feeders.

The Asset Management Planning process [70] involves a formal presentation and approval of the selected asset management scope and maintenance of the long term Asset Management Plan. It then directs the organization to implement the improvements. The procedure defines the process to select and approve Asset Management options to achieve a resource leveled, integrated Asset Management Plan that will provide safe, reliable long term operation in alignment with corporate strategic and business planning objectives.

Scoping and Identification of Critical SSCs [92] ensures the safety important systems are identified.

The Bruce A and B Station Plant Health Committees BP-PROC-00559 [129] are discussed more fully in Section 5.14. They are an effective management tool enabling the station leadership team to make informed and timely decisions in support of equipment reliability that results in safe and reliable plant operation. The SPHC provides management oversight regarding the status of Equipment Reliability issues that challenge safe and efficient plant operations.

The Margin Management process [155] describes the steps to manage the safe and reliable plant operation of the plant by maintaining margins, ensuring plant equipment configuration and performance are consistent with design and licensing requirements, and conducting day-to-day operations reflecting consideration of design and operating margins. The Margin Management document is aligned with the structure described in INPO document 09-003, Excellence in the Management of Design and Operating Margins.

Maintaining margin is a basic principle of nuclear plant design and operation. "Margin" is conservatism included in operating limits, design limits, analysis and fabrication of every SSC. Margin accounts for normal wear and ageing of equipment, degradation of safety analysis assumptions and analytical method uncertainties. Site organizations are aware of what margins exist and how they are controlled so margin concerns can be recognized and managed.

Examples which show Bruce Power continues to manage margins are illustrated through the Heat Transport Low Flow Trip and Heat Transport High Pressure Trip improvement projects [156] [157] [158]. Bruce Power is relying on the highly reliable reactor stepback on pump breaker [159] while improvements in the shutdown systems are being finalized. A review of these projects shows detailed up-to-date trip coverage maps for all loss of flow events have not been provided and are not included in the Safety Report. Bruce Power has flagged this shortcoming as part of its supplements to the PROL renewal application to support licence renewal [148]. Bruce Power has acknowledged improvements are necessary and they are updating their analysis models to compensate for ageing. The analyses using these models are planned to be captured in the Safety Report Improvement initiative [160] but recognizing there are more significant gaps in the Safety Report, Bruce Power is planning to focus on the inclusion of Common Mode Failures in the Safety Report over the next two years [148]. Future improvements such as updating the extent of the changes to trip coverage windows for the key aged impacted accident scenarios of loss of flow, neutron overpower protection, small break loss of coolant accidents in compliance with R-10, while considering the use of the modified 37-element bundle to reduce the trip coverage window [157] will be captured later in the Safety Report Improvement project [162]. For completeness, this is identified as gap SF8-5 in Table 7. Regarding Common Mode Failures, Safety Factor 5 identified gap SF5-2, which stated that "…Common-mode failure events are not included in Part 3 of the Safety Report."

These analyses continue to show sufficient margin is available or in some cases identify improvements to restore margin. Bruce Power provided an update of their Aging Management Program as part of the PROL renewal process [163].

With the exception of the gap noted above, Bruce Power programs and processes meet the requirements of this review task.

5.7. Modifications to SSCs Important to Safety

This section addresses Section Review Task 1e.

Bruce Power has a process in place for routine recording and evaluation of temporary or permanent modifications to SSCs Important to Safety. These include:

- Engineering Change Control, BP-PROG-10.02 [56];
- Design Change Package, BP-PROC-00539 [89]; and
- Configuration Information Change, BP-PROC-00542 [90].

The Engineering Change Control process helps ensure the plant design basis is maintained so the structures, systems and components continue to meet the design basis and the plant can continue to operate safely within its design basis [56]. It interfaces with the design process [55] and configuration management programs which ensure the design basis, plant documentation and the as-built and operated plant are consistent.

The Design Change Package (DCP) process, as documented in BP-PROC-00539, specifies the control of modifications to plant systems, structures, components, and significant tools, including temporary modifications. The overall objective is to meet regulatory requirements, ensure safety, and minimize loss to the company through appropriate risk management activities [89].

The DCP procedure describes how to:

- Prepare, issue, and close out DCPs.
- Prepare, issue, and close out Design Change Notices (DCNs) and Field Change Notices (FCNs).

The DCP process is used to ensure changes to the design of the facility, facility operation, equipment or procedures that would change the operational limits referred to in the Operating Policies and Principles or introduce hazards different in nature or greater in probability than those considered by the Final Safety Analysis Report and Probabilistic Safety Assessment, without the prior written consent of the Commission, or a person authorized by the Commission are appropriately reviewed and approved.

The Configuration Information Change process, as documented in BP-PROC-00542 [90], governs the acceptance, creation, revision, obsolescing and superseding of design information when one or more of the following apply:

- Design information is being corrected.
- No inspection, testing, or commissioning activities are required to verify the field against the new design information.

Bruce Power provided the CNSC with an update on the status of the close-out transition plan defining the outstanding documentation for the DCPs for Restart of Units 1 and 2 as part an effectiveness inspection [164]. The DCPs are on production related systems.

In addition to these processes, the Business Risk Management process is followed to determine which systems may be enhanced as was discussed in Section 5.6.

Examples which show Bruce Power is modifying SSCs to account for ageing degradation are illustrated through the New Neutronic Trip improvement and the modified 37-element fuel bundle projects [165] [157]. Extensive lists of other improvements can be found in the Safety Report Improvement Plan (Section 4.24 of [166]) and the Integrated Implementation Plan [167]. Furthermore, the Bruce A Safety Basis Report [2], Sections 4.1.7 and 4.2.2.3, discuss other modifications made to improve safety margins.

Separately, as part of the Bruce Power response to the Fukushima Dai-ichi event in Japan in 2011, Bruce Power has developed a comprehensive action plan which responds to each of the CNSC Fukushima Action Items [167]. Bruce Power has initiated design changes to improve defence-in-depth and means to respond to severe accident events, including updates to operating documents and the severe accident management guidelines. Many of the action plan tasks have been completed and changes have already been implemented in the Units, recognizing more are underway. The actions in the plan are expected to be fully implemented by 2018, and a semi-annual action plan update is provided to the CNSC [168] [169].

From a trending perspective it was noticed that some conceptual design modifications which are initiated via safety analyses to improve safety margins take a significant amount of time to move from the conceptual design phase to implementation, commissioning and available for service. For example the New Neutronics Trip project discussed in the 2014 Licence Renewal application [34] was discussed in 2008 as part of Action Item 080705 as a replacement for the Low Void Reactivity Fuel Project ([144] Section 1.1.10.2). Similarly a heat transport high pressure trip has been discussed on Units 3 and 4 to restore safety margin since 2010 [158]. These improvements appear to take a significant time frame to implement particularly when the conceptual design relies on collecting station data and outages to implement [169]. Therefore a trend has been identified pointing out the need to close the gap between the notifications to the CNSC of safety margin improvement to their implementation in the Units to ensure margins are not eroded over time particularly since the safety analyses inputs may have changed since the inception of the project. This is identified as gap SF8-4 in Table 7.

From a qualification of worker perspective ([3] clause 5.94), Safety Factor 12 shows Bruce Power has processes and procedures in place to ensure workers are qualified. However, in addition to worker training and qualification, workers require the methodology, models and tools to perform their tasks. This includes assurance the codes and models for performing Safety

Analysis, Probabilistic Safety Assessments and Fuel Design are available so the work is repeatable. A strength found during the reviews is the control Bruce Power took with respect to its modification of the 37-element fuel design (37M). Bruce Power staff were instrumental in the completion of the design, and Bruce Power owned the design and worked with the manufacturers to ensure the requirements were understood and incorporated. With the continuing fragmentation of some of the Vendors who support the Stations, this strength was important in ensuring the safety improvement was completed on schedule and as committed to the CNSC.

Bruce Power modified low-pressure turbine generator stators as part of the Bruce A refurbishment project and successfully exchanged and upgraded them on Units 1 and 4 in August 2012. Recently six turbine generator rotors were safely moved from barges by a 600-ton crane and transported into the Bruce A station and are ready to be installed in future planned outages in Units 2 and 3 [170]. The new turbines will add 40 years of life to the generators in Units 2 and 3. As part of the move of the turbine generator stators it was noted the Safety Report Deterministic Safety Analyses does not cover moves of this magnitude and crane moves in general; neither does the Probabilistic Risk Assessment. Similarly in 2013 a review was performed to ensure an appropriate Safety Case pertaining to Craning of primary heat transport system motors existed following action request 28373157. Finally, the Bruce B Location and Separation Design Guide, Section 6, explicitly mentions consideration of crane hazards but no similar Bruce A document exists [171].

Bruce Power should clarify where postulated initiating events involving hazard analyses of this nature are documented to ensure the adequacy of protection of the NPP against internal and external hazards. Presently these safety assessments tend to be in various documents (e.g., Seismic, Pipe-whip and Fire [167] [169]) so it would be useful to provide an integrating document to confirm completeness, to ensure the hazard assessments remain current as knowledge is improved and modifications are made to the SSCs, and the integration and overlap with Deterministic Safety Analysis and Probabilistic Safety Assessments are well known. This suggestion is identified as gap SF8-6 in Table 7.

With the exception of the gaps identified above, Bruce Power programs and processes meet the requirements of this review task.

5.8. Unavailability of Safety Systems

This section addresses Section 1.2 Review Task 1f.

Bruce Power has processes in place for routine recording and evaluation of unavailability of safety systems. These include:

- CNSC Interface Management, BP-PROG-06.03 [54];
- Reporting to the CNSC, BP-PROC-00833 ([86] Section 4.2.1. sub-clause 1. b)); and
- Bruce A and B Quarterly Operations and CMLF Quarterly Technical Reports, BP-PROC-00139 [112].

These procedures define the process for the Quarterly Operations Reports and the Annual Reliability Report. Section 3.2 of these Quarterly reports provides unavailability statistics pursuant to S-99 Section 6.4.1 (h). Unavailability of Safety Systems and Safety-Related Systems is reported in detail in the Annual Reliability Report.

The Bruce A Annual Reliability Report [172] is submitted to meet the CNSC annual reporting requirements. The CNSC reporting requirements, outlined in Regulatory Standard S-99, Section 6.4.9, require a report on the reliability of the nuclear power plant. S-99 stipulates that only systems which are determined to be “risk significant” are to be detailed in this report. In addition the special safety systems are included per CANDU Owners Group guidance to form the S-98 Systems Important to Safety. Bruce Power has aligned the format of this report with the CNSC template for the Annual Reliability Report.

All systems important to safety met their predicted future unavailability target except the Standby Class III Power System in 2012 and 2013. The system was over target due to corrections in the Standby Class III Power System unavailability model to reflect plant operations. Corrective actions to bring the predicted future unavailability back to within target are being managed through the Bruce Power Corrective Action Program.

The Unit 1 and Unit 2 Qualified Power Supply, Emergency Coolant Injection System, Shutdown System 2 and Emergency Heating, Ventilation and Air Conditioning system failed to meet their actual past unavailability target in 2012 and 2013 due to an event in which passive ventilation was blocked in instrument rooms (R1-316, R1-317, R2-316, R2-317) and QPS rooms (R1-336, R2-336). The Unit 3 Shutdown System 1 and Shutdown System 2 failed to meet their actual past unavailability target due to an incorrect calibration event on temperature transmitters that are used for Reactor Inner Zone Inlet Header/Reactor Outer Zone Inlet Header impairment temperature calculations [172] [173].

Bruce Power programs and processes meet the requirements of this review task, but there is a gap meeting the unavailability targets of the Standby Class III Power System, and passive ventilation blockage resulted in multiple systems not meeting their unavailability targets. This is identified as gap SF8-9 in Table 7.

5.9. Radiation Doses to Workers

This section addresses Section 1.2 Review Tasks 1g and 4.

Bruce Power has a process in place for routine recording and evaluation of radiation doses to worker. These include:

- Dosimetry and Dose Reporting, BP-RPP-00020 [105];
- Bruce A and B Quarterly Operations and CMLF Quarterly Technical Reports BP-PROC-00139 [112]; and
- Quarterly CNSC Performance Indicator Reports B-REP-00531-00025 [138] and B-REP-00531-00049 [139].

Section 5.2 of the Bruce A and B Quarterly Operations and CMLF Quarterly Technical Reports provides Occupational Dose information in compliance with S-99, Sections 6.4.1 (m) and (n) alert the CNSC to events or likely events where workers may receive a significant dose and provides information on whole body collective dose statistics and doses by work groups (operators, Projects and Modifications, Chemistry, various Maintenance groups).

Section 8.2 of the Quarterly CNSC Performance Indicator Reports provides Operational reports on the Total Station Whole Body Radiation Dose and identifies the number of workers, including those with no dose.

Worker dose control continued to comply with the regulatory requirements to measure and record doses received by workers. No worker or member of the public received a radiation dose in excess of the regulatory dose limits or action levels established in the Bruce Power RP program. The dose information for Bruce A and B was provided in section 2.7 and appendix D ([136] Section 3.1.7). Since the last Safety Review Bruce Power worked aggressively to resolve the Unit 1 and 2 alpha issue discovered during the refurbishment project. As discussed in Section 7.3, Action Item 1107-2924 - BPRD-2011-AB-011 - Radiation Protection Alpha Monitoring and Control was raised by the CNSC to confirm the appropriate actions were taken by Bruce Power and Section 7.1.7 covers a FASA performed by Bruce Power.

Additionally worker doses to members of the public were reported in the Bruce A Refurbishment Annual Follow-up Monitoring Program Report, 2013 [174].

CNSC staff did not identify any regulatory non-compliances or areas requiring improvement in 2013 in the application of ALARA. All areas for improvement identified in 2012 related to the implementation of Bruce Power's ALARA program were addressed in 2013. Bruce Power has established a five-year ALARA plan that includes numerous dose reduction initiatives. In October 2013, during the compliance inspection, CNSC staff noted the successful implementation of ALARA initiatives at Bruce A and B to reduce worker exposures ([136] Section 3.1.7).

Similar information is provided annually to the CNSC, for example, the 2014 request for dose input for the Nuclear Power Plant Summary Report was requested from Bruce Power.

Bruce Power has effective radiation protection measures in place to protect the public and environment. Safety Factor 15 discusses specific improvements to the processes themselves.

Bruce Power programs and processes meet the requirements of this review task.

5.10. Off-Site Contamination and Radiation Levels

This section addresses Section 1.2 Review Tasks 1h, 3, and 4.

Bruce Power has a process in place for routine recording and evaluation of off-site contamination and radiation levels. These include:

- Reporting to CNSC – Power Reactor Operating Licences BP-PROC-00165 [111];
- Formal Correspondence with the CNSC, BP-PROC-00064 [85]; and
- Bruce A and B Quarterly Operations and CMLF Quarterly Technical Reports, BP-PROC-00139 [112].

Reporting to CNSC – Power Reactor Operating Licences, Section 4.2.2, the Reaching of an Action Level satisfies S-99, Section 6.3.2.1 which requires the licensee to notify and report to the CNSC when the licensee becomes aware that an action level referred to in the licence for the purpose of Section 6(2) of the "Radiation Protection Regulations" has been reached. The Designated Representatives of the Licensee responsible for reporting when an action level has been reached are as follows:

- The Department Manager, Environment Oversight and Waste is responsible for Environmental Protection Action Levels. These action levels are listed in Section 8.3 of the Bruce A and Bruce B LCHs.
- The Department Manager, Safety Programs is responsible for Radiation Protection Action Levels. These action levels are listed in Section 9.2 of the Bruce A and Bruce B LCHs.

Once the responsible Designated Representative of the Licensee has determined a situation or event is reportable under S-99, Section 6.3.2.1, he or she shall:

1. Notify the designated CNSC contact within the time frame specified in the licence (7 days).

- The notification may be completed orally (by telephone) followed by e-mail, or by e-mail alone and should include all available information consistent with S-99, Section 6.3.2.1.
- The e-mail shall be assigned the appropriate CNSC Correspondence number(s) and shall otherwise be managed in accordance with the registered e-mail requirements provided in BP-PROC-00064 [85].

2. Ensure an investigation is conducted to determine the cause for reaching an action level in accordance with BP-PROC-00060 and associated corrective action and investigation procedures. Collectively, the investigations conducted shall obtain the information required by S-99, Section 6.3.2.1(b) for inclusion in the report.

3. Ensure an Action Level Report is filed with the CNSC designated contact(s) within 45 days of the date the Designated Representative of the Licensee determined that the action level had been reached. The Designated Representative of the Licensee shall ensure the following:

- The report shall be prepared, reviewed, processed and managed as formal correspondence in accordance with BP-PROC-00064 [85] however, due to the nature of this report, the report details shall be included as a signed attachment to a covering letter.
- The report shall contain the information described in S-99, Section 6.3.2.1(b).
- If the report was not prepared by the Authorized Health Physicist (AHP) for the station, then the AHP shall review the report and should also sign the report as a reviewer. AHP signature on the report is not required if the AHP's signature is included on the Correspondence Routing Sheet for the letter.

Bruce A and B Quarterly Operations and CMLF Quarterly Technical Reports [112] Section 5.1, provides quarterly updates of in-station radiological conditions including gamma surveys around the station, airborne contamination (tritium and particulate), loose surface contamination, and alpha.

Trend Analysis is reviewed against the past quarters. Adverse trends are reported through the Station Condition Record process as described in Section 4.6.

Additionally dose to members of the public was reported in the Bruce A Refurbishment Annual Follow-up Monitoring Program Report, 2013 [174].

As reported in the CNSC Staff's Integrated Safety Assessment of Canadian Nuclear Power Plants for 2013 [136], from a radiological hazard control perspective there were no action level exceedances with respect to radiological hazards, including surface contamination at Bruce A. In the 2013 report [136], CNSC staff confirmed that Bruce Power complies with the requirements for radiological hazard control and has improved from the previous year.

From an estimated dose to public perspective the reported dose to a member of the public from the Bruce site (which includes Bruce A, Bruce B, Central Maintenance and Laundry Facility, Western Waste Management Facility, and the decommissioned Douglas Point reactor) was 0.0013 mSv, well below the public dose regulatory limit (for a member of the public) of 1 mSv ([136] Section 3.1.7).

Bruce Power has effective measures in place to protect the public and environment. Bruce Power programs and processes meet the requirements of this review task.

5.11. Discharges of Radioactive Effluents

This section addresses Section 1.2 Review Tasks 1i and 4.

Bruce Power has a process in place for routine recording and evaluation of discharges of radioactive effluents. These include:

- Environmental Safety Management program, BP-PROG-00.02 [47];
- Reporting to CNSC – Power Reactor Operating Licences, BP-PROC-00165 [111]; and
- Bruce A and B Quarterly Operations and CMLF Quarterly Technical Reports, BP-PROC-00139 [112].

The Environmental Safety Management Program, BP-PROG-00.02, Section 4.7.1 and Appendix C, identifies supporting processes covering emissions management.

From a review of the last few years of Quarterly Field Inspections: emissions were low and well below regulatory limits. Environmental monitoring equipment was observed to have no indications of impairments to functionality (see Section 7.3.2).

Bruce A and B Quarterly Operations and CMLF Quarterly Technical Reports [112] Section 4.2 provide quarterly updates of Waterborne (Aqueous) Radiological Emissions [175] [176] [177].

Additionally effluent discharges were reported in the Bruce A Refurbishment Annual Follow-up Monitoring Program Report, 2013 [174]. The Follow-up Monitoring Program Report utilizes data from the Environmental Monitoring Program Report.

Bruce Power has implemented and maintained an environmental monitoring program that meets applicable regulatory requirements. Based on the review of the licensee's reports, CNSC staff concluded that the radiological releases from Bruce A and B remained below their regulatory limits and action levels. (See Section 7.3.1, Environmental Monitoring Program Report [134].)

Bruce Power updated its Derived Release Limits (DRLs) and action levels in accordance with N288.1-08, Guidelines for calculating DRLs for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities. The new DRLs were reviewed and accepted by CNSC staff in May 2013. In January 2014, the Commission approved and issued amended operating licences to Bruce Power with the updated DRLs ([178] Section 3.1.9).

Groundwater monitoring at the Bruce site indicated no adverse impact on the groundwater environment due to operation ([136] Section 3.1.9).

Bruce Power continued to make satisfactory progress with respect to limiting releases based on the activity at the site i.e., hydrazine releases into the environment. The Ministry of the Environment (MOE) reviewed the 2013 discharges at the Bruce Site and reported concentrations of hydrazine were below levels of concern for aquatic life. The MOE had no environmental concerns ([136] Section 3.1.9).

Bruce Power provides an annual Environmental Monitoring Program [134] update describing its effluent monitoring program related to Operations in compliance with PROL Condition 1.7.

Bruce Power programs and processes meet the requirements of this review task.

5.12. Generation of Radioactive Waste

This section addresses Section 1.2 Review Tasks 1j and 5.

Bruce Power has a process in place for routine recording and evaluation of solid wastes. These include:

- Environmental Safety Management, BP-PROG-00.02 [47];
- Segregation and Handling of Radioactive Waste, BP-RPP-00010 [103];
- Low Level Radioactive Waste Minimization, BP-PROC-00714 [107];
- Radioactive Waste Management, BP-PROC-00878 [108]; and
- Bruce A and B Quarterly Operations and CMLF Quarterly Technical Reports, BP-PROC-00139 [112].

The Environmental Safety Management Program, BP-PROG-00.02, Section 4.7.4 and Appendix C, identifies supporting processes covering Waste Management.

Data on the generation of radioactive waste are reviewed to determine whether operation of the plant is being optimized to minimize the quantities of waste being generated and accumulated, taking into account the national policy[11] on radioactive discharges and international treaties, standards and criteria. CNSC staff concluded that the waste management Safety Control Area at Bruce A met performance objectives and applicable regulatory requirements. As a result, each station received a “satisfactory” rating, unchanged from 2012. Bruce Power’s nuclear waste management program sets requirements for the minimization, segregation and handling, assessment of hazard levels, monitoring and processing of radioactive waste. During 2013, radioactive waste was disposed of properly in accordance with regulations and Bruce Power’s operating procedures. Waste management practices were in compliance with the requirements for management and control of radioactive waste in 2013. A compliance inspection of hazardous waste management was conducted in September 2013. Results of the inspection indicated that Bruce Power’s hazardous waste management program met CNSC requirements ([133] Section 3.1.1)

Quarterly Operations Report Section 5.3.4 reports on Radioactive Wastes and Shipments while Fuel is covered in Section 5.3.1 of the quarterly reports [176] [177].

Final processing and storage of solid radioactive waste is performed by Ontario Power Generation’s Western Waste Management Facility located on the Bruce Nuclear Power Development Site. Wastes are packaged and delivered according to agreed waste acceptance criteria.

Bruce Power programs and processes meet the requirements of this review task.

5.13. Compliance with Regulatory Requirements and Guidance Documents

This section addresses Section 1.2 Review Task 1k.

Bruce Power has processes in place for routine recording and evaluation of compliance with Regulatory Requirements. These include:

- Reporting to CNSC – Power Reactor Operating Licences, BP-PROC-00165, [111]; and
- Power Reactor Operating Licence Amendment or Renewal, BP-PROC-00114 [84].

The CNSC staff performs compliance and field inspections as discussed in Sections 7.3.1 and 7.3.2 to confirm Bruce Power meets Regulatory Requirements, and reviews Bruce Power’s compliance with the Licence as part of the Licence Renewal process as discussed in Section 5.1. These CNSC staff inspections and reviews have not identified significant regulatory issues or non-compliances based on the reporting requirements from S-99 ([136] Section 3.1.3).

When amending or renewing the PROL, Regulatory Affairs staff consult with CNSC staff regarding their expectations related to implementation of existing and new requirements including, regulations, licence conditions, codes, standards and Regulatory Documents coming into force in the forthcoming licensing period [84], and:

[11] There is no overall national policy on waste, because wastes typically fall under provincial jurisdiction. However, NRCan issued a “radioactive waste policy framework” in 1996 (http://www.llrwmo.org/wp-content/uploads/Policy_Framework.pdf).

- Determine CNSC staff expectations regarding implementation requirements and the extent of transitional arrangements that need to be included within the licence renewal applications.
- Consult with internal stakeholders regarding the stated CNSC staff expectations and ensure any positions ultimately taken have senior management endorsement, including acceptance of any impacts on the five year business plan and provision of the resources necessary to implement the changes.
- In consideration that forward looking transition plans may be subject to change, ensure that any positions established (that will be included in the licence application) include sufficient flexibility to facilitate future changes if necessary.

The Integrated Safety Review and Systematic Review of Safety performed for: the return to service of Bruce A Units 3 and 4 [7]; the Life extension of Units 1 and 2 [8] [9] [15] [44]; proposed refurbishments of Units 3 and 4 [10] [11] [12]; and the more recent Safety Basis Report and Periodic Safety Review for Units 1-8 [2] are tools which can be used to confirm the extent of Regulatory Requirement Compliance and to assist in ensuring the CNSC and Bruce Power are in agreement on new or amended requirements.

The Bruce A 2013 Environmental Compliance Approval (Water) Compliance Report for Bruce A [179] provides explanations for the exceptions taken including exceedances and non-compliance, and meets the annual reporting required by the Environmental Compliance Approval. No environmental penalties were issued.

The reported dose to a member of the public from the Bruce site (which includes Bruce A, Bruce B, Central Maintenance and Laundry Facility, Western Waste Management Facility, and the decommissioned Douglas Point reactor) was 0.0013 mSv, well below the public dose regulatory limit (for a member of the public) of 1 mSv ([136] Section 3.1.7).

Bruce Power's Radiation Protection program performance satisfies the requirements of the Radiation Protection Regulations and includes performance indicators to monitor RP program performance. The RP program documents and supporting procedures are maintained current, taking into consideration operating experience and industry best practices. In 2013, there were no regulatory findings in this area. The oversight applied in implementing and continuously improving this program has been effective in protecting workers ([136] Section 3.1.7).

Bruce Power proactively and effectively conducted Periodic Safety Reviews against the IAEA Safety Guide NS-G-2.10 [10] and SSG-25 [3], but has no permanent process or procedures defining how to conduct the Periodic Safety Reviews and the process has not been agreed with the Regulator as per SSG-25.Bruce Power has been progressively updating its regulatory documentation through updates of the implementing procedures of BP-PROG-06.03 and ensuring it has the processes and documentation in place to show it is meeting Regulatory Requirements in anticipation of the new Regulatory Requirements in the PROL. Bruce Power should consider upgrading the processes to include a procedure covering the CNSC draft Regulatory Document, CNSC REGDOC-2.3.3, on Integrated Safety Reviews. This CNSC REGDOC sets out the CNSC's requirements and guidance with regard to the conduct of a PSR at an NPP.

Bruce Power and the CNSC recognize an ISR is a comprehensive evaluation of the design, condition, and operation of a nuclear power plant and an effective way to obtain an overall view of actual plant safety and to determine reasonable and practical modifications to ensure continued safe operation. Bruce Power has been proactively enhancing their procedures to include governance procedures covering Integrated Safety Reviews. The CNSC has already inquired about which procedure was followed in the previous review [180]. Bruce Power has provided a draft Program document [153]. However, the draft Program document Section 2.0 is inconsistent with the current process and SSG-25, as Section 2.0 of the draft Program document has an Exception for radiation safety. This is identified as gap SF8-1 in Table 7.

A review of the S-294 Project shows Bruce Power identified it was necessary to compile Bruce station specific data to close an information gap. This data was first due on December 15, 2012 ([181] Table 1 item (5)). Procedures were written to collect this data [182]. The date was committed more formally for Bruce A by December 2013. As part of a Type II inspection of S-294, it was confirmed this data was still not available. The results of the PSA show the risks are sufficiently low and well balanced as some Bruce A data was used along with more conservative generic industry data [149]. However, using Bruce A data is expected to give a more accurate representation without potentially skewing the results. Bruce Power has committed to complete this by June 30, 2016 [150]. Furthermore, as is the standard practice, Bruce Power acknowledges it is transitioning to show compliance with CNSC REGDOC 2.4.2 the next time the Probabilistic Safety Assessments are updated [149].

Recent beyond design basis improvements have been introduced as part of Bruce Power's response to the Fukushima event. From an integrated Licensing Basis, Design Basis and Safety perspective, no Canadian Design Basis and Configuration Management regulatory document exists and no CSA Standard has been written (the CANDU Owners Group had compiled a document on Design Basis and Recommended Principles for Managing it (COG-11-9024) but it is not used in the Bruce Power governance). The Bruce Power Plant Design Basis Management Program, BP-PROG-10.01, references among its external standards, ANSI/NIRMA CM 1.0-2000, Configuration Management of Nuclear Facilities and IAEA-TECDOC-1335, Configuration Management in Nuclear Power Plants, January 2003 [183] which touch upon Design Basis and its integration with the Licensing Basis and Safety. Design Basis and Configuration Management standards strive to ensure licensing requirements, design requirements and the as-built physical plant and operation of the plant are consistent. CNSC Regulatory document CNSC REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants, which sets out the CNSC's requirements and guidance for the design of new water-cooled nuclear power plants (NPPs), is a design regulatory document with limited discussion on Design Basis.

It would assist staff in future modifications and licensing assessments if a document was produced that clearly explains the relationship and impact of the licensing-driven changes on the design basis, safety analyses and assessments. Furthermore, explanation of the use of new terms not used in the design basis and requirements documentation, such as pseudo-Group 1 or pseudo-Group 2 SSCs, can clarify the intent for this Bruce A document. For example, this would help ensure that the Safety Design Guides [171] and Design Requirements/Manuals are systematically revised to incorporate the Fukushima type design changes. This gap has been identified as SF8-7 in Table 7.

Bruce Power programs and processes meet the requirements of this review task, noting improvements have been suggested.

5.14. Overall Safety Performance

In addition to the aforementioned processes, Bruce Power has other processes and the companion methodology to evaluate and assess operating experience to ensure safe performance. These include means to integrate the Station condition as multiple degraded conditions may be arising simultaneously and there needs to be a method to prioritize which issue is dealt with first. These processes are discussed in the following three subsections on: Safety Performance Integration; Prioritization of Safety Issues; and Safety Performance Communication.

5.14.1. Safety Performance Integration

Bruce Power has processes in place for routine recording and evaluation of the integration of safety performance. These include:

- Plant Operational Review Committee (PORC), BP-PROC-00136 [109];
- Station Plant Health Committee, BP-PROC-00559 [129]; and
- Nuclear Safety Review Board ([63] Section 7.2).

The aforementioned committees and boards are over and above the separate diverse and continuous day-to-day Operational condition responses, which are driven by the Nuclear Safety Culture and Training, such as: Response to Transients; Abnormal Incidents Manual; Conservative Unit Operating Modes – Safety Related System Impairments Manual; Operating Memos; Operational Decision Making; Emergency Response; Environmental Protection; Spill Response; Handling Potentially Rabid or Contaminated Wildlife; Severe Weather Response; High Risk Evolutions; and Technical Operation Evaluations and the companion Training documents that educate Operators about these processes. These committees and boards report back to the respective Bruce Power managers responsible for committees and boards as outlined in the respective procedures.

The Plant Operations Review Committee was established to ensure a high level multidisciplinary oversight. The PORC conducts reviews of issues that have the potential to impact on reactor safety. These reviews provide assurances these issues are being addressed in a timely and safe manner. These reviews may include:

- Plant transients or equipment problems and decisions associated with these problems.
- External OPEX events to ensure appropriate compensatory actions have been implemented as necessary.
- Proposed pro-active plans for future or anticipated events (such as outage maintenance or adverse system health events).
- Proposed Operations/Maintenance/Engineering activities.

The PORC consistently supports the basis of conservative decision making as outlined in the Bruce Power Nuclear Safety Policy, the Bruce Power Policy on Conduct of Operations and the Procedure on Conservative Decision Making. The PORC serves as a forum for challenging the safety culture of the organization and fosters open constructive criticism in the spirit of continuous improvement. Due to the senior diverse makeup of the PORC, the group can consider the integrated aspect of issues.

The Bruce A and B Station Plant Health Committees (SPHC) are an effective management tool enabling the station leadership team to make informed and timely decisions in support of equipment reliability that results in safe and reliable plant operation. The procedure [129] takes authority from BP-PROC-00782, Problem Identification and Resolution, and BP-PROG-11.01, Equipment Reliability. The SPHC provides management oversight regarding the status of Equipment Reliability issues that challenge safe and efficient plant operation; identifies additional issues that require increased management attention needed to improve plant performance and ensuring these items are tracked to completion (repeat failures, rework, corrective actions, bridging strategies); ensure that the proper prioritization, ownership, organizational alignment, resources and accountability are in place to resolve station issues affecting system/component performance; proactively look forward to known issues that can impact the ER Index and ensure the proper prioritization, ownership, organizational alignment, resources and accountability are in place to mitigate the effects; reports out on status of PHC endorsed work orders at each meeting; and acts as the primary filter for investment proposals that affect the station, ensuring that capital projects align with key station priorities, risks and strategic direction.

The Nuclear Safety Review Board has the responsibility for considering and advising the Board of Directors on the extent that affairs are conducted in a manner that promotes reactor, radiological, industrial and environmental safety and for continuing to emphasize the long-term effort required to improve safety culture permanently, including changing management behaviours and demonstrating leadership. Items include advising on the extent that plant operations are within the Operating Licence and Safety Analysis and the effectiveness of reactor, radiological, industrial and environmental safety practices.

5.14.2. Prioritization of Safety Issues

This section provides further information to address Section 1.2 Review Task 3.

Bruce Power has processes in place for routine recording and evaluation of the risk of safety performance. The specific processes involved are extensive so this section just points to a few items to show the extent of the involvement of various groups. Some processes include:

- Business Risk Management, Risk Management – Business Risk Register Bruce Power Procedure BP-PROC-00162 [184];
- Safety Related System List, BP-PROC-00169 [110];
- Systems Important to Safety (SIS) Decision Methodology, DPT-RS-00012 [122];
- Preparation and Maintenance of Operational Safety Requirements, DPT-NSAS-00012 [39];

- Integrated Aging Management for Safety Assessment, DPT-NSAS-00016 [121];
- Station Plant Health Committee, BP-PROC-00559 [129];
- Aggregate Risk Assessment and Monitoring, BP-PROC-00849 [97];
- Scoping and Identification of Critical SSCs, BP-PROC-00778 [92];
- Long Term Planning & Life Cycle Management, BP-PROC-00783 [96];
- Trend Identification and Reporting of SCRs, BP-PROC-00412 [79];
- Risk-Informed Decision Making, B-REP-03611-00004 [185]; and
- Observation and Coaching, BP-PROC-00271 [65].

The overall Risk process is defined in Business Risk Management – Business Risk Register, BP-PROC-00162 [184], which provides necessary guidance and tools to:

- Identify threats and opportunities,
- Reinforce the management of risk is one of the primary accountabilities,
- Maintain a comprehensive and up to date register (i.e., Risk Register) of threats and opportunities,
- Monitor the effectiveness of risk mitigating and optimizing activities, including ensuring that actions are developed and executed in a timely fashion and that risks are managed to an acceptable level,
- Facilitate the Executive Team's review of risks and quarterly reporting of top risks to the Board of Directors.

Risk owners assess the impact of the risk by multiplying the probability of occurrence by its impact (Probability x Impact = Net Impact). In addition to ranking the risks based on their Net Impact, risk owners develop action plans that "mitigate the threat to an acceptable level of exposure".

The Risk Status Rating used in this process includes four levels:

- Green which indicates that either the risk has been reviewed and accepted and no response plan is required or that the risk response plan is complete;
- White which indicates that the response plan is defined and approved;
- Yellow which indicates that the response plan is defined and is being implemented; and
- Red which indicates that either the threat has materialized or that the response plan is not effective.

Guidance is provided for risk identification and includes sources such as Asset life cycle management, System and component health assessments, and SCRs.

The following procedures, referenced in BP-PROC-00162, are in place to ensure that staff are cognizant of the Safety-Related Systems, the Risk Importance of those Systems, what Operational Limits are important to Safety and how the Operators need to maintain the reactor systems to stay within the Safe Operating Envelope from a safety analysis perspective and finally how the safety analysis and assessments use information on ageing of key SSCs:

- Safety Related System List, BP-PROC-00169 [110],
- Systems Important to Safety (SIS) Decision Methodology, DPT-RS-00012 [122],
- Margin Management (Design and Operating Margins), BP-PROC-00786 [155], and
- Safety Performance Metric and Monitoring, BP-PROC-00651 [64].

Reactor Safety Management leadership attends the SPHC meetings to reinforce Nuclear Safety's position and to provide greater understanding of the requirements. The proper prioritization, ownership, organizational alignment, resources and accountability are put in place to resolve station issues affecting system/component performance ensuring compliance with the four pillars of Safety.

Under the Equipment Reliability Program [57] as described in Safety Factor 2, Condition Assessment of Generating Units in Support of Life Extension, BP-PROC-00498 [123], evaluates the physical condition, functionality of, and remaining service life of SSCs. The assessment leads to two determinations:

- First, are there any SSCs which are not practical to replace that would prevent a life extension project from being undertaken. (An example might be vault concrete deterioration.)
- Second, which structures, systems and components are recommended for replacement or repair during a contemplated refurbishment outage and the identification of the repairs which may be made during future outages.

Station Engineering then follows its procedures such as Scoping and Identification of Critical SSCs [92]; Aggregate Risk Assessment and Monitoring [97]; and Long Term Planning & Life Cycle Management [96] to implement the equipment improvements.

Finally, staff, including contractors and consultants, are encouraged to identify when adverse conditions arise and report these in SCRs, and many have the knowledge of identifying trends if they see them, and can utilize the Trend Identification and Reporting of SCRs [79] process; and managers ensure a continuing awareness of the importance of safety and risk mitigation through the various Human Performance improvement procedures including the Observation and Coaching [65] process.

The Risk Informed Decision Making (RIDM) process is applied when assessing potential gaps against modern codes and standards. The RIDM process determines the increase to risk of plant operation (i.e., Δ risk) from design, operational, or programmatic issues, assesses the significance of that Δ risk, and provides guidance on the course of action and overall level of resource expenditure that would be commensurate with mitigation of the Δ risk. Where risk control is considered necessary, or prudent, the RIDM process then guides determination of the decrease in risk achievable through specific design, operational, or programmatic change(s) identified as options to address the issue, assesses the significance of that decrease in risk, and provides guidance on the practicability (i.e., benefit commensurate with resource expenditure) of the risk reduction options as a function of the Δ risk of the issue. Options determined to be practicable are then considered for implementation following application of Bruce Power's existing procedures for business risk management.

Older plants are licensed to standards at the time of construction, to achieve an acceptable level of safety. Modern codes and standards are introduced by the regulator over time to improve upon that level of safety. Therefore, while gaps arise against more recent and modern standards due to the evolving benchmarks, the level of safety provided by the older codes and standards is still considered to be fully acceptable. However, the gaps are examined with the RIDM process to determine whether there are practicable design, operational, or programmatic changes which can be instituted to close or reduce the gaps. The first consideration is the Δ risk inherent in the gap between the modern standard and the current licence requirement. If that Δ risk is sufficiently low, and/or changes to provide a meaningful reduction in the gap are determined to be impracticable, the process should be halted and documented at this stage. However, if the assessment is that risk control should be examined, the next consideration is the Δ risk inherent in the gap between the modern standard and the current measure (as opposed to the current licence requirement). The need to examine risk control measures are then based on the actual level of Δ risk and the practicability of making design changes to provide a meaningful reduction in the actual gap.

As identified in the audit described in Section 7.3.1, BP-PROC-00498 [123] be revised to use a consistent list of systems important to safety and to ensure a risk-informed decision making process is added to better prioritize current and new items as discussed under Action Item 2014-07-4687 - BRPD-AB-2014-002 - Condition Assessment Inspection. This is identified as gap SF8-2 in Table 7.

5.14.3. Safety Performance Communication

In addition to the Integration and Prioritization processes, Bruce Power reviews the day-to-day safety performance with staff via daily, weekly, monthly and annual communications updates such as: Managers Review Meetings, local Visual Management Boards, Our Week in Review, Outage Status Updates, and the Chief Nuclear Operator Safety Reminders, the Monthly Safety Review Meetings and Continuous Training. These cover the four pillars of safety and inform staff on the performance of the stations. Each day the Managers Review Meetings reinforce items on such topics as Achieving High Equipment Reliability, the Plant Operational Focus, First Indications of Degrading Performance, Conservative Decisions Making and Nuclear Safety.

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 4.2, addresses the plant design basis management program to maintain the design basis and ensure the plant can operate safety for the full duration of the operating life of the plant.

- "Safety Factor 2: Actual condition of SSCs" in Section 4.0, addresses the plant design basis and equipment reliability programs. In Section 5.10, Safety Factor 2 also addresses the progress on maintenance backlogs and in Section 5.1, discusses SSCs important to safety and their classification.
- "Safety Factor 7: Hazards Analysis" in Section 5.1.1, addresses resulting CNSC Action Items from the Fukushima event.
- "Safety Factor 9: External OPEX and R&D" in Section 5.3, addresses the use of other plants' operating experience and research findings external to the station, including elements of event investigations and the Corrective Action Program not addressed in the current report.
- "Safety Factor 12: The Human Factor" in Sections 5.2 and 5.3, reviews the Bruce Power programs for worker qualification and training in terms of adequacy.
- "Safety Factor 14: Radiological Impact on the Environment" in Appendix A, reviews Bruce Powers plans to implement industry standards regarding effluent monitoring programs and environmental risk assessments, as well as specific CSA N288 series standards.
- "Safety Factor 15: Radiation Protection" in Appendix B.1, has assessed the state of Bruce Power's Radiation Protection Program guidance against applicable guidance.

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.

7.1.1. General Self-Assessments

General assessments of performance improvement were conducted by the Performance Improvement (PI) department following the Operating Experience Program, BP-PROG-01.06 [51] processes. Including:

- SA-PI-2014-04, Effectiveness of FASA Process Improvements, Performance Improvement.
- SA-PI-2013-06, FASA Program Effectiveness, Performance Improvement.

These assessments are relevant as they examined the state of the Focus Area Self-Assessment (FASA) process to confirm the oversight enhancements and initiatives to increase awareness of the FASA process and revisions to the procedure have been effective and embedded into the procedures for each program. An Annual Self Evaluation Plan worksheet tracks FASA completion requirements. To improve the independent oversight and effectiveness of FASAs the Nuclear Oversight and Regulatory Affairs organization developed quarterly nuclear oversight reports and the Focus Area Self Assessment Status and Summary Reports (see Section 7.1.9). Past FASA actions are reviewed in the quarterly reports to ensure they are completed. The improved effectiveness of FASAs was confirmed in SA-PI-2014-04, Effectiveness of FASA Process Improvements.

7.1.2. Equipment Reliability and Maintenance Program Self-Assessments

The following FASAs are relevant to Equipment Reliability:

- SA-ERI-2013-02, Effectiveness of Engineering Programs, Station Engineering.
- SA-ERI-2013-03, System and Component Performance Monitoring Program Compliance, Equipment Reliability.
- SA-ERI-2013-04, Equipment Reliability 2013 Annual Self Evaluation Plan, Equipment Reliability.
- SA-ERI-2013-05, Equipment Reliability Performance Review Meeting, Station Engineering.
- SA-ERI-2013-08, Effectiveness of ERCOE Implementation in Reducing Equipment Failures, Equipment Reliability.
- SA-ERI-2013-09, Ensure FH Software Documents Verified and Approved, Plant Engineering.
- SA-COM-2013-10, Critical Systems (SG, EPG, and QPS) – Maintenance Readiness, Procurement & EQ Engineering.
- SA-ERI-2014-05, Equipment Reliability 2014 Annual Evaluation Plan, ER Interface with PB Program, Equipment Reliability.
- SA-ERI-2014-07, Quality of System Health Reporting, Quick Hit Self-Assessment, Station Engineering.

Of the aforementioned FASAs, the ones relevant to Safety Performance and the reason for their relevance follow:

FASA SA-ERI-2013-02 is relevant to Safety Performance as it highlighted the Engineering Programs have not been fully consistent with the 14 principles of CSA N286-05 and the Engineering Programs were not aligned fully with the Equipment Reliability Centre of Excellence (ERCOE), resulting in less than sustainable performance. Corrective actions were initiated and completed earlier this year to improve the PROG-11.01 documentation. This is discussed further in Safety Factor 2.

FASA SA-ERI-2013-03 is relevant to Safety Performance as it included a review of equipment reliability root cause investigation reports and included a review of long term reliability and repeat issues.

FASA SA-ERI-2013-04 is relevant to Safety Performance as it notes the software to log performance improvement is missing operating and design limits which can be compared to system conditions, so system engineers can quickly speak to margin management concerns.

FASA SA-ERI-2014-07 is relevant as it points out the need to improve the System Health Report content so it is a better communication tool for the System Plant Health Committee so they can be driven through the work management process and better align changes for success. These changes were scheduled to be implemented and impact BP-PROC-00559 [129] and DPT-PE-00010 [127].

7.1.3. Limits

The following FASA is relevant to Operating Limits:

- SA-CHEM-2014-02, Chemistry Control Administrative Limits Review.

This FASA reviewed the spread or variability of analytical data for a selection of Control and Regulatory Chemistry parameters in relation to action levels and administrative limits. The assessment concluded that most of Chemistry Control and Regulatory parameters are bounded by acceptable administrative limits to prevent action level violations. A corrective action was initiated to document opportunities to improve chemistry monitoring and control.

7.1.4. OPEX

The following FASA is relevant to Operating Experience:

- SA-PI-2014-02, Evaluation of Significant Operating Experience Reports (SOERs & SERs).

SA-PI-2014-02 is relevant to Safety Performance as it was done to confirm whether the Significant Operating Experience Report (SOER) evaluation process was being implemented properly. BP-PROC-00062 [71] was revised to account for the findings.

The aforementioned information addresses Section 1.2 Review Task 3.

7.1.5. Corrective Action

The following FASAs are relevant to the Corrective Action Program:

- SA-PI-2013-01, CAP – Capco Job Description and Role, Performance Improvement.
- SA-ERI-2013-07, CAPE Department Section Manager Training Effectiveness, Station (Component) Engineering.
- SA-COM-2013-11, CAP Effectiveness in Engineering.
- SA-PI-2014-03, Root Cause Process, Performance Improvement.
- SA-PI-2014-07, Serious and Systematic Problems as per CSA 286-05 Clause 5.11.

SA-PI-2014-07 is relevant to Safety Performance as it investigates whether issues are resolved within the Corrective Action process. Not identifying and resolving serious and systemic issues could impact the four pillars of nuclear safety. This FASA revealed there are no clear definitions for serious and systemic leading to different interpretations of the meaning and inconsistent implementation. A corrective action was initiated to resolve this issue.

The other FASAs identified corrective actions and opportunities to further improve already effective processes and procedures. In one case it was noted Section Managers were not fully kept up-to-date on procedural changes and the Equipment Reliability procedures were not effectively rolled out, so a quarterly review of the FASAs were rolled out as discussed in Section 7.1.9 to improve the communications and lessons from key FASAs.

7.1.6. Environmental Safety Management

The following FASAs are relevant to Environmental Safety Management:

- SA-ENV-2013-01, Transition to CSA N288.6 Environmental Risk Assessments at Class 1 Nuclear Facilities and Uranium Mines and Mills.
- SA-TRGD-2013-07, Assess the Non-Licensed Operator Training Program Against the Significant Environmental Aspects.
- SA-ERI-2013-06, Execution of 2013 Buried Piping Inspection Scope – Lessons Learned.
- SA-ENV-2013-01 discusses the steps to ensure compliance to the new procedure.
- SA-ERI-2013-06 shows no adverse conditions were identified with respect to buried piping, but opportunities for improvement were numerous.
- SA-TRGD-2013-07 showed the nuclear operators needed to be more familiar with significant environmental aspects.

The aforementioned information addresses Section 1.2 Review Task 4.

7.1.7. Radiation Protection Program

The following FASAs are relevant to the Radiation Protection Program:

- SA-RPR-2013-02, Bruce Power CANDU Radiological Protection Benchmarking Project Assessment, Radiation Protection Programs Department.
- SA-RPR-2013-05, Discrete Radioactive Particle Control Evaluation for Bruce A, Radiation Protection.
- SA-RPR-2014-01, EPD Alarm Follow-up at Bruce A and Bruce B, Quick Hit Self-Assessment.

Numerous other Radiation Protection self-assessments have been performed (e.g., FASA SA-RPR-2013-03 against WANO RP Guidelines, FASA-Locked High Radiation Area Controls

SA-RPR-2013-04). These are captured in Safety Factor 15, as they are more programmatic related and do not focus on Safety Performance.

The following Radiation Protection self-assessment focuses on Safety Performance aspects:

FASA SA-RPR-2013-02 is relevant to Safety Performance as it shows Bruce Power is interested in improving their RPP so it meets WANO Good Practices and is an indicator Bruce Power wishes to make significant improvements in RPP and is proactively learning from other CANDU utilities.

The aforementioned information addresses Section 1.2 Review Task 5.

7.1.8. Miscellaneous Self-Assessments – S-210 and RD/GD-210

The following FASA is relevant to RD/GD-210:

- SA-MPR-2014-03, Quick Hit Self-Assessment.

This FASA is relevant to Safety Performance as it reviews how well post-maintenance testing procedures meet the guidance of RD/GD-210 Section 3.5.5. It concluded Bruce Power documents comply with the new Regulatory Document as well as the Electric Power Research Institute and Institute of Nuclear Power Operators testing guidance.

The following FASA is relevant to Operator Fundamentals:

- SA-OCP-2014-01, Evaluate the Health of Operator Fundamentals Program – WANO SOER 2013-1 REC #2 “Operator Fundamentals Weaknesses”.

This FASA showed there were strengths in the overall improvements that had been made to the Operator fundamentals from 2012, but there was a weakness in the application of the Operator Fundamentals. Field and control room supervisors are not sufficiently identifying any weaknesses for follow-up. Operations need to provide improved indicators to measure the state of Operator Fundamentals [186]. Corrective actions were raised to drive further improvements.

SA-MPR-2014-03, Post Maintenance Testing

This FASA concluded the procedures meet the Post Maintenance Testing requirements and guidance in RD/GD-210 and the EPRI Post-Maintenance Testing Guidance, and INPO’s post-maintenance testing guidance. Four corrective actions ensured improvements were made to BP-PROC-00669 and -00685.

7.1.9. Performance Improvement Quarterly Review of FASAs

Increased oversight of the FASA completion and effectiveness process was implemented in 2014 with the introduction of Quarterly Focus Area Self Assessment Status & Summary Reports [186][187][188]. These reports provide on a quarterly basis an integrated summary view of the FASAs performed across the site by each Functional Area, with the major findings and gap closing measures initiated to close them. These reports provide management with insight on the health of the FASA process so program improvements can be implemented. The reports were instituted in response to weaknesses discovered in the FASA Program Effectiveness SA-PI-2013-06.

7.2. Internal and External Audits and Reviews

The objective of the audit process as stated in BP-PROG-15.01 [189] 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 [30]).

Audits are planned and scheduled on an annual basis and tracked to ensure they are performed regularly. Over 145 independent audits were performed covering the Bruce Power Programs over the period 2009 to 2013, with a focus on those which improve the Equipment Reliability, Plant Maintenance, Emergency Measures, and Radiation Protection. Requirements and the frequency of audits for specific areas generally range from annually to every three calendar years, as given in documents such as CSA N286, the PROL based on CSA N285, N288.4, 288.5, 288.7, 293, and S-296 ([190] Appendix B).

From a Safety Performance perspective the key audits by PROG for Bruce A include:

Equipment Reliability BP-PROG-11.01

AU-2013-00005, Relief Valve Field Repairs, March 17, 2014
AU-2012-00007, Relief Valve Field Audits, February 1, 2013
AU-2012-00006, Equipment Reliability, December 11, 2012
AU-2011-00028, Performance and Condition Monitoring, February 3, 2012
AU-2011-00025, Preventative Maintenance Deferral Process, October 13, 2011
AU-2011-00018, Steam Generator Life Cycle Management, August 4, 2011
AU-2011-00017, SST Scheduling and Completion, June 7, 2011
AU-2011-00007, Relief Valve Program and Field Repair, September 2, 2011
AU-2010-00037, Relief Valve Field Repairs, January 18, 2011
AU-2010-00027, Primary Heat Transport Feeder Management, June 16, 2010
AU-2009-00034, Relief Valve In-Situ Testing, August 23, 2009
AU-2009-00010, Containment Leakage Rate Test, December 4, 2009

On-Line Work Management BP-PROG-11.02

AU-2012-00014, On-Line Work Management Program, May 23, 2012
AU-2011-00019, Summer Readiness, September 28, 2011

AU-2010-00022, H1/H2 Work Prioritization Surveillance, November 16, 2010

Outage Work Management BP-PROG-11.03

AU-2013-00008, Outage Management, November 25, 2013
AU-2010-00026, Forced Outage Management, June 15, 2010
AU-2009-00043, Outage Management, November 4, 2009
AU-2009-00035, Validation of Outage Milestones, August 13, 2009

Plant Maintenance BP-PROG-11.04

AU-2013-00018, Fluid Leak Management Program, March 21, 2013
AU-2013-00006, Maintenance Program, May 15, 2013
AU-2011-00027, Foreign Material Exclusion, February 28, 2012
AU-2010-00008, CMLF ISO 9001, April 16, 2010
AU-2009-00031, Bruce B - Corrective Maintenance Backlog, May 20, 2009
AU-2009-00003, CMLF ISO 9001-2000 Program, May 11, 2009

Corrective Action BP-PROG-01.07

AU-2011-00010, Performance Improvement, October 31, 2011
AU-2010-00024, Root Cause Investigation, March 19, 2010
AU-2010-00007, S99 Reporting, January 11, 2011
AU-2009-00017, Effectiveness Review of Fact Finding Process, March 13, 2009

Operating Experience Program BP-PROG-01.06

AU-2011-00010, Performance Improvement, October 31, 2011
AU-2009-00025, Benchmarking Program, July 16, 2009
AU-2009-00023, Forced Outage: Root Cause Review Assessment, July 16, 2009

Environmental Safety Management BP-PROG-00.02

AU-2013-00003, Environmental Safety Management, August 8, 2013
AU-2012-00004, Radiation Environment Monitoring, February 11, 2013
AU-2012-00003, Environmental Safety Management, August 2, 2012
AU-2011-00002, Environmental Management System and Environmental Compliance, August 11, 2011
AU-2010-00035, Radioactive Environmental Monitoring Program, November 18, 2010
AU-2010-00005, EMS and Environment Compliance Audit, September 14, 2010
AU-2009-00001, EMS and Environment Compliance Audit, September 21, 2009

Radiation Protection Program BP-PROG-12.05

AU-2013-00011, Dosimetry Program - Health Physics Lab, November 25, 2013
AU-2012-00010, Dosimetry Program - Health Physics Lab, November 5, 2012
AU-2011-00013, Radiation Protection and Alpha Radiation Recovery Plan, November 18, 2011

AU-2011-00012, Dosimetry Program - Health Physics Lab, November 4, 2011
AU-2010-00030, Radioactive Shipments, June 15, 2010
AU-2010-00006, Dosimetry Program, January 26, 2011
AU-2009-00042, Health Physics Lab – Dosimetry, March 2, 2010
AU-2009-00013, Radiation Protection Practices, May 19, 2009

The key findings from the Safety Performance perspective are:

Equipment Reliability and Plant Maintenance

AU-2012-00006 on Relief Valves highlights in spite of 17 audits in the last 3 years, ineffective use of the SCR and the Corrective Action Processes have not resolved the issues.

AU-2011-00025 shows the Preventative Maintenance (PM) Work Order deferral process has not been effectively managed to ensure that equipment performance meets industry standards. This condition was identified as an issue (WANO Evaluation 1999). Although some performance improvement has been experienced, the Equipment Reliability Index performance continued to be in the Red despite the numerous improvement plans that have been developed and implemented. Improvement initiatives had shown some improved performance in reducing the number of PMs going past their late date, an increasing number of PMs going to completion and improved timely completion of PMs based on the assignment of strong PM Coordinators and the development of the Preventative Maintenance Oversight Group with an altered focus on removing barriers that prevent completion of PMs prior to the late date, are the main drivers. Since the findings from audits performed in 2011 and 2012 Bruce Power has, and continues to make, improvements in the PM procedures and processes.

The Equipment Reliability Integration Engineering Department is making good use of industry benchmarking to develop the program and effective use of evaluations to determine program issues.

AU-2009-00010 showed co-ordination and understanding of the Containment Leakage Test is not well communicated and responsibilities for CSA N287.7 implementation was poorly defined making it more difficult to effectively complete the 5-year cycle of this important safety testing.

AU-2011-00019 showed the Summer Readiness program was ineffective when initially rolled out based on industry leading External Experience.

AU-2013-00006 showed BP-PROG-11.04 is generally compliant with S-210, but not fully compliant. These are captured in other documents. Work has subsequently been done to ensure more effective compliance. Compliance for S-210 is now captured in other subordinate procedures to BP-PROG-11.04, as identified in Appendix B of BP-PROG-11.04.

AU-2013-00018 showed the Program is not fully compliant so leaks are not always identified as spills and not included in Station leak inventories. Leak codes are not always flagged in the System Health reports.

Corrective Action and Operating Experience Program

No audits are current as the procedures have been revised multiple times since the audits were performed, including in response to the audits which occurred in the period 2009-2011. The procedures have been improved since the time of the audits.

Environmental Safety Management

Audits AU-2012-00003 and AU-2013-00003 concluded that Bruce Power's Management System generally meets the requirements of the ISO 14001 standard and in the vast majority of cases is compliant with legislation. There were no gross absences in the requirements of any of the ISO Elements. Some opportunities for improvement existed but these have been addressed through the SCR process but issues were identified as late as 2012 and 2013 (seven (AU-2012-00003) and eight (AU-2013-00003) of the eighteen areas had non-conformances, respectively).

Separately, the Radiation Monitoring Program was shown not to be in full compliance with the Environmental Monitoring Program, per AU-2010-00035, illustrating non-compliance with CSA N288.4-10, in areas of documentation, sampling procedures and practices and reporting. Furthermore past corrective actions were insufficient to improve the program. Audit AU-2012-00004 identified there was a transition from the Radiation Environmental Monitoring Program to the more integrated Environmental Monitoring Program. These audits were proactive reviews against more modern codes not presently in the licensing and design basis. As discussed in Reference [134] (page 5), Bruce Power is continuing towards the implementation of CSA N288.4-10, N288.5-11 and N288.6-12 as agreed with the CNSC.

The aforementioned information addresses Section 1.2 Review Task 4.

Radiation Protection Program

The Dosimetry Section meets the requirements of the Dosimetry Service Licence and ISO/IEC 17025:2005, S-106 Revision 1 and S-260 Revision 0 standards. Minor issues have decreased annually since 2009. Corrective actions were raised to improve the processes.

Audit AU-2011-00013, showed improvements were necessary in the Radiation Protection documentation. Subsequent CNSC Field Inspections show these improvements have been made. See Section 7.3.

The aforementioned information addresses Section 1.2 Review Task 5.

7.2.1. Internal Audits and Reviews

Bruce Power had an independent nuclear industry evaluation of their nuclear oversight program [191] and a Nuclear Oversight and Regulatory Affairs (NORA) improvement initiative where NORA continuously reviews the effectiveness of Oversight against the WANO Performance Objectives and Criteria to learn the lessons from WANO 1 Stations around the world [192] [193]. The Nuclear Industry Evaluation Program (NIEP) evaluation is covered in Section 7.2.2 under external reviews, while the NORA oversight review is discussed next.

The NORA Nuclear Oversight Quarterly Reports [192] [193] were initiated in the second quarter of 2014. Their purpose is to follow the WANO assessment process which utilizes observations that are debriefed with line management, followed by the development of Problem Development Sheets (PDS) or a detailed SCR, as applicable, for areas of strengths or improvement to identifying areas exceeding or lagging industry excellence. This information is aligned to provide Station managers with information needed for their quarterly meeting reviews. These reviews are important as WANO has published and regularly updates as new information arises a set of Performance Objectives and Criteria (POC) intended to provide a common set of high standards in nuclear performance for its member utilities. These POCs are used by WANO representatives during their independent peer reviews of member utilities, and are readily comparable to the Safety Performance reporting factors and corrective action reporting processes. These POCs are consistent with the purpose and intent of IAEA SSG-25 [3].

In the last quarter Bruce A completed 44 observations and published 8 PDSs related to assessments in fuel handling manual manipulations, adverse condition monitoring, plant status control, engineering daily monitoring, chemistry fundamentals, human performance advocates, and station traffic light communications. Nine SCRs were raised. One item noteworthy was at the start of the Bruce B, quarter one B1471 outage supplemental staff were not receiving or being re-qualified in general employee training. The Bruce A management team accepted the insights and feedback provided by the Nuclear Oversight assessment team, and were proactively implementing the corrective actions.

A common theme from the assessments conducted in Operations, Engineering and Chemistry was personnel were rationalizing why the core procedural requirement of trending data to proactively predict problems is not as important as responding to emergent issues and the need to improve communication between groups. The Bruce A team launched a Step-it-Up campaign to bring focus to expectations and standards so an awareness of the importance of trending is permeating each group.

During the initial quarterly review [192] the Radiation Protection organizations were seen to be conducting beneficial practices during station outage. The organization change made in 2013 had a positive effect on dose control and dose reduction. Experience, both negative and positive from the B1471 outage was applied to the quarter two A1431 outage and strengths were emulated and lessons learned incorporated in areas where improvements were needed.

In addition to these reviews Bruce Power has performed comprehensive reviews of its programs such as its Ageing Management Program to improve them. As part of these reviews, it objectively looks at the past audits to integrate the results and conclusions to get a more comprehensive understanding of their programs [194].

The aforementioned information addresses Section 1.2 Review Task 4.

7.2.2. External Audits and Reviews

The 2014 NIEP evaluation of Bruce Power found the Programs were effective in meeting the Nuclear Oversight Audit and Supply Chain Quality Services requirements. This assessment concluded all of the 6 areas audited were effective. Within those 6 areas, 75 factors were Satisfactory, although 9 areas which were Satisfactory had Recommendations, 3 had a Deficiency and 1 had a Strength. The deficiencies were in ensuring the reports were filed on time, to review the Nuclear Procurement reports on Suppliers, and the frequency of meetings of the Plant Operations Review Committee. The filing of reports was the key deficiency with respect to Safety Performance as it delays the raising of the Action Requests and their actions to complete the audit report deficiencies. The other two items did not impact Safety Performance.

Each Deficiency and Recommendation was entered as an Action Request for follow-up in the Corrective Action and Action Tracking Programs.

The strength was: The audit organization has a well-developed Auditor Training program which used a Systematic Approach to Training based training design. Job Task Analysis is documented for knowledge and skill elements. The training program is documented and aligned to develop proficient auditors upon completion of qualifications. Auditors are professional and meet expectations of managers for performance as qualified auditors. This is important from a Safety Performance perspective as the Auditors are qualified to assist other groups in improving their performance.

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.

The CNSC regularly performs Compliance Inspections of wide aspects of the Bruce Power Programs to ensure continuing compliance with CNSC Regulations, Standards and Guidance documents, as well as the internationally recognized Codes and Standards Bruce Power has adopted in their management system. Also the CNSC conducts quarterly Field Inspections. Both these review process are done to ensure continued and improved Safety Performance. The Compliance Inspections are discussed first and then the Field Inspections.

The following information addresses Section 1.2 Review Tasks 1, 3, 4 and 5.

7.3.1. Regulatory Compliance Inspections

Over the last five years Compliance Inspections relevant to Safety Performance have included multiple reviews of the Radiation Protection, Chemistry, Human Performance, Environmental Monitoring, Corrective Action and Problem Identification, the Management System Manual, Operating Experience, Condition Assessments, S-99, the Safety-Related Systems Tests, Independent and Self Assessments, Wastes, Worker Dose, and the Preventative Maintenance process. Additionally audits are performed on individual SSCs, the Unit 1 and 2 Restart Effectiveness, Engineering Change Control, Environmental Qualification, Human Factors, Radiography, and the Abnormal Incident Procedures.

A review of these inspections shows compliance with the majority of the requirements, continuing improvement, but also repeat occurrences of non-compliances and slowness to improve for example, with maintenance backlogs.

Examples of the Compliance Inspections relevant to Safety Performance are shown in Table 5.

Table 5: Examples of Compliance Inspections Relevant to Safety Performance

NK21-CORR-00531	BRUCE A COMPLIANCE INSPECTION REPORT	Issues	Summary Comments
-10925 -11382 -11517 -11706	Action Item 2014-07-5109: BPRD-AB-2014-004 – Assessment (Self and Independent)	Frequency, depth and width of audits; pressure boundary checklists; summary report on audits; tracking actions to completion	Need to Implement a risk-based audit methodology so Graded approach for Audits of the Management System added BP=PROC-00955.
-11508 -11596	Action Item 2014-07-5294: BRPD-AB-2014-007 – Problem Identification and Resolution – Corrective Action	Train staff performing trend analysis; improve common cause analysis reports; improve quarterly performance assessment reporting; perform more casual trend analysis	Problems Identified and Corrective actions assigned and tracked to completion
-09245 -09721 -09869 -09870 -11117 -11139 -11436 -11445	Action Item 1107-2924 - BPRD-2011-AB-011 - Radiation Protection Alpha Monitoring and Control Action Item 1307-4696 - BRPD-AB-2013-018 – Radiation Control - Worker Dose Control	A process establishing requirements for alpha monitoring is required; hazard posting frequency; personal air samplers; deficiencies with whole body monitor calibration data labels; procedure verification	Worker dose activities in compliance with regulatory requirements but improvements have been suggested.

NK21-CORR-00531	BRUCE A COMPLIANCE INSPECTION REPORT	Issues	Summary Comments
-08074 -08165 -08380 -08487 -08557 -09721 -09833 -09851 -10219 -10220 -10221 -10222 -10282 -11422 -11459 -11661 -11704	Action Item 100712: BRPD-2010-AB-002 Radiation Protection Compliance Inspection Report Action Item 110706 – BRPD-2010-AB-007 - Radiation Protection Program Action Item 1107-2924 - BRPD-2011-AB-011 – Radiation Protection Alpha Monitoring and Control Action Item 1207-3516 – BRPD-AB-2012-009 – Radiological Hazard Control Action Item 2949 CNSC review of Bruce Power's effectiveness review, of the implementation of BP-RPP-00022, R009 Contamination Control Action Item 2014-07-5397 – BRPD-AB-2014-010	Update Restart Radiation Safety Plan and Procedures to become consistent with Station procedures; perform FASA on contractor and employee onboarding; improve clearances of waste materials; posting and communication of hazards; air purifying respirators; Radiation Exposure Permits; Housekeeping; monitoring at zonal boundaries; CCA requirement compliance; alpha monitoring; lunch room surveillance; dosimetry; waste removal; radiation instrument management; qualification; Contamination Control	Bruce Power was in the process of revising their documentation to ensure top down compliance of the lower tier documents; corrective action plan defined the change timeline. Occupational ALARA Planning and Control meet regulatory requirements with areas and opportunities for improvement
-11507 -11547 -11684	S-99 Reporting	Improve preliminary report timeliness; improved detailed reports	Meeting S-99 reporting requirements
-11025	BRPD-A-2013-008 – Human Performance	Management should focus on high priority tasks; consider involving HF design group in the performance monitoring of implemented design changes and including HF experience in the HU program	Significant gains in HU made; plans in place to improve further
-08638 -08673 -08746	Action Item 110719 – BRPD-2011-R-010 – OPEX	Training qualification record deficiency;	

NK21-CORR-00531	BRUCE A COMPLIANCE INSPECTION REPORT	Issues	Summary Comments
-11262 -11380 -11534	Action Item 2014-07-4687 - BRPD-AB-2014-002 - Condition Assessment Inspection	Improvement of BP-PROC-00498 to use a consistent list of systems important to safety and implementation of a risk-informed decision making process for opportunities for improvement	Satisfactorily implemented
-04168 -06165 -06776 -08296 -08643 -11635	Environmental Monitoring System (EMS) at Bruce Site Inspections of the Implementation BRPD-2010-AB-010 Action Item 1407-4709 – Refurbishment Annual Follow-up Inspection of establish EMS	Radiological Environmental Monitoring Program review	Meeting requirements
-11653	Action Item 2014-07-5291 - Reactive Inspection of Bruce Power's Housekeeping and Fire Loading Practices During the 2014 Unit 3 Planned Outage - BRPD-A-2014-005	housing keeping and fire loading issues	Reactive Inspection
-09539 -09628 -09735	Action Item 1207-3289 – BRPD-R-2012-0019 – Safety System Tests	Notification of testing	No issues
-10716 -10899	BRPD-AB-2013-014 - Waste Management Program	Recommendations for improvement include: Dedicated chemical technician like Bruce B; official log book for waste accounting; inventory list be taken of chemical cabinets; separation of the oil and water within the hazardous waste facility.	Bruce Power had yet to respond to the audit at the time this document was completed but ARs to respond were initiated.
-10695 -10857 -11132 -11251	Action Item 1307-4229 – BRPD-AB-2013-008 – Preventative Maintenance Oversight Group (PMOG) Inspection	BP-PROC-00501 consistency with S-99 and BP-PROC-00456; equipment risk justifications for deferrals; aggregate risk needs to be considered; multiple deferrals; high PM backlog	Deferral Technical Evaluation performed; SCR raised for multiple deferrals; procedures revised; PMOG or Operations Manager accepts responsibility for medium and high risk deferrals.

CNSC Type II Compliance Inspection Report, BRPD-AB-2014-004, Action Notice AN2 highlighted instances of non-compliance with procedures requiring annual or bi-annual FASAs to be conducted. These issues were addressed immediately by SCRs 28428688 and 28428961. Additionally SCR 28448865 resulted in an action plan to ensure the issues were rectified prior to the 2015 Self Evaluation Annual Planning per SA-PI-2014-04 and the delinquent PROGs identified and changed to ensure the appropriate oversight embedded in their procedures. These actions were completed.

Reactive Inspections point out the CNSC felt the need to conduct an unplanned more detailed inspection due to an observation during routine inspections. An increase in frequency of these inspections is an indication of poor performance but this has not been the case, as a review shows the number of inspections has fluctuated from two (2) in 2009 to three (3) in 2014 with peaks of four (4) in 2011 and 2013. In 2010 and 2012 there were none.

7.3.2. Regulatory Quarterly Field Inspections

In addition to the Type I and II CNSC Inspections, thirteen Quarterly Field Inspection Reports were completed by CNSC staff from the last quarter of 2011 through 2014[12] covering the field surveillance inspections conducted to cover the CNSC Safety Control Areas which are closely aligned to the IAEA SSG-25 Safety Factors. These are shown in Table 6.

The CNSC staff Compliance and Verification activities did not find evidence of unsafe operation that would result in undue risk to health and safety of persons, the environment, or that would compromise respect of Canada's international obligations. Major issues result in an Action Item being opened so the issue resolution can be tracked. Minor issues are usually corrected immediately by Station staff or acceptable responses for the issues were provided. Major issues were reviewed to see if they impacted Safety Performance but no gaps were identified as the CNSC would have requested quick remedial action.

Table 6: Quarterly Field Inspections Reports Completed by CNSC Staff Between 2011 and 2014

NK21-CORR-00531	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT	# of field inspections Bruce A	Minor Issues	Major Issues / comments
-06987	BRPD-20009-AB	27	Information Purposes	None
-09267	BRPD-2011-AB-019	16	Seismic restraining; Radiation protection, Maintenance backlogs	None

[12] Note the CNSC quarters start with Q1 being April to June, as their fiscal year starts in April.

NK21-CORR-00531	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT	# of field inspections Bruce A	Minor Issues	Major Issues / comments
-09826	BRPD-AB-2012-008 ACTION ITEM 1207-3510	11	5 areas with minor findings; 15 positive findings; Maintenance backlogs Work Request Tagging Operator Walk-downs; 3 action notices and 1 recommendation	None
-10080	BRPD-AB-2012-014	16	16 positive findings; 7 areas with minor findings; key area: Maintenance backlogs;	None
-10247	BRPD-AB-2012-017	16	13 positive findings; Issues found in 9 areas; fire blanket use for combustible material; scaffolding, work requests for Control Room Panels	2 recommendations/ enforcement actions;
-10539	BRPD-AB-2013-005	16	18 positive findings; 5 areas minor issues; Key - Elective Maintenance Work Request high backlogs; 3 action notices and 2 recommendations on elective maintenance	None
-10731	BRPD-AB-2013-010 - ACTION ITEM 1307-4270	11	16 positive findings; 6 areas of minor issues; 3 areas needing improvement; Operator Surveillance, (Elective) Deficient Maintenance Work Requests; Scaffold inspections; 1 action notice and recommendation	2 Enforcement Actions
-11018	BRPD-AB-2013-015	16	18 positive findings; 4 areas of minor issues; 3 areas needing improvement; Operator Surveillance, (Elective) Deficient Maintenance Work Requests; Whole body counters; 1 action notice and recommendation	None
-11194	BRPD-AB-2014-001	16	21 positive findings; 2 areas of minor issues; 2 areas needing improvement; Operator Surveillance, (Elective) Deficient Maintenance Work Requests; Whole body counters; 1 recommendation	Improve tagging recommended

NK21-CORR-00531	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT	# of field inspections Bruce A	Minor Issues	Major Issues / comments
-11354	BRPD-AB-2014-003	13	17 positive/ compliant findings; 6 areas of minor issues; 2 areas needing improvement: Operator Surveillance, (Elective) Deficient Maintenance Work Requests;	None
-11381	BRPD-AB-2014-005		1 small area for improvement; 1 recommendation on Fukushima implementation with respect to Unit 4 Safety Relief Valve instrument air hoses for consistency with the other Bruce A units.	Concurrence on procurement of equipment and modifications to date as consistent with progress updates
-11551 -11607	BRPD-AB-2014-008	11	17 compliant findings; 5 areas of minor issues; 4 areas needing improvement: Deficient Maintenance Work Requests, Housekeeping, combustible material management and scaffolding inspection; 1 action notice	Reviewing the process for inspecting scaffolds.
-11698	BRPD-AB-2014-011	17	18 compliant findings; 5 areas of minor issues; 4 areas needing improvement: Deficient Maintenance Work Requests, and scaffolding inspection;	None

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.

Performance indicators relevant to the safety performance of the Station include Chemistry, Health and Safety, Plant Status, Audits and Assessments, Corrective Action, Human Performance, Reactivity Management, Operator Experience, Radiation, Staff Qualification, Security, Maintenance and Reliability, and Emergency Preparedness.

In addition, Bruce Power submits quarterly reports of Performance Indicators to the CNSC, in compliance with CNSC REGDOC-3.1.1. These quarterly reports include data on industrial accidents, chemistry, change control, emergency preparedness, non-compliances, preventative maintenance, radiation, SSTs, unplanned transients, unplanned capability loss factor and power history.

The following FASAs are relevant to Performance Indicators related to safety performance of the Station and address Section 1.2 Review Task 2:

- SA-RA-2013-02, Assess Timeliness of S-99 Preliminary Reporting.
- SA-AUD-2013-02, Effectiveness of Industry Oversight Metrics.
- SA-AUD-2014-02, Stakeholder Review of Assessment Process.

These FASAs showed Bruce Power had many strengths in ensuring compliance with S-99 requirements and few opportunities for improvement. Improvements were made to the Event Reporting process for preliminary S-99 reports. The performance indicator metrics review showed Bruce Power was effectively communicating the metrics within and outside the NORA department but should consider adding two more metrics. By 2014 the FASAs did not identify any adverse conditions.

In addition to the performance indicators monitored by Bruce Power, the CNSC produces an annual report on the safety performance of Canada's NPPs. The report for 2013, "CNSC Staff Integrated Safety Assessment of Canadian Nuclear Power Plants for 2013", issued in September 2014 [136], summarizes the 2013 ratings for Canada's NPPs in each of the 14 CNSC Safety and Control Areas (SCA), and presents an integrated plant rating. For 2013, the Bruce A integrated plant rating was "satisfactory".

7.5. Operational Readiness Reviews

Prior to each Outage the Department Manager responsible for the outage reviews contingency plans, and lessons learned from previous outages to ensure Safety Performance is maintained. High Impact Teams are established and trained to address potential vulnerabilities. Outage Improvement Initiatives such as scope control, 72-hour look-a-heads, accountability reviews, daily metric reviews, vault access and re-enforcement of WANO leadership behaviours have been established. Both Reactor Safety and Radiation Safety are key pillars in all reviews. The focus of the outage reviews is to ensure risk are identified, then prevented and/or mitigated. Each outage has metrics on items such as: unplanned reactor configuration changes, overall dose, personnel contamination, lost time incidents and environmental spillage. Targets are established and monitored throughout the outages and stretch targets are set to focus on continuous improvement. Radiation Protection throughout the outage and dose control (As Low As Reasonably Achievable (ALARA)) are key items of consideration.

From a Safety Performance perspective outages are key times both from the perspective that some safety systems may be taken out of service so there are fewer barriers available following postulated initiating events, and they provide the opportunity to improve the condition of the systems important to safe performance.

Key FASAs relevant to outage operational readiness include:

- SA-OGO-2013-01, Maintenance & Test Equipment (M&TE).
- SA-OGO-2014-01, Self Assessment – B1451 PO-6 Meeting.

SA-OGO-2013-01 highlighted numerous shortcomings in the M&TE resulting in weaknesses of the calibration of this equipment. Workgroups and management responsible for this area are now receiving reports on overdue M&TE performance to focus resources on improving the performance. The Tool Specialists and Single Points of Contact understand the process for removing these assets.

SA-OGO-2014-01 was a self assessment to ensure outage readiness. This assessment recommended the addition of an improved Aggregate Plant Health Outage related indicator which was then used in subsequent outages. Outage Readiness Reviews, e.g., SA-OGO-2013-04, B1471 PO-2 Readiness Review and SA-OGO-2013-01, A1241 Pilot Assessment, are conducted by the Manager responsible for the outage. Safety and Human Performance discussions lead the department presentations during these reviews. The reviews are conducted prior to the outages to ensure staff has the resources and knowledge to conduct the outages effectively.

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 plant's safety performance indicators and records of operating experience, including the evaluation of root causes of plant events, indicate the need for safety improvements. This specific objective has been met by the completion of the review tasks specific to safety performance.

The Safety Performance Safety Factor covers a broad range of safety-related areas with a focus on the Station's safety performance indicators and records of operating experience, including how the Station evaluates and overcomes root causes of events that arise and whether there is a need for safety improvements.

There were few strengths or opportunities for improvement above those identified in the other Safety Factors or based on a review of the Station audits, self-assessments, the Regulatory inspections, the internal NORA review against the WANO 2013 Performance Objectives and Criteria and the external NIEP evaluation.

A strength involves the commitments to improvements that are systematically being undertaken, based on the strong direction and guidance from the Nuclear Oversight and Regulatory Affairs organization, both in their audit and assessment reviews and their push to comply with more recent Regulatory Documents, Guidance Documents and Standards. The organization was re-organized to improve their focus on both Audits and Assessments and has committed to the

CNSC to introduce a risk-informed process to their audits and assessments process to ensure risk significant areas are reviewed more frequently.

NORA and Performance Improvement documents that summarize information for easier review by management include:

- Quarterly NORA Oversight Reviews covering audits and performance based assessments per Nuclear Oversight Management, BP-PROG-15.01 [189]; and
- Quarterly Focus Area Self Assessment Status & Summary Reports from Performance Improvement per BP-PROG-01.06, Operating Experience Program [51].

Furthermore, the audit organization has a well-developed Auditor Training program which used a Systematic Approach to Training based training design. Job Task Analysis is documented for knowledge and skill elements. The training program is documented and aligned to develop proficient auditors upon completion of qualifications. Auditors are professional and meet expectations of managers for performance as qualified auditors.

Bruce Power's organization shares Safety Performance OPEX, Compliance Reporting and Corrective Action processes as commonly-maintained programs with Bruce B, and thus observations and lessons learned at Bruce B can be used at Bruce A. Additionally, there is an opportunity to share knowledge from Bruce B by transferring mangers to Bruce A and vice-versa. Thus, strengths at each station and means to see how the other Station prevents and mitigates less desirable situations are shared to increase the corporate knowledge and experience.

Table 7 summarizes the key issues arising from the Integrated Safety Review of Safety Factor 8.

Table 7: Key Issues

Issue Number	Gap Description	Source(s)
SF8-1	Governance procedures for the Integrated or Periodic Safety Review process need to be finalized to ensure staff understanding of the Regulatory direction.	Section 5.13
SF8-2	A risk-informed decision making process should be included in Equipment Reliability program so as to continually better prioritize activities.	Sections 5.14.2 and 7.3.1
SF8-3	The Safety Report improvement project needs to capture changes in Margin Management and adverse trend in the erosion of margin in LBLOCA.	Section 5.3

Issue Number	Gap Description	Source(s)
SF8-4	The integrated time frame from conceptual design to station implementation for Nuclear Safety improvements that restore or improve margins (e.g., New Neutron Trip Project) needs to be reduced.	Section 5.7
SF8-5	Update the Safety Report Analysis of Record for single and dual Heat Transport pump events, with consideration of improvements, such as the modified 37-element fuel bundle.	Section 5.6
SF8-6	The documentation coverage for postulated initiating events not explicitly addressed in the Safety Report or PSAs needs to be improved. Neither the Safety Report deterministic safety analysis nor the PSAs explicitly include Crane Hazard analysis. Complete Hazard Analysis of Record and integrate it with the Deterministic Analysis and PSAs.	Section 5.7
SF8-7	Produce a document that explains the relationship and impact of the Fukushima type changes on the design basis, safety analyses and assessments, as they have been included in the licensing basis. This is necessary to ensure that the Design Basis and Configuration Management implications are understood. As appropriate, ensure Design Requirement and Design Manuals are updated appropriately, including capturing of Design Extension conditions if appropriate.	Section 5.13
SF8-8	Maintenance Backlogs were defined as needing improvement in the 2008 Bruce 3 and 4 ISR, based on a review of the backlog history. Although progress has been made on backlogs they are still identified as an area for improvement.	Sections 5.5, 7.3.1 and 7.3.2
SF8-9	Standby Class III Power System predicted unavailability targets exceeded in 2012 and 2013 due to an inconsistency between the modelling and plant operation. This requires correction action to reduce the unavailability.	Section 5.8

Issue Number	Gap Description	Source(s)
SF8-10	BP-PROC-00136 and BP-PROC-00169 are not affiliated with a Program.	Section 4.1, Table 4, footnote 7

The overall conclusion is that, with the exceptions noted in Table 7, Bruce Power's programs meet the requirements of the Safety Factor related to Safety Performance.

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

A.1. Discussion and Review of CSA N286-05 and CSA N286-12

CSA N286-05 [30], "Management System Requirements for Nuclear Power Plants" places requirements on Bruce Power as the licensee pertaining to the assurance of quality throughout the life cycle of the nuclear power plant. Included in these is a requirement for continuous improvements in the safe direction. The Standard was reaffirmed in 2011 and has been included in the previous the Power Reactor Operating Licences for the Bruce Stations. Bruce Power has routinely shown how it has organized and administers control and direction over all aspects of the quality of the life cycle of a nuclear power plant through its Management System Manual Sheet 0003, MSM List of Applicable Governing Acts, Codes & Standards, [35].

Introduction of CSA standard N286 places requirements on the licensee pertaining to the assurance of quality throughout the life cycle of a nuclear power plant.

As is discussed in Reference [17] Section 1.4, safe and reliable nuclear power plants requires commitment and adherence to a set of management system principles and, consistent with these principles, the implementation of a planned and systematic pattern of actions that achieves the expected results. The principles, the required supporting actions, and the documentation that describes them constitute the management system.

Assurance that the licensee is qualified and makes adequate provisions for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed (i.e., meets the CNSC mandate) is based on this management system.

Bruce Power is to ensure safe operation through compliance with N286 and as agreed with the CNSC notifies them annually, in writing of changes March 31 of organizational and structural changes. Bruce Power continues to comply with the CNSC request (References [16] and [17] Section 1.4).

During the PROL period from 2014 to 2019 the CNSC has requested Bruce Power to utilize the latest version of CSA N286. The implementation of CSA N286-12 [31] has been discussed amongst the parties [37]. The Bruce Power management system follows the principles of N286-12 as they apply to nuclear plants, and it is Bruce Power's intention to move to the updated standard. Bruce Power stated it is premature to include the 2012 version of the standard in the next PROL as Bruce Power must manage the documentation change to ensure clarity and compliance throughout the various stages of development and implementation. Bruce Power requested the 2005 version of N286 be retained in the next PROL and informed the CNSC they are developing a transition plan which should be accepted by CNSC staff before the changes are implemented to ensure the CNSC agrees with the implementation process [37].

N286-12 supersedes N286-05, and contains clauses 0, 1 to 3 covering positioning statements on introduction, scope, reference publications and definitions, and then general requirements for the management system, while section 7 covers high energy reactor facilities requirements. Other clauses extend the requirements beyond the nuclear plant to comprise nuclear facilities, including sections 5, 6, 8, and 9, for uranium mines and mills; uranium processing and fuel manufacturing facilities; research and isotope processing facilities; and radioactive waste management facilities. These later sections do not apply to the Bruce Power facilities. Additionally, a new principle was established: Safety is the paramount consideration, guiding decisions and actions; supported by requirements. This is to be embedded in the Bruce Power programs and processes.

Numerous CNSC and Bruce Power audits have been conducted to re-affirm the on-going commitment to this Standard. For example, Audit AU-2013-00007, pointed out procedural shortcoming and inconsistencies amongst documents, which have subsequently been corrected, but throughout the process no safety performance concerns were identified.

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

No codes or standards relevant to Safety Factor 8 were subjected to a clause-by-clause assessment. This Appendix is retained only for consistency with the Appendix numbering scheme in all other Safety Factor Reports.