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candesco
Division of Kinectrics Inc.

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A Report Submitted to Bruce Power

April 12, 2016

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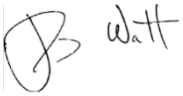
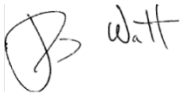
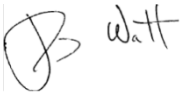
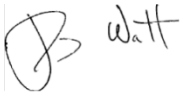
Issue R00	**Reason for Issue:** For use				
	Author: C. Ngo  V. Foster 	Verifier: G. Aldev  C. Stallman 	Reviewer: G. Archinoff  L. Watt 	Approver: L. Watt 	Date: June 30, 2015
Issue R01	**Reason for Issue:** High-Level assessment of NUREG-0700 provided in Appendix A.2. Sections 3.5, 5.11, 5.12, 8.0, and 9.0 updated based on this new assessment.				
	Author: C. Ngo 	Verifier: H. Semeralul 	Reviewer: L. Watt 	Approver: L. Watt 	Date: Apr 12, 2015
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Acronyms and Abbreviations

AIM	Abnormal Incident Manual
ANO	Authorized Nuclear Operator
AR	Action Request
BEST	Bruce Emergency Services Team
CFAM	Corporate Functional Area Manager
CNSC	Canadian Nuclear Safety Commission
CRT	Cathode Ray Tube
CSA	Canadian Standards Association
DCC	Digital Control Computer
EA	Environmental Assessment
EFPH	Equivalent Full Power Hours
EME	Emergency Mitigating Equipment
ERO	Emergency Response Organization
ERPs	Emergency Response Procedures
ESM	Emergency Services Maintainers
FASA	Focus Area Self Assessments
GET	General Employee Training
HF	Human Factors
HFE	Human Factors Engineering
HFEPP	Human Factors Engineering Program Plan
HFESR	Human Factors Engineering Summary Report
HMI	Human-Machine Interface
HRA	Human Reliability Analysis
HSI	Human-System Interface
IAEA	International Atomic Energy Agency
INPO	Institute of Nuclear Power Operations
ISR	Integrated Safety Review
LCH	Licence Conditions Handbook
LTEP	Long Term Energy Plan

MCR	Main Control Room
NLO	Non-Licensed Operator
NSCA	Nuclear Safety and Control Act
PRA	Probabilistic Risk Assessment
PROL	Power Reactor Operating Licence
PSA	Probabilistic Safety Assessment
PSR	Periodic Safety Review
QA	Quality Assurance
SBR	Safety Basis Report
SCA	Safety and Control Areas
SCR	Station Condition Record
SFR	Safety Factor Report
SME	Subject Matter Expert
TIMS	Training Information Management System
TPO & C	Training Performance Objectives and Criteria
TQD	Training Qualification Documents

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 IAEA 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 IAEA 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 the status of the various human factors that may affect the safe operation of the nuclear power plant.

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 human factors (HF) will consider the procedures and processes in place at the nuclear power plant to ensure the following:
    a. Adequate staffing levels exist for operating the plant, with due recognition given to absences, shift working and restrictions on overtime;
    b. Qualified staff are available on duty at all times;
    c. Adequate programs are in place for initial training, refresher training and upgrading training, including the use of simulators;
    d. Operator actions needed for safe operation have been assessed to confirm that assumptions and claims made in safety analyses (for example, Probabilistic Safety Assessment (PSA), deterministic safety analysis and hazard analysis) are valid;
    e. Human factors in maintenance are assessed to promote error-free execution of work;
    f. Adequate competence requirements exist for operating, maintenance, technical and managerial staff;
    g. Staff selection methods (for example, testing for aptitudes, knowledge and skills) are systematic and validated;
    h. Appropriate fitness for duty guidelines exist relating to hours, types and patterns of work, good health and substance abuse;
    i. Policies exist for maintaining the know-how of staff and for ensuring adequate succession management in accordance with good practices; and
    j. Adequate facilities and programs are available for staff training.
2. The following aspects of the human-machine interface (HMI) will be subjected to an overall review to determine if the HMI continues to be satisfactory:
    a. Design of the control room and other workstations relevant to safety;
    b. Human information requirements and workloads; and
    c. Clarity and achievability of procedures.

2. Methodology for 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. Power Reactor Operating Licence

The list of codes and standards related to Human Factors that are referenced in the Bruce Power Reactor Operating Licence (PROL) [15] and Licence Conditions Handbook (LCH) [16] are identified in Table 1.[2] The edition dates referenced in the third column of the table are the modern versions used for comparison.

[2] PROL 18.00/2020 [17] and LCH-BNGS-R000 [18] came into effect on June 1, 2015. However, PROL 15.00/2015 [15] and LCH-BNGSA-R8 [16] are the versions referred to in this ISR, as these were in force when the assessments in the Safety Factor Reports were performed.

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

Document Number	Document Title	Modern Version used for ISR Comparison	Type of Review
CNSC G-323 (2007)	Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement	CNSC G-323 (2007) [19]	NR
CNSC G-278 (2003)	Human Factors Verification and Validation Plans	CNSC G-278 [20]	NR
CNSC S-210 (2006)	Maintenance Programs for Nuclear Power Plants	CNSC RD/GD-210 (2012) [21]	NR
CNSC RD-204 (2008)	Certification of Persons Working at Nuclear Power Plants	CNSC RD-204 (2008) [22]	NR
CNSC RD-360 (2008)	Life Extension Of Nuclear Power Plants	CNSC RD-360 (2008) [4]	NR
CNSC Internal Guide, 2010/08	CNSC Expectations for Licensee Hours of Work Limits - Objectives and Criteria	CNSC Internal Guide, 2010/08 [23]	NR
CNSC Internal Guide, 2009/05	Requirements for the Requalification Testing of Certified Shift Personnel at Nuclear Power Plants	CNSC Internal Guide, 2009/05 [24]	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) [25]	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) [26]	NR

Document Number	Document Title	Modern Version used for ISR Comparison	Type of Review
CSA N286-05 [27]	Management System Requirements for Nuclear Power Plants	CSA N286-12 [28]	NR
Assessment type: Clause-by-Clause (CBC); Code-to-Code (CTC); High Level (HL); No Assessment Required (NR); Confirm Validity of Previous Assessments (CV)			

CNSC G-323: Table C-1 of the ISR Basis Document [1] calls for the confirmation of validity of the CNSC guidance document G-323. CNSC G-323 ensures the presence of sufficient qualified staff at Class I Nuclear Facilities – minimum staff complement has not been updated since its previous consideration in 2008. However, the Station Shift Complement – Bruce A [29] has been updated since the previous assessment and is discussed further in Section 5.2, Availability of Qualified Staff.

CNSC G-278: Table C-1 of the ISR Basis Document [1] calls for the confirmation of validity of CNSC G-278. G-278 has not been revised since the previous assessment and therefore has not been assessed as a part of this ISR. Moreover, this regulatory guide is included in the current licence and accordingly no further assessment of G-278 is performed for this ISR.

CNSC RD/GD-210: Regulatory document RD/GD-210 [21], 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 [21] 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 ISR.

CNSC RD-204: CNSC RD-204 [22] 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. CNSC RD-204 remains part of the licence and has not been revised, and therefore has not been assessed as a part of this ISR.

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

REGDOC-2.3.3 stated that it was consistent with SSG-25, and the assessments in the Safety Factor Reports were performed on that basis. The issued version of CNSC REGDOC-2.3.3 also states that it is consistent with SSG-25, and therefore it is considered that the ISR envelops the guidelines in CNSC REGDOC-2.3.3.

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 N286-12: 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" [30].

Bruce Power had agreed to perform a Gap Analysis and to prepare a detailed Transition Plan, and to subsequently implement the necessary changes in moving from the CSA N286-05 version of the code to the CSA N286-12 version, during the next licensing period [31]. This timeframe will facilitate the implementation of N286 changes to the management system, and enable the gap analysis results from the large number of new or revised Regulatory Documents or Standards committed in the 2015 operating licence renewal. Bruce Power has also proposed that in the interim, CSA N286-05 be retained in the PROL to enable it to plan the transition to CSA N286-12, and committed to develop the transition plan and communicate the plan to the CNSC by January 30, 2016 [32]. Bruce Power further stated CSA N286-12 does not establish any significant or immediate new safety requirements that would merit a more accelerated implementation. This Safety Factor therefore has not performed a code-to-code assessment between CSA N286-05 and CSA N286-12 and will not be performing a clause-by-clause assessment of CSA N286-05, since it is in the current licence.

3.3. Regulatory Documents

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

Table 2: Regulatory Documents

Document Number	Document Title	Reference	Type of Review
CNSC G-276 (2003)	Human Factors Engineering Program Plan	[33]	HL
CNSC REGDOC-2.2.2 (2014)	Personnel Training	[34]	CBC
CNSC REGDOC-2.5.2	Design of Reactor Facilities: Nuclear Power Plants	[35]	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 G-276: CNSC G-276 Human Factors Engineering Program Plan provides guidance to assist licensees in developing human factors engineering program planning documentation that demonstrates how human factors considerations are incorporated into activities licensed by the CNSC. Since G-276 was previously considered in the Bruce A Units 1 and 2 Return to Service – Systematic Review of Safety [9], a high level programmatic assessment was performed and summarized in Appendix A.

CNSC REGDOC-2.2.2: CNSC REGDOC-2.2.2 Human Performance Management – Personnel Training was issued in August 2014. A programmatic clause-by-clause assessment has been performed since an assessment against this document has not been performed in the past. REGDOC-2.2.2 [34] sets out requirements and guidance for the analysis, design, development, implementation, evaluation, documentation and management of training at nuclear facilities within Canada, including the essential principles and elements of an effective training system. REGDOC-2.2.2 [34] a clause-by-clause assessment has been performed in Appendix B (B.1).

CNSC REGDOC-2.5.2: Table C-1 of the ISR Basis Document [1] does not identify CNSC REGDOC-2.5.2 as relevant to Safety Factor 12. However, Section 7.21 of REGDOC-2.5.2 is directly applicable to Human Factors. A clause-by-clause assessment of REGDOC-2.5.2, including Section 7.2.1, has been performed in Safety Factor 1, and is not repeated in Safety Factor 12.

3.4. CSA Standards

The Canadian Standards Association (CSA) has issued standards that form the basis of the Quality Assurance (QA) programs for all Canadian nuclear facilities. These high-level documents are used primarily as a foundation or basis on which nuclear utility operators have developed specific, internal policies, programs, and procedures.

There are no specific CSA Standards relevant to this Safety Factor.

3.5. International Standards

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

Table 3: International Standards

Document Number	Document Title	Reference	Type of Review
IAEA SSG-25	Periodic Safety Review For Nuclear Power Plants	[3]	NR
NUREG-0700	Human System Review Guidelines	[120]	HL
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.

NUREG-0700: NUREG-0700, Human System Review Guidelines, is used by the U.S. Nuclear Regulatory Commission as guidance for the evaluation of interfaces between plant personnel and plant's systems and components. A high level assessment has been performed of this guidance document in Appendix A (Section A.2) at the request of the CNSC.

3.6. Other Applicable Codes and Standards

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

4. Overview of Applicable Bruce A Station Programs and Processes

Section provides an overview of Bruce Power programs and processes related to this Safety Factor.

4.1. Key Implementing Documents

The key Bruce Power documents related to implementation of the elements related to human factors, human performance, and ergonomics are indicated in Table 4.[3]

Table 4: Key Implementing Documents

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
BP-MSM-1: Management System Manual [36]	BP-PROG-00.07: Human Performance Program [37][4]	BP-PROC-00617: Human Performance Tools for Workers [38]	
	BP-PROG-01.02: Bruce Power Management System (BPMS) Management [39]	BP-PROC-00166: General Procedure and Process Requirements [40]	
	BP-PROG-01.04: Leadership Talent Management [41]	BP-PROC-00221: Succession Management [42]	
	BP-PROG-02.01: Worker Staffing [43]		
	BP-PROG-02.02: Worker Learning and Qualification [44]		
	BP-PROG-02.04: Worker Development and Performance Management [45]		
	BP-PROG-02.06: Worker/Labour	BP-PROC-00276: Code of Conduct [47]	

[3] 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.

[4] BP-PROG-00.07 is now at Revision R011.

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
	Relations [46]	BP-PROC-00389: Conventional Safety Programs [48]	BP-SM-00037: Industrial Ergonomics [49]
			BP-SM-00015: Office Ergonomics [50]
			BP-SM-00043: Working in Hot Environments [51]
			BP-SM-00033: Personal Protective Equipment [52]
	BP-PROG-02.08: Total Rewards [53]	BP-PROC-00005: Limits to Hours of Work [54]	
		BP-PROC-00024: Base Work Week for Management and Professional Staff [55]	
	BP-PROG-08.01: Emergency Measures Program [56]	BP-PLAN-00001: Bruce Power Nuclear Emergency Response Plan [57]	
	BP-PROG-10.01: Plant Design Basis Management [58]	BP-PROC-00335: Design Management [59]	DPT-PDE-00001: Human Factors Minor Change [60]
			DPT-PDE-00013: Human Factors Engineering Program Plan [61]
	BP-PROG-10.02: Engineering Change Control [62]	BP-PROC-00539: Design Change Package [63]	

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
	BP-PROG-11.04: Plant Maintenance [64]	BP-PROC-00699: Maintenance Work [65].	BP-PROC-00694: Maintenance Procedure Development and Revision [66]
	BP-PROG-12.01: Conduct of Plant Operations [67]	DIV-OPA-00001: Station Shift Complement – Bruce A [29]	
		GRP-OPS-00050: Requirements for Station Operating Procedure Development and Revision [68]	
		BP-PROC-00250: Writer's Guide for Station System Procedures [69]	

The Human Performance Program [37] describes Bruce Power's systematic approach to improving human performance through the use of event-free tools, managing defences, and other elements that enhance human performance. Bruce Power's Human Performance Program uses a strategic approach to managing Human Performance by reducing errors and managing defences. Bruce Power's Human Performance Program identifies four lines of defence or control to improve station resilience to human error and related events: Administrative Controls; Culture Controls; and Oversight Control; and Engineered Controls. The implementation of these controls is discussed briefly.

Bruce Power implements administrative controls through the programs that govern the development of procedures, training, and work processes. Various policies and expectations direct activities so that they are predictable and safe, especially for work performed in and on the plant [37]. The various programs and procedures with respect to staffing, training, employee wellness and health management including fitness for duty and ergonomics, as well as clarity and achievability of procedures are further discussed in Section 5.

The lines of defence associated with cultural and oversight controls as defined in the Human Performance Program [37] are discussed in Safety Factor 10.

Bruce Power's Human Factors Engineering Program outlined in DPT-PDE-00013 [61], focuses on ensuring that Human Factors is considered in design and provides an input to the development of engineered controls through design as a line of defence. Considering this objective, the implementation of the program resides within Plant Design Engineering and is integrated into Bruce Power's Design Change Package process described in BP-PROC-00539 [63] and is invoked by BP-PROG-10.02, Engineering Change Control [62]. Because Human Factors is integrated into the engineering change control process, Human Factors activities, depending on the scope of work, align with the process map identified in BP-PROC-00539 [63], Appendix A and is invoked through the identification of stakeholder involvement (HF being a required stakeholder) early on for the design change package. DPT-PDE-00013 [61] is based upon NUREG 0711 [70], Human Factors Engineering Program Review Model, and conforms with CNSC documents G-276, Regulatory Guide for Human Factors Engineering Program Plans and G-278, Regulatory Guide for Verification and Validation Plans. The NUREG-0711 model is recognized internationally as a well developed, comprehensive model for the review of HF. Inherently, the model proves very useful for design as well. The technical elements listed below and the applications of the elements are described in Appendix B of DPT-PDE-00013:

- HF Program Management (planning);
- Operating Experience Review;
- Functional Analysis and Function Allocation;
- Task Analysis;
- Staffing and Qualification;
- Treatment of Important Human Actions;
- Human System Interface Design;
- Procedure and Training Program Development;
- Design Verification;
- Design Validation;
- Design Implementation; and
- Human Performance Monitoring.

Safety in the plant is also supported by Bruce Power's Conventional Safety Programs outlined in BP-PROC-00389 [48]. The Conventional Safety Programs provide a framework for identifying, measuring, evaluating and controlling chemical, biological, physical, and ergonomic hazards. The program encompasses over 30 safety manuals, including key ergonomic documents such as BP-SM-00037, Industrial Ergonomics [49]; BP-SM-00015, Office Ergonomics [50], BP-SM-00043, Working in Hot Environments [51]; and BP-SM-00033, Personal Protective Equipment [52].

5. Results of the Review

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

5.1. Adequacy of Staffing Levels for Operating Plant

This review task includes review of the programs for adequate staffing levels for operation of the plant, with due recognition given to absences, shift working and restrictions on overtime.

Activities associated with workforce planning are governed by Bruce Power's Worker Staffing program, BP-PROG-02.01 [43]. The objective of the Worker Staffing Program is to recruit, orient, and deploy staff that possess the competencies required for maintaining staffing levels consistent with the requisite organization structure, and includes the subsequent release of staff. All staffing activities and procedures must fulfill the requirements of all applicable employment legislation including safety, employment equity and diversity, privacy, and human rights. The same applies to all Collective Agreement obligations. The key elements of the program are as follows:

- fulfillment of all legislative and contractual agreements;
- approval of the organization to hire staff;
- development of approved competencies and selection criteria;
- detailed process for recruitment searches;
- identification of employment conditions; and
- a process for hiring, orientation and departure of employees.

In recognition of Bruce Power's value of "Safety First" and the potential impact shift work may have on safety, Bruce Power has implemented a process for monitoring and controlling the hours of work for all employees. This process is described in BP-PROG-02.06, Worker and Labour Relations [46]. A framework has been put in place to facilitate compliance with the regulatory expectations of the CNSC, as well as any applicable legislative requirements such as those set out in the Employment Standards Act, regarding hours of work and any agreements with applicable unions. Details on the Bruce Power procedure on the limits to hours of work are found in BP-PROC-00005, Limits to Hours of Work [54]. A review of an internal assessment on compliance with the Limits to Work summarized in Section 7.1.1, identified that there was a decreasing trend in the hours of work violations in 2013. This suggests that while there are still some issues, Bruce Power's programs are effective in maintaining adequate staffing levels.

It is concluded that Bruce Power programs meet the requirements of this review task.

5.2. Availability of Qualified Staff

This review task includes review of the shift complement programs to ensure qualified staff are available on duty at all times.

DIV-OPA-00001, Station Shift Complement - Bruce A [29], defines the normal, minimum scheduled and minimum shift complements for operation of Bruce A, in order to ensure safe operation of the nuclear units, both during normal conditions and in the event of a transient that could affect reactor safety. Complements are given for four units operating. This document implements the requirements of BP-OPP-00002, Operating Policies and Principles - Bruce A, 01.5 Station Staffing [71] as well as the staffing requirements of the Bruce A PROL [15]. As cited in DIV-OPA-00001 [29], the basis for the minimum shift complement is given by NK21-REP-09034-00006, Analysis of Resource Requirements to Respond to Abnormal Incidents at Bruce A [72]. At the start of each shift, each accounting Manager confirms there is at least a minimum complement present in the assigned locations. If, for any reason the incoming shift is projected to be below minimum shift complement, the outgoing Shift Manager will hold over sufficient staff until qualified replacement personnel arrive. The hold-over of any staff for minimum shift complement should follow the guidelines outlined in GRP-OPS-00055, Fitness for Duty Considerations for Shift Complement Staff Held Over for More Than 13 Hours [73], to mitigate the impact of fatigue and ensure safe and efficient operation of the station. Persons filling minimum complement positions must have the associated qualification for the role they are performing. Each Bruce A station complement role has an associated qualification in TIMS (Training Information Management System). Line Management ensures that crew numbers, experience and skills, including Special Safety System qualifications, are balanced across the five shift crews. Attrition and the integration of junior staff (newly hired and newly certified staff) is managed so as to maximize the opportunity for effective mentoring, as well as the transfer of operating experience and skills. In addition, the Bruce Power Nuclear Emergency Response Plan, BP-PLAN-00001, [57] identifies support staff levels required in case of an emergency. Review and references to emergency staffing is provided in Safety Factor 13.

The CNSC's Type II Inspection of hours of work discussed in Section 7.3.2 identified an increasing number of work violations since Bruce A started operating all four units. The largest contributing cause to these violations is the shortage of certified staff. The CNSC recognize that Bruce Power is continuing to work towards certifying more staff and in the interim are mitigating potential Human Performance issues through improved rest facilities, supplemental training based on any deficiencies identified in the review and improving the traceability of Fitness for Duty Checklists (FORM-12987) [74].

While Bruce Power's program documentation meets the requirements of this review task, the effectiveness of the program in ensuring the availability of qualified staff is an issue that Bruce Power continues to work on.

5.3. Adequacy of Programs for Training

This review task is to confirm adequate programs are in place for initial training, refresher training and upgrading training, and that this training includes the use of simulators.

The Worker Learning and Qualification program, BP-PROG-02.02 [44], satisfies the worker qualification and worker training requirements of applicable Bruce Power Licences and governing acts, codes and standards as referenced in BP-MSM-1 Sheet 0003, MSM - List of Applicable Governing Acts, Codes & Standards - Sheet 0003, commensurate with Bruce Power's business needs, including commitments made in the PROL application, and requirements included in the PROL [15]. The Worker Learning and Qualification program ensures conformance with clause 5.3 of N286-05, Management System Requirements for Nuclear Power Plants [27], which states that personnel must "be competent at the work that they do". The Worker Learning and Qualification program [44] sets the standard for the entire company on how to ensure that personnel are competent at the work that they do.

The Bruce Power training processes follow a Systematic Approach to Training based upon the performance objectives defined in the Institute of Nuclear Power Operations (INPO) document, ACAD 02-001, The Objectives and Criteria for Accreditation of Training in the Nuclear Power Industry [75]. Worker learning and qualification is a continuous endeavor and is in alignment with the following aspects of Bruce Power's Training Performance Objectives and Criteria [76]:

- Training is used as a strategic tool to provide highly skilled and knowledgeable personnel for safe, reliable operations and to support performance improvement.
- Resources and an infrastructure of training processes are applied consistent with the needs to support training program sustainability.
- The initial training program uses a Systematic Approach to Training to provide personnel with the necessary knowledge and skills to perform their job assignments independently.
- Continuing training uses a systematic approach to training to refresh and improve the application of knowledge and job related skills and to meet management expectations for personnel and plant performance.

As per BP-PROG-02.01 [43], Worker Staffing, all new staff must receive a comprehensive two-phase orientation. Phase 1, intended for new employees, is a general orientation activity that must be delivered on the first day of employment. This is followed by two days of General Employee Training (GET) and, when required and the need identified, Orange Badge training, which provides entry level radiation protection training for workers, will be rostered. Phase 2 is a department specific orientation activity that is completed when the employee arrives in the new job/department. The department specific orientation is for new and transferring employees [43].

To support learning and qualification, Bruce Power has a variety of training facilities (see further details in Section 5.10). These facilities include full scope main control room (MCR) simulators used for initial certification training of Bruce Power station staff, examination of staff, and continuing training of certified staff.

Bruce Power's Simulator Validation document, SEC-SIMM-00001, establishes the validation procedure for the full scope CANDU control room simulator [77]. The validation procedure is used to confirm that the full scope simulators are capable of providing the correct observable simulated control room responses during the training and testing exercises. The Bruce A Simulator Reference unit is Bruce A Unit 2 (all unit processes within the scope of simulation), Unit 3 (all unit processes within the scope of simulation) and Unit 0 (common and switchyard processes).

The Design Change Package process, BP-PROC-00539 [63], ensures that changes to the plant are reflected in the MCR simulator. The Simulator Change Control, SEC-SIMM-00002 [78], is used for documenting changes to the simulator. These procedures provide instructions for development, review, verification, approval, installation, commissioning, and closeout of any modification to the simulator.

A clause-by-clause review of Bruce Power's training program against REGDOC-2.2.2, Personnel Training [34] has been documented in Appendix B. The results of the clause-by-clause review concluded that Bruce Power's training program, as documented, meets the intent of REGDOC-2.2.2 requirements.

Bruce Power's training program documents meet the requirements of this review task. However, Bruce Power continues to improve upon the training program documents through feedback drawn from self assessments and audits. The internal audit report, AU-2013-00013 [79], discussed in Section 7.2.1, identified seven adverse conditions that resulted in corrective actions and program document revisions to address the issues identified in the adverse conditions.

5.4. Operator Actions Needed for Safe Operation

This review task includes review of the Bruce safety analysis programs to ensure that assumptions and claims made about Operator actions under accident conditions have been assessed and confirmed valid.

Credited Human Actions, which are actions most important to safety, are identified by probabilistic and deterministic analyses.

Tables 1-1 to Table 1-10 of Bruce A Safety Report- Part 3: Accident Analysis, NK21-SR-01320-00003 [81], provide a summary of the operator actions credited for the various accident categories based on deterministic safety analysis. For each accident scenario identified in the tables, the credited operation action time, the unambiguous indicators that inform the operator of the accident, and the station operating context in which the accidents occur are presented. The Bruce A Probabilistic Risk Assessment (PRA) documents the credited actions identified through PRA [82].

The Human Factors Engineering Program Plan, DPT-PDE-00013, HFE Program Element 6 covers treatment of important human actions with respect to engineering changes [61]. DPT-PDE-00013 notes that the Risk Assessment is part of the Licensing Basis for both Bruce A and Bruce B and contains human reliability modeling. If design changes impact event sequences in the Probabilistic Risk Assessment (PRA), human reliability estimates may be affected and these credited human actions are required to be assessed through a Human Reliability Analysis (HRA). Human Reliability Analysis is normally only monitored during a design modification where the Nuclear Safety Risk is at Levels 1, 2 or 3 on a project, or if an Abnormal Incident Manual (AIM) action is impacted due to the potential for, and mechanisms of human error that might affect plant safety. If the change is found to meet the above level criteria, the affected human actions must be reviewed to determine if they affect the PRA or deterministic safety analysis. In some cases the deterministic safety analysis may include human actions that are credited in the analyses to prevent or mitigate the accidents and transients. These Human

actions may, or may not, be found as risk-important by the PRA but are considered deterministically as significant requiring analysis or review. Significant human actions must be addressed in design changes through task analyses and the design of the human-system interfaces (HSIs) as described in DPT-PDE-00013 [61] to minimize personnel errors, support their detection, and ensure recovery capability.

While the Human Factors Engineering Program Plan, DPT-PDE-00013 covers assessment for credited human actions as a result of design changes, the assessment and validation of credited human actions that are not a part of design changes are validated through other activities. Safety Factor 5 (Section 5.7) provides further information on methods used for development and validation of emergency operating procedures and the accident management program at the plant.

Bruce Power Abnormal Incident Manual Project Human Factors Engineering Summary Report (HFESR), B-REP-06700-00002, documents the validation exercises completed to ensure that all credited human actions, as noted in the Bruce A PRA [82] and included in AIMs, could be completed safely and within the required time, using minimum complement. It also verified the availability of the required controls, equipment and information. The report did not mention whether the actions noted in the Safety Report [81] were also included in the validation exercises. It is possible that the actions in the Safety Report may overlap with the credited actions noted in the PRA and included in the AIMs that were a part of the exercises; however, this could not be confirmed. A gap (SF12-1) has been raised in Table 5 regarding the possibility that not all operator actions under accident conditions were assessed and validated.

5.5. Human Factors in Maintenance

This review task includes review of the Bruce Power Programs to ensure that human factors in maintenance are assessed to promote error-free execution of work.

As discussed in Section 4, Bruce Power's Human Performance program describes the approach to reducing error and managing defences to promote error-free work and optimizing human performance [37]. The Human Performance Program encourages workers to use Human Performance tools identified in BP-PROC-00617 [38] to anticipate, prevent and detect errors before they cause harm to people, plant, property or the environment. These skills, behaviours, and practices apply to all personnel and are supported by Bruce Power's Maintenance Fundamentals as outlined in BP-PROC-00580 [83]. The Maintenance Fundamentals procedure sets forth the expectations for performing, assessing, and reinforcing the Maintenance Fundamentals to ensure maintenance activities achieve industry best performance. These fundamentals constitute a set of standards and behaviours for all Bruce Power Maintenance Departments across site and include the following key areas:

- Maintenance Personnel Knowledge;
- High-Quality Corrective and Preventive Maintenance;
- Deliberate and Conservative Actions;
- Communication of Technical Information; and

- Ownership of Plant Performance.

Consistent with the strategic approach outlined in the Human Performance Program is the application of Human Factors in design through Bruce Power's side-wide Human Factors Engineering Program Plan, DPT-PDE-00013 [61]. DPT-PDE-00013 outlines a process for considering tasks of users including maintenance personnel in the design of new and modified systems. The process also invokes the use of Bruce Power's Human Factors Design Guide: Maintenance, Inspection, and Testing, B-DG-06700-00003 [84]. The guidelines in this design guide are concerned with design features that can potentially affect preventive and corrective maintenance of systems and promote consideration for HF issues such as task compatibility of equipment design, error-tolerant design, and arrangement and location of items for ease of access.

Safety Factor 2 discusses the implementation of Bruce Power's maintenance programs.

It is concluded that Bruce Power programs meet the requirements of this review task.

5.6. Competence Requirements for Operating, Maintenance, Technical and Managerial Staff

This review task includes review of training programs to ensure adequate competence requirements exist for operating, maintenance, technical and managerial staff.

As indicated in Section 5.1, the objective of Worker Staffing [43] is to recruit, orient and deploy workers who possess the required competencies. All Bruce Power staff are recruited using current organizational technical and behavioural competencies specified in approved job documents and selection criteria.

The Worker Learning and Qualification program, BP-PROG-02.02 [44], sets the standard for the entire company on how to ensure that personnel are competent at the work that they do. The procedures and job aids required to implement the Worker Learning and Qualification program gain their authority from this program. These procedures and job aids:

- Implement the necessary controls to ensure personnel are competent to do the work assigned to them. Competencies are assessed through the evaluation of education, training, skills, experience, and ability. Training programs based on the work performed by personnel are systematically developed and implemented so that the required competency is achieved and maintained. Any prerequisite education, experience, and training is identified.
- Implement the intent of the Bruce Power Training Performance Objectives and Criteria (TPO&C). The Bruce Power TPO&C address the intent of both the CNSC and INPO training performance objectives and criteria. The Training Performance Objectives and Criteria handbook, B-HBK-09500-00003 [76], documents the relationship between the Bruce Power and the CNSC performance objectives and criteria. The Bruce A PROL [15] requires compliance with the CNSC examinations guides EG-1: Requirements and Guidelines for Written and Oral Certification Examinations for Shift Personnel at Nuclear

Power Plants and EG-2: Requirements and Guidelines for Simulator-Based Certification Examinations for Shift Personnel at Nuclear Power Plants.

- Require the training elements that support Worker Qualifications approved for inclusion within the Training Qualification Documents (TQDs) be created, managed and conducted in a manner that fully meets the intent of the Bruce Power Training Performance Objectives and Criteria TPO&Cs.

A TQD is a governing document that identifies the prescribed qualifications and training required by Bruce Power personnel to perform assigned tasks independently. The TQD also identifies the training program structure for: Engineering Support personnel, Certified Operator Training, Nuclear Operator Training, Control Maintenance personnel, Mechanical Maintenance personnel, Chemical Technologists and Responsible System Chemists, Radiation Protection Technicians and Health Physicists, and Authorized/Responsible Health Physicists. The TQDs identify all specific qualifications and cross functional qualifications that are required. Employees with the appropriate occupation codes are linked to the required selection of qualifications from the TQD to perform their function by their line supervision.

BP-PROG-01.04, Leadership Talent Management [41], defines, based on business needs, the leadership competencies required of its managers from Vice President to First Line Manager. These competencies are derived from a review of the mission, vision, values and business plans and then translated into specific demonstrable behavioral expectations.

Bruce Power programs meet the requirements of this review task. Although issues were identified in Section 7.1.2 with respect to ensuring that emergency services staff filling roles for minimum staff complement are qualified, corrective actions are in place to resolve the issues.

5.7. Staff Selection Methods

This review task includes review of programs and processes for staff selection to confirm they are systematic and validated.

The objective of the Worker Staffing program, outlined in BP-PROG-02.01 [43], is to recruit, orient and deploy workers who possess the competencies required for maintaining staffing levels consistent with the requisite organization structure. The program applies to both internal and external hires. Employees must be recruited against current organizational competencies (i.e., technical and behavioural), which are specified in an approved job document and selection criteria. An internal or external search must not commence until these documents are approved and in place. The selection criteria must be reviewed, and updated where necessary, for each recruitment activity. Hiring processes for different employee classifications are detailed in the following specific procedures: BP-PROC-00319, Student Hiring [85]; BP-PROC-00355, Hiring Process (Contractors) [86]; and BP-PROC-00465, Hiring Process (Regular Positions) [87].

Recruitment procedures must include a work/reference check process and pre-placement qualification checks to ensure the candidate meets or exceeds the qualification criteria.

Bruce Power is committed to ensuring there are capable managers and achieves this through both the Succession Management procedure outlined in BP-PROC-00221 [42], which outlines a process for developing successors for key positions and roles as well as the Talent

Management process. The Talent Management process for managers described in BP-PROG-01.04 [41], defines how managers are selected for both their leadership and technical skills, and then how managers are on-boarded, managed and developed. It also defines how Bruce Power ensures sufficient number of managers with the right leadership and technical skills are available to deliver the business plan, which includes safe operations targets.

Managers are selected based on technical job requirements and the leadership behavioral competencies for the position level. The selection process for managers is part of the general selection process for all employees and is documented in BP-PROC-00465, Hiring Process (Regular Positions) [87], and BP-PROG-02.01, Worker Staffing [43].

BP-PROG-02.02, Worker Learning and Qualification [44], is the program that ensures personnel are competent to do the work assigned to them. Competence is assessed through the evaluation of education, training, skills, experience, and ability. Training programs based on the work performed by personnel are systematically developed and implemented so that the required competency is achieved and maintained. Any prerequisite education, experience, and training is identified. Evaluation methods are used systematically to assess training effectiveness and modify training to improve personnel and plant performance.

BP-PROC-00213, Training - Administer Training Evaluation [88], defines the process for evaluating the efficiency, effectiveness and quality of learning at Bruce Power, and defines the process for initiating corrective actions based upon the results of these evaluations.

Bruce Power programs meet the requirements of this review task. Although issues were identified in Section 7.1.2 with respect to selecting that emergency services staff filling roles for minimum staff complement that are not qualified, corrective actions are in place resolve the issues.

5.8. Fitness for Duty

This review task includes the review of fitness for duty guidelines addressing the hours, types and patterns of work for all Bruce Power Staff and a review of the programs which assess good staff health and substance abuse problems.

Bruce Power has a detailed process outlining the daily, weekly and yearly limits of hours worked per worker type (day worker, rotating shift worker, etc.). This process is documented in Limits to Hours of Work, BP-PROC-00005 [54] and describes the responsibilities to ensure this process is followed to minimize the likelihood of human errors caused by worker fatigue. The process is further supported by reference to the Base Work Week for Management and Professional Staff procedure, BP-PROC-00024, [55], which describes the base work week for management and professional staff. Both documents take authority from the Total Rewards program outlined in BP-PROG-02.08 [53].

Fitness for Duty guidelines, BP-PROC-00610 [89] and Code of Conduct BP-PROC-00276 [47] training are part of the orientation training of all new hires and are part of refresher training for all staff at site. Staff performing functions under the Code of Conduct Program, including Supervisors and Managers, will receive ongoing training. Initial and periodic health assessments

have conducted for CNSC certified staff as per the Bruce Power Health Surveillance procedure, BP-PROC-00378 [90] to evaluate the impact (if any) of medical conditions on fitness for duty.

A worker who is unfit for duty may identify this to the supervisor, or the supervisor may notice that the worker's behaviour or appearance in the workplace indicates there may be a fitness for duty issue. Another worker may also report concerns regarding a co-worker's fitness to a supervisor. The supervisor performs a preliminary assessment of fitness for duty utilizing the following tools as required:

- Assessing Fitness for Duty Guideline;
- FORM-12987 - Fitness for Duty Checklist [74]; and
- FORM-13981 - Fitness for Duty Checklist - Fatigue Assessment [91].

Guidelines specific for assessing fitness for duty for minimum shift complement staff held over for more than 13 hours are provided in GRP-OPS-00055 [73].

The assessment will result in a determination that:

- The worker is fit for duty and may return to work with or without accommodation;
- The worker is fit for duty and there is a performance issue; or
- The worker is unfit for duty.

When the worker is considered unfit for duty, they will be removed from the work area and a determination will be made for transportation to hospital, the worker's home, or into the care of a responsible person. If the worker is fit for duty, the supervisor will determine whether there is a need for performance management if the worker is not performing to the job performance standards (BP-PROC-00411, Managing Employee Performance [92]). If the worker requires an absence for a fitness for duty issue or has been referred to external medical personnel, the supervisor must ensure they are reviewed for fitness for duty by Employee Wellness on their return (refer to BP-PROC-00071, Injury/Illness Disability Management [93]).

Bruce Power's Fitness for Duty procedure, BP-PROC-00610 [89], describes the approach used by Bruce Power is to resolve problems affecting a worker's performance, health or safety through support, education, counseling and/or treatment. Specifically, BP-PROC-00610 states, "Bruce Power is committed to helping individuals seek assistance and provides a program for reducing the workplace and human costs associated with substance abuse and various health issues. Workers are encouraged to come forward voluntarily in order to obtain confidential professional counseling and medical assistance, however they must demonstrate commitment to address these issues. While participating in programs, the worker's employment or advancement opportunities will not be affected provided treatment is undertaken which results in satisfactory control/elimination of identified problems." Information and assistance on the Employee Wellness programs and services are described on the Wellness webpage on the Bruce Power intranet [89].

Bruce Power prohibits the use, sale or possession of illegal substances, and/or any other drug for non-medical reasons on Bruce Power premises. Any such incidents, if established, may result in summary dismissal and, where illegal drugs are involved, notification of the appropriate

police authorities. Any off-duty conduct where any employee is engaged in the use of and/or sale of illegal substances and/or any other drug may also be liable for discipline up to and including dismissal. Similarly any employee found to be under the influence of alcohol or drugs while at work may be liable for discipline up to and including dismissal.

Bruce Power's documented programs meet the intent of the review tasks and actions are being taken to ensure the effectiveness of the Fitness for Duty protocols in light of the minimum staff complement violations that were identified in the Hours of Work Inspection described in Section 7.3.2.

5.9. Maintaining Know-How of Staff and Adequacy of Succession Management

This review task includes the review of Bruce Power's programs and procedures for maintaining the know-how of staff and for ensuring adequate succession management in accordance with good practices. BP-PROC-00468 [94], Workforce Planning Process, outlines the process that is used to identify positions that will be required in the future, and is regarded as a sub-process for business planning feeder processes. The Human Resources function of Workface Planning is accountable for delivering a 5-year workforce plan, through the annual business planning process and integrating with the recruiting function to develop hiring plans for all divisions across site.

The 5 year business plan is developed in accordance with Business Planning, BP-PROC-00485 [95], and the interfacing procedures. The Executive Team provides the strategic direction to the organization for the development of the business plan. The plan identifies how the company will achieve targeted performance for each identified target by identifying the accountable organizations, resources, and any activities requiring investment beyond core work. Each team's plan is rolled up into a corporate business plan. Workforce planning is an input to business planning and takes into account the activities and resources required to meet the direction set by the executive. Each division identifies the roles, responsibilities, head count, rationale and/or assumptions and the risk and/or impact required to meet the direction laid out. The divisions also identify the labour funding type and any incremental head count they feel is required. The executive team then reviews and challenges the resources and activities as developed by the divisions, considering any potential risks or impacts to the strategic plan, and considers any potential alternatives. Once agreed upon, the workforce plan is input to the final business plan.

The Executive Team, as the highest level management team, identifies which positions are critical from the perspective of needing to have a capable incumbent and/or a ready successor. For positions that are not business critical, succession management will lie with the line organization and be monitored via standard reporting within the line.

For positions that are critical to the business the Worker Development and Performance Management process [45] identifies the approach for worker development and succession planning especially for employees with critical skills. Worker development and performance is linked to business plans and managed through the establishment of personal performance plans**,** BP-PROC-00006 [96]. Also, management succession is outlined in a specific procedure,

Succession Management, BP-PROC-00221 [42]. In addition to identifying people who can perform in the position on an ongoing basis, people who can act as an emergency replacement ("safe pair of hands") to maintain a position on a short term basis will be identified as a contingency for emergency situations.

To maintain the knowledge of the plant, Bruce Power has placed a strong emphasis on documentation as described in the Controlled Document Life Cycle procedure, BP-PROC-00068 [97]. This document states that a one, two or three-year review cycle is mandatory for all Bruce Power Programs and General Procedures (some maintenance procedure types excepted). In addition, there is flexibility within the procedure to allow staff to submit changes and new requests for procedures prior to review cycle deadline by submitting an Action Request type Document Change Request (using ESuite). The process is described in the procedure development and revision procedure for Maintenance Procedure Development and Revision [66] and the procedure for Requirements for Station Operating Procedure Development and Revision [68].

Bruce Power also has a program in place to identify and collect undocumented knowledge that has the potential to jeopardize the company should the personnel holding it become unavailable through retirement or other causes. This process is documented in Training – Administer Critical Knowledge Retention, BP-PROC-00360 [98].

Bruce Power programs meet the requirements of this review task.

5.10. Adequacy of Facilities and Programs for Staff Training

This review task includes review of the facilities available to support staff training programs.

The objective of the Worker Learning and Qualification program, BP-PROG-02.02 [44], is to ensure personnel are provided with the competencies and qualifications necessary to satisfy the requirements of applicable legislation commensurate with Bruce Power business needs. The program follows the Systematic Approach to Training model defined by INPO. The training program is described in further detail in Section 5.3, Adequacy of Programs for Training.

Bruce Power has in-place training facilities, including full scope simulators used for initial certification training of Bruce Power station staff, examination of staff, and continuing training of certified staff.

Two full scope main control room simulators are discussed in Section 5.3. Other simulators include a fuel handling simulator, classroom simulators and kiosk simulators. The fuel handling simulator is used for training personnel from both Bruce A and B. The classroom simulators are non-interactive displays used for training operators outside of the main control room simulators, while the kiosk simulators are not used for training but are available for the Simulator Support department and select instructors and examiners to develop training and examination simulations, as well as troubleshoot and upgrade the simulators.

In addition to simulators, Bruce Power has dedicated training facilities, both on and off site to provide regular and contract staff the necessary training for their specific roles. These facilities include, but are not limited to the Bruce Learning Center, Bruce Technology Skills Training Centre, and the Kincardine training facility. The list of all of the training facilities is included in

the scheduling database and is used to assign the appropriate facility to each course. Included in these facilities are class rooms, maintenance training shops, station component mock ups and rehearsal spaces.

For example, Bruce Power has a Fire Training facility at site. The facility is used to train Emergency Response personnel on fire fighting techniques. Bruce Power provides general guidelines regarding the use of the facility through SEC-CST-00001 [99]. The guidelines provide instructions covering the day-to-day operation of the Fire Training Field Area to ensure minimal impact on the environment and surrounding buildings from the training exercises.

Bruce Power programs meet the requirements of this review task.

5.11. Human Machine Interfaces for the Design of Control Room and Other Workstations Relevant to Safety

This review task includes review of the Human-Machine Interfaces (HMI) of control rooms and other workstations relevant to safety, to ensure that the design continues to support safe operation of the plant.

The Bruce A Main Control Room has been in operation for over 30 years and has undergone modifications based on requirements from Bruce 3 and 4 Restart as well as Bruce 1 and 2 Refurbishment. Based on this experience, it can be concluded that interfaces in the MCR provide appropriate information in a usable format. Issues associated with the MCR may be raised as a Station Condition Record (SCR) using Bruce Power's Station Condition Record Process, BP-PROC-00060 [100]. The identified adverse condition identified in the SCR may be addressed via another managed process, which may include an engineering change. Any engineering changes that necessitate changes in the MCR are addressed through the Human Factors program described in DPT-PDE-00013 [61]. The HF program is supported by various design guides (full list noted in the Human Factors Engineering Program Plan, DPT-PDE-00013 [61]) that provide guidance on the design of HMIs to ensure consistency and standardization of existing HMI conventions as well as application of HF principles.

The Secondary Control Area (SCA) for Bruce 3 & 4 was designed during the Bruce 3 & 4 Restart project with Human Factors systematically incorporated. The appropriate information for the SCA was determined by completing functional analyses, task analyses, HSI design and conducting a MCR uninhabitable validation during the design process. The results of the HF activities are summarized in NK21-REP-06700-00001, Bruce A Restart Human Factors Engineering Summary Report [101]. The HF assessment that was conducted in support of the SCA for Units 1 & 2 is summarized in NK21-REP-63760-00002, Human Factors Assessment of the Bruce Unit 1 and 2 Secondary Control Area [102]. The assessment identified some high-level issues. Bruce Power has accepted and is responsible for the tracking and recording the dispositions to these issues.

In addition to the on-going Human Factors program, Bruce Power had an assessment done to evaluate the extent to which Bruce Power's design guidance and subsequently MCR and SCA design adheres to modern guidelines for interface design. This analysis work was completed with the objective of identifying improvement opportunities to HF design guidance and where practicable, provides recommendations for the improvement of MCR and SCA design. The

results of the review identified that the MCR and the SCA interfaces reviewed are approximately over 73 percent compliant with the clauses in the guidelines reviewed. Any deviations were resolved with the understanding that many represent known stereotypes that are relevant to Bruce Power or the industry in general, and changes would increase the likelihood of error. Improvement opportunities related to modifying guidance and continuing review of items difficult to assess were provided as well. The results of the assessment are summarized in B-REP-06700-00001, Human Factors Review against Modern Safety Standards Human Factors Engineering Summary Report [103].

The adequacy of the HMI in supporting safe operation of the plant is further supported by an AIM validation exercise that was carried out in 2010. The goal of exercise was to ensure that all AIMs could be completed safely and within the required time, using the minimum staff complement. The analysis also verified the availability of the required controls, equipment and information. The exercise is summarized in B-REP-06700-00002, Bruce Power Abnormal Incident Manual Project Human Factors Engineering Summary Report [104].

Safety Factor 1 addresses the adequacy of the design of the plant including the Bruce A MCR, SCA, and emergency response facilities.

NUREG-0700, Human System Review Guidelines [120] address the physical and functional characteristics of HSIs, and as such are denoted as Human Factors Engineering (HFE) guidelines as opposed to related considerations such as instrumentation and control and structural design. NUREG-0700 can be considered as a guidance tool relevant to this review task. A high level assessment is performed in Appendix A (Section A.2), which illustrates that Bruce Power meets the intent of some aspects of NUREG-0700, but that there were a number of issues that could not be resolved with the information that was reviewed. A gap (SF12-2) in regards to NUREG-0700 guidance has been identified in Table 5.

Based on the review of relevant supporting documentation, Bruce Power programs meet the requirements of this review task, with the exception of those related to the guidance provided in NUREG-0700.

5.12. Human Information Requirements and Workloads

This review task includes review of programs and processes to ensure human information requirements and human workload are considered in human system interface designs.

Human-machine interfaces, human information needs and workload are addressed in the Human Factors Engineering Program Plan, DPT-PDE-00013 [61], which is supported by various Design Guides associated with specific plant systems (see Section 5.11). The overall approach is based on the U.S. Nuclear Regulatory Commission's NUREG-0711, Human Factors Engineering Program Review Model [70]. Human Factors analysts who support the program are qualified in accordance with reference DPT-PDE-00013 [61].

Changes to human interfaces and workloads require human factors analysis which is called out by the Design Change Package process [63]. Human information needs and workloads are reviewed through task analysis and staffing analysis, by a qualified HF analyst.

As described in Human Factors Engineering Program Plan, DPT-PDE-00013 [61], Task analyses identify the performance demands on personnel and the task requirements for accomplishing functions allocated to them. Appropriate levels of task analysis are applied to design changes in accordance with the complexity and safety significance of the change. This includes analyses that identify the specific tasks needed to accomplish personnel functions, and also the alarms, information, control- and task-support required to complete those duties, roles and responsibilities.

An analysis of staffing examines the organization, number of staff, and the distribution of job responsibilities among staff impacted by the design change (e.g., control room staff, field personnel). Typically staffing review is done through a validation exercise using the current staffing level or proposed staffing levels. It may also be appropriate to perform a workload analysis, at the discretion of the HF Analyst, based on the requirements of a particular project.

Bruce Power programs meet the requirements of this review task.

5.13. Clarity and Achievability of Procedures

This review task includes review of procedure development and validation processes to confirm clarity and achievability of station procedures.

BP-PROC-00166, General Procedure and Process Requirements [40], specifies the requirements for administrative process and procedure document formatting and presentation. It establishes standards, methodology and processes with consideration to industry standards such as the AP-907 series and other INPO program guides, as cited by BP-PROC-00166 [40], to ensure Bruce Power practices reflect a strong commitment to nuclear safety and a consistent approach to procedure quality.

Requirements for Station Operating Procedure Development and Revision, GRP-OPS-00050 [68], and Maintenance Procedure Development and Revision, BP-PROC-00694 [66], establish the requirements for requesting, developing, reviewing, validating, verifying, and approving station operating procedures.

BP-PROC-00250, A Writer's Guide for Station System Procedures [69] specifies the requirements for Station System procedure format and writing methodology. Well written procedures which use consistent structures, styles and language help reduce human error and promote consistent results.

Bruce Power procedures follow the same format and are produced using standard templates. Procedures are structured such that the purpose is clearly stated. Regulatory and management requirements are clearly laid out. Definitions of terms and acronyms are included. Exceptions to the use of the procedures are listed. References and forms associated with the procedure are identified. The procedure states the responsibilities of personnel. A process map is included where applicable to provide an overview of the process described in the procedure.

Validation is a process of exercising procedures performed by a user, prior to initial use, to ensure that they are useable and the language and level of information is appropriate for the individuals for whom they are intended, and that the procedures will function as intended. One or more of the following methods can be used to validate procedures:

- Field Walk Through;
- Mockup/Simulation;
- Table Top;
- Comparison; and
- Cross Discipline.

Additional information on procedures is found in Safety Factor 11, where it states that each Operating Procedure is reviewed, verified and validated before being approved and distributed for use [105].

Based on the review of relevant supporting documentation, Bruce Power programs meet the requirements of this review task.

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 Appendix B.2, addresses Clause 7.21 of REGDOC-2.5.2 which is directly applicable to Human Factors. The results of this assessment have been applied directly to the review tasks of this safety factor.
- “Safety Factor 2: Actual Condition of SSCs” in Section 5.6, discusses the implementation of Bruce Power’s maintenance programs.
- “Safety Factor 5: Deterministic Safety Analysis” in Section 5.7, addresses the methods used for development and validation of emergency operating procedures and the accident management program at the plant. In Section 5.5 of “Safety Factor 5” deterministic safety analysis assumptions regarding credited operator actions is discussed.
- “Safety Factor 6: Probabilistic Safety Analysis” in Section 5.1, reviews the existing probabilistic safety analysis including the representations of operator actions.
- “Safety Factor 10: Organization and Administration” in Section 5.3 addresses arrangements for suitably qualified staff, adequate training facilities and programs (as well as review of policies and processes which foster safety culture in Section 5.4.
- “Safety Factor 11: Procedures” in Appendix B.1, assesses compliance against IAEA SSR-2/2 which assesses management of operational safety including human performance considerations related to procedures.
- “Safety Factor 13: Emergency Planning” in Appendix B.1, addresses adequate staffing for emergency planning.

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.

Self assessments within Bruce Power are conducted in accordance with Bruce Power's Focus Area Self Assessment (FASA) procedure, BP-PROC-00137 [106]. FASAs generate, as an outcome, opportunities for improvements for the Functional Area. The results of the FASAs as well as the suggestions for the opportunities for improvement must be accepted by the Corporate Functional Area Manager (CFAM) before actions can be carried out. The FASAs that were reviewed are:

- SA-HRS-2013-04, Hours of Work [107];
- SA-TRGD-2011-09, Out of Station ERO Complement Qualifications [108]; and
- SA-PDE-2008-02, Human Factors Application for Unit 1 & 2 Restart [109].

The following subsections provide a summary of the findings from the FASAs reviewed.

7.1.1. SA-HRS-2013-04, Hours of Work

The Hours of Work FASA, SA-HRS-2013-04 [107], was conducted to evaluate Bruce Power's compliance with the Hours of Work Procedure, BP-PROC-00005 [54] for 2013. The assessment confirmed that monitoring and reporting is occurring as per the procedure. Analysis of the reports shows a decreased trend in hours of work violations from the beginning of the year to the end of the third quarter, which is consistent with operational activity and outage programs. Bruce A had the greatest number of authorized staff violations over the first and third quarter as compared to Bruce B. This was attributed to minimum staff complement issues and the Zebra Mussels Project, as well as outage program work at Bruce A for both the authorized and non-authorized violations. Conversely, Bruce A had the fewest non-authorized violations compared to Bruce B. Bruce B violations, authorized and non-authorized, can be attributed to the Active Liquid Waste project and outage program work.

Continuing awareness and application of the Limits to Hours of Work procedure, BP-PROC-00005 [54] to manager's training was recommended as an improvement opportunity.

7.1.2. SA-TRGD-2011-09 Out of Station ERO Complement Qualifications

An assessment of the out-of-station Emergency Response Organization (ERO) complement qualifications was performed to determine whether the minimum complement was being met by qualified staff in the Bruce Emergency Services Team (BEST) organization. The findings from the assessment are documented in SA-TRGD-2011-09 [108]. The assessment was conducted against the minimum complement qualifications for the BEST organization, which are defined in the Bruce A Station Complement, DIV-OPA-00001 [29]. The conclusion from the self assessment was that the BEST organization does not fully understand minimum qualifications requirements necessary hold a minimum complement position. The conclusion was supported by the following findings:

- People are being assigned minimum complement positions that are not fully qualified.
- BEST are calling BEST members to work overtime to replace someone who has been assigned a specific ERO minimum complement position without checking to see if the person they are calling actually has the qualification that is needed.
- BEST are hiring Appendix A employees and assigning to them to minimum complement work before they are qualified Emergency Services Maintainers (ESM).

Corrective actions were assigned under an SCR and to date all corrective actions were completed under the SCR with one exception under TCR-4786, which could not be found. TCR-4786 identified an action to perform a Training Needs Analysis to determine what is required for an Appendix A staff to perform complement qualifications for BEST members.

7.1.3. SA-PDE-2008-02, Human Factors Application for Unit 1 & 2 Restart

The objective of this assessment was to confirm that human factors was being appropriately and consistently applied and reviewed, in accordance with the Human Factors Engineering Program Plan for Bruce A Units 1 & 2 Restart Project, DPT-PDE-00013 [61] or industry best practices where appropriate. The findings concluded that Management of Human Factors for the Bruce 1 and 2 Restart project did not meet the requirements as written in the Human Factors Engineering Program Plan (HFEPP) (PMC 6.2.025 Rev 2) [110] governing the treatment of Human Factors within the 1 & 2 Restart project or DPT-PDE-00013 [61] (the Bruce Power HFEPP) which governed the treatment of Human Factors within the restart project prior to the creation of PMC 6.2.025 [110]. Improvement opportunities with respect to access to documentation, tracking of information on restart modifications, as well as consistent close out of HF reviews of the modifications were recommended.

7.2. Internal Audit

The objective of the audit process as stated in BP-PROG-15.01 [111] was 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 was achieved by providing a prescribed method for evaluating established requirements against plant documentation, field conditions and work practices. The process described 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.

Five internal audit reports were identified as being applicable to Safety Factor 12; however, all the audits relate to training. AU-2013-00013 [79] was chosen for review as it provides an

overview of the effectiveness of Bruce Power's training program and was the most recent audit performed.

7.2.1. AU-2013-00013 - Training Program

An internal audit was conducted on the Training Program documentation as summarized in AU-2013-00013. The audit found that the documented processes outlined in Revision R012 of the training program (BP-PROG-02.02-R012 [80], Worker Learning and Qualification) was deemed not fully effective. The program does have well defined and controlled Tier 1, 2 and 3 metrics, which are aligned with oversight activities being undertaken through various committees. The existing governance does not fully capture all of the business requirements and expectations. Processes and procedures which implement the program do not always provide full instruction to staff, including the governance for performance monitoring (Tier 4 metrics and performance indicators). In addition, the audit identified:

- Some examples of procedure non-adherence were observed from the sampling of process data and results of work activities.
- Records were not always prepared and located per the expectations of process governance.
- The Corrective Action process, BP-PROC-00060, Station Condition Record Process, is not always fully and effectively utilized by training staff to identify and resolve problems.

The audit has identified seven adverse conditions related to:

- Training Program Document, specifically BP-PROG-02.02-R012 [80];
- Training Implementing Documents;
- Oversight of Training Program;
- Training Program Adherence;
- Training Records Management;
- Training Program Corrective Action; and
- Training Program Organizational Manuals.

Each adverse condition has an SCR associated with it. All SCRs are in "Release" status. Since the audit report was issued, over 97 percent of the actions identified across multiple SCRs are complete. This also involved a revision of 23 of 30 training process documents. The changes associated with these actions will require time to take effect.

7.2.2. External Audits and Reviews

There are no external audits and reviews applicable to this Safety Factor.

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.

7.3.1. Human Factors in Design Desktop Review

A desktop review of Human Factors activities in Engineering Changes was carried out at Bruce Power from August 12 to 16, 2013 [112].

The objective of the desktop review was to verify that Bruce Power is properly taking into account Human Factors in the design processes of a sample of six selected Engineering Change packages. This desktop review was a follow-up to the actions and recommendations raised in the 2012 Type II Inspection on Human Factors in Design.

The review concluded that Bruce Power generally uses the approved process for taking into account Human Factors in the design process, and the Human factors activities generally followed the DPT-PDE-00013, Human Factors Engineering Program Plan [61]. No regulatory actions have been placed on Bruce Power as a result of this desktop review. However, areas for improving the adherence to procedures were noted.

The findings note there was evidence that the prescribed procedure was not followed to carry out the required HF activities but the concerns were alleviated due to those issues being identified already as a part of two SCRs that were closed by incorporating modifications into revisions of the relevant Bruce Power procedures.

Consequently, DPT-PDE-00013 [61] was revised to include a requirement to enter an item in the issues tracking list of the EC in question to require a completed signed FORM-11221, Human Factors Minor Change Worksheet [113]. Also, the Design Scoping Checklist, FORM-10700 [114] was modified to clarify that the project must ensure Human Factors is a part of stakeholder involvement. Since SCRs were raised by Bruce Power to address the issues, no regulatory action is raised by the CNSC.

7.3.2. Hours of Work Reactive Type II Inspection BRPD-A-2013-002

Bruce A has had an increasing number of hours of work violations since it has returned to four Unit operations it has. CNSC staff recognized that the largest contributing cause to these violations is the shortage of certified staff, particularly Authorized Nuclear Operators (ANOs). Bruce Power is working towards obtaining more certified nuclear operators.

An Hours of Work Reactive Type II Inspection was carried out in light of the recent increasing trend in the number of ANOs hours of work violations at Bruce A, CNSC staff interviewed control room staff on three different shifts at Bruce A, and performed a desktop review. From this inspection CNSC staff concluded that Bruce Power is effectively implementing good practices to mitigate the risk of fatigue, although some small areas of improvement were noted.

The most notable area of improvement was related to the current rest area provided for fatigued certified staff.

Given the correlation between the number of hours of work violations and Bruce Power's challenges in appropriately staffing Authorized Nuclear Operator (ANO) positions on shifts, CNSC staff is concerned that hours of work violations will continue to be a recurring problem impacting workloads and affecting safety over the next several years.

No actions were placed on Bruce Power as a result of the inspection, as the CNSC acknowledges that Bruce Power is taking actions to certify more staff, however there were three recommendations.

Bruce Power provided a response to the recommendations that will result in improved rest facilities, supplemental training based on any deficiencies identified in a review, and improving the traceability of the Fitness for Duty Checklist (FORM-12987 [74]) for auditing purposes while still protecting medical privacy. The responses are documented in NK21-CORR-00531-10495 [115]. The response did not identify a target date for the improved rest facilities and there was no Action Request (AR) associated with this recommendation. Additionally, review of the action requests for the two other recommendations identified that the recommendations are in “Notify” status.

7.3.3. CNSC Type II Compliance Inspection Report: BRPD-A-2013-010 – Emergency Operating Procedures & Minimum Shift Complement Validation

On October 16th, 2013, Bruce Power conducted a site emergency exercise with the purpose of demonstrating field operations of a common mode event using minimum shift complement resources and concurrent procedure use. As part of the compliance and verification program, CNSC staff carried out a Type II inspection to assess compliance of the development and use of the Emergency Operating Procedures and the implementation of the Minimum Shift Complement Validation process at Bruce A from October 16th to 18th, 2013. The inspection is documented in NK21-CORR-00531-11126 [116]. The CNSC identified positive aspects to the exercise that was carried out but also identified some concerns. The concerns resulted in two action notices and six recommendations.

Bruce Power responded to the inspection findings in NK21-CORR-00531-11210 [117] by agreeing to:

- Conduct a review of the process for validating emergency mitigating equipment (EME) procedures and ensure that this process is documented and the validation is auditable;
- Ensure compliance with BP-PLAN-00001 [57];
- Provide copies of EME procedures at each unit desk within the stations;
- Ensure that EME procedures and Emergency Response Procedures (ERPs) are put on required readings with station Emergency Response Organization (ERO) staff. The Emergency Plans Section will follow up with Training to discuss EME procedures being used in station licensed training;
- Determine a more detailed set of performance measures and acceptance criteria in advance of any future validation exercise or emergency exercise; and
- Conduct a review regarding the allocation of staff for this emergency to ensure that the key field actions are completed within the required time.
- These action notices and recommendations, tracked as Action Item 1407-4703, were completed in December 2014. Bruce Power has submitted the completion notes for Action Item 1407-4703 in NK21-CORR-00531-11717 and are currently awaiting CNSC response on acceptance and closure of Action Item 1407-4703.

7.3.4. CNSC Type II Compliance Inspection Report: BRPD-AB-2013-017 - Non-Licensed Operator Training Program at Bruce Power

CNSC staff conducted a Type II inspection of the Certification Training Program for Non-Licensed Operators at Bruce Power from October 28 to 31, 2013 [118]. The purpose of the inspection was to verify compliance with licence requirements in the Bruce A and Bruce B Power Reactor Operating Licences [15] and Canadian Standards Association CSA N286-05 [27]. The inspection identified a number of strengths in the implementation of the Non-Licensed Operator training program, as well as some minor areas for improvement.

Overall, CNSC staff concluded that the current Non-Licensed Operator (NLO) training program follows the Systematic Approach to Training and meets the regulatory requirements of the Bruce A and B Power Reactor Operating Licences [15] and CSA N286-05 [27].

CNSC staff has identified two action notices and six recommendations to be raised as a result of this inspection.

Bruce Power responded to the inspection in NK21-CORR-00531-11094 [119] by agreeing to:

- Review, verify and update, in TIMS database, all the Terminal Learning Objectives related to NLO training such that job performance perspective characteristics are incorporated.
- Working down the backlog of required reviews and revisions to NLO training materials.

These actions are still in progress and are due to be complete in March 2017. Bruce Power has agreed to implement all recommendations as stated.

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.

The following performance indicators related to human factors work are monitored:

- Percentage of Design Change Packages that were screened by a human factors analyst prior to moving to the "approved" stage (the goal is 100%).
- Percentage of Design Change Packages with human factors work completed at the "closed" stage (the goal is 100%).

Key human performance indicators are also monitored to determine human performance program effectiveness in the prevention of events. The key indicators are:

- Human performance event free days;
- Human performance clock resets; and
- Human performance event rate.

Additional performance indicators related to training for security, emergency response organization and emergency and protective services personnel are also monitored.

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 [121], summarizes the 2013 ratings for Canada's NPPs in each of the 14 CNSC Safety and Control Areas (SCA), including human performance management. The human performance management SCA covers personnel training, personnel certification, and work organization and job design. For 2013, the Bruce A rating for the human performance management SCA was "satisfactory".

8. Summary and Conclusions

The overall objective of the Bruce A ISR is to conduct a review of Bruce A against modern codes and standards and international safety expectations and provide input to a practicable set of improvements to be conducted during the Major Component Replacement in Units 3 and 4, and during asset management activities to support ongoing operation of all four units, that will enhance safety to support long term operation. The specific objective of the review of this Safety Factor is to determine the status of the various human factors that may affect the safe operation of the nuclear power plant. This specific objective has been met by the completion of the review tasks specific to the human factor.

No specific strengths were identified specific to the Human Factor.

Table 5 summarizes the key issues arising from the Integrated Safety Review of Safety Factor 12.

Table 5: Key Issues

Issue Number	Gap Description	Source(s)
SF12-1	A review of Bruce Power documentation could not confirm that all operator actions under accident conditions have been assessed and confirmed valid. While it is clear that all credited human actions, as noted in the Bruce A PRA [82] and included in AIMs were validated, it is not clear whether human actions identified in the Safety Report [81] were a part of the credited human actions validated.	Section 5.4
SF12-2	The design of the control room and other workstations relevant to safety does not meet the guidance provided in NUREG-0700.	Section 5.11 Microgaps against guidance clauses: NUREG-0700 – Part 1 NUREG-0700 – Part 2

The overall conclusion is that, with the exception noted in Table 5, Bruce Power's programs meet the requirements of the Safety Factor related to the Human Factor.

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

A.1. CNSC G-276, Human Factors Engineering Program Plan

The procedures for incorporating HF into the design process are in place and meet the CNSC Guideline, G-276. The Human Factors Engineering Program Plan, DPT-PDE-00013 [61], describes the human factors considerations and activities that will be implemented to ensure that the system or licensable activity is designed and evaluated according to established human factors principles and practices. DPT-PDE-00013 as a Human Factors Engineering Program Plan outlines an HF program applicable site-wide that meets the intent of every clause of G-276 as stated in Section 5.1 of DPT-PDE-00013. Furthermore, DPT-PDE-00013 identifies the expectations for the development of an HF plan consistent with G-276 for Bruce Power engineering projects using a graded approach.

A.2. NUREG-0700, Human System Review Guidelines

NUREG-0700, Human System Review Guidelines [120] is used by the U.S. Nuclear Regulatory Commission as guidance for the evaluation of interfaces between plant personnel and plant's systems and components. The review guidelines address the physical and functional characteristics of human-system interfaces (HSIs) and as such are denoted as Human Factors Engineering (HFE) guidelines as opposed to related considerations such as instrumentation and control and structural design. NUREG-0700 can be considered as a guidance tool for the review of the following Safety Factor review item:

The following human–machine interface should also be reviewed:

- Design of the control room and other workstations relevant to safety;

When the units were designed and commissioned over thirty years ago, HFE was in its infancy in Canada and it was not routinely applied in engineering projects. However, Bruce Power was designed with a set of station conventions. These conventions are mainly captured in the following Bruce Power guidelines.

- B-DG-06700-00001, BNGS Human Factors Minor Change Design Guidelines [122]
- B-DG-06700-00003, Human Factors Design Guide: Maintenance, Inspection and Testing [84]

Bruce Power also provides guidelines for the modification and development of computer based interfaces and reactor maintenance tooling that reflect more recent conventions. These guidelines are:

- B-DG-06700-00004, Human Factors Design Guide For Computer Interfaces [123]
- B-DG-06700-00005, Human Factors Design Guide for Manual Reactor Maintenance Tooling [124]

In principle, the guidelines were developed with consideration to modern design guidance for controls and interface while supporting operators in the performance of their tasks in the existing plant. The guidelines incorporate existing station conventions and references applicable national codes. In addition, where appropriate these guidelines refer to international or U.S. guidelines. The early Bruce Power design guidelines did not contain reference sections; as such, NUREG-0700 is not explicitly cited in these documents, but possibly provided guidance in the design. The uses of these guidelines are governed by Bruce Power's site-wide Human Factors program outlined in DPT-PDE-00013 [61], which was prepared with consideration to NUREG-0700. As such these guidelines are applied to engineering changes. DPT-PDE-00013 also encourages the use of NUREG-0700 for guidance where Bruce Power guidelines do not provide guidelines on particular Human System Interface components. B-DG-06700-00005, Human Factors Design Guide for Manual Reactor Maintenance Tooling is the only Bruce Power guideline that references NUREG-0700, specifically. While NUREG-0700 is not referenced, B-DG-06700-00003, Human Factors Design Guide: Maintenance, Inspection and Testing considers best practices in DOE-HDBK-1140-2001, Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance [125], which has overlapping guidance with NUREG-0700. In addition to these guidelines, BP-PROC-00389, Conventional Safety Programs [48] lists a suite of safety manuals that are not specific to HSI design but cover topics such as Industrial Ergonomics, Office Ergonomics, Working in Hot Environments, and Personal Protective Equipment etc.

The scope of this high level review is to ascertain the applicability of the sections of NUREG-0700 to Bruce Power systems, summarize alignment of Bruce Power guidance to NUREG-0700 sections, and subsequently summarize the alignment of applicable Bruce Power systems to NUREG-0700 and establish whether there is a potential gap in guidance.

Part I of NUREG-0700 provides guidelines for the basic HSI elements: information display, user-interface interaction and management and controls. The guidelines associated with basic HSI elements for Bruce A are outlined in:

- B-DG-06700-00001, BNGS Human Factors Minor Change Design Guidelines [122]
- B-DG-06700-00004, Human Factors Design Guide For Computer Interfaces [123]

Bruce Power performed a review of certain sections of NUREG-0700 against specific Bruce Power guidelines and subsequently against Bruce A MCR and SCA panels to determine the extent of alignment to the NUREG-0700 guidance and possible deviations. The scope of the review is provided in B-PLAN-06700-18MAR2010-P and the results of the review are provided in B-REP-06700-00001, Human Factors Review against Modern Safety Standards Human Factors Engineering Summary Report [103].

The review was conducted for B-DG-06700-00001 and DPT-PDE-00033, Bruce 5-8 NGS Human Factors Minor Change Design Guidelines for Cathode Ray Tube (CRT) Displays [126]. DPT-PDE-00033 was used in the absence of specific guidelines for Bruce A. While DPT-PDE-00033 may have been appropriate for Bruce A, the applicability of the guideline to Bruce A is not documented and therefore the extent to which the review covers Bruce A systems is unclear. The review was against over 600 clauses in NUREG-0700, but only represented some sections in Part 1, likely due to the fact that some sections within NUREG-0700 are applicable to technologies not employed within Bruce A.

The results of this review identified that B-DG-06700-00001, is at least 78% compliant with NUREG-0700 clauses reviewed and DPT-PDE-00033 is estimated to be 41% compliant with NUREG-0700. The MCR and SCA interfaces reviewed are approximately between 73% and 80% compliant with NUREG-0700 and MIL-STD 1472F [127]. All deviations were dispositioned in the report and it was noted in the report that many deviations represent known stereotypes that are relevant to Bruce Power or the industry in general, and changes may have the potential of increasing the likelihood for error.

A limitation of the review is that there were no field HSIs reviewed, which means that there was no review done of field HSIs, that are referenced in the Abnormal Incident Manuals (AIMs), against modern guidelines. However, validation exercises were performed to ensure that all credited human actions, as noted in the Bruce A Probabilistic Risk Assessment and included in AIMs, could be completed safely and within the required time, using minimum complement with the HSIs that are in place. This activity is documented in the Bruce Power Abnormal Incident Manual Project Human Factors Engineering Summary Report (HFESR), B-REP-06700-00002 [104].

Part II of NUREG-0700 provides guidelines for reviewing seven systems: alarm system, safety function and parameter monitoring system, group-view display systems, soft control systems, computer-based procedure systems, and computerized operator support systems.

Based on the definition and descriptions of computer-based procedures, group-view display systems, and computerized support systems, there is no evidence that Bruce Power has such systems. NUREG-0700 guidance associated with these systems is not applicable to Bruce Power. The development and guidance associated with paper-based procedures are discussed in Safety Factor 8, Safety Performance.

NUREG-0700 provides guidelines on alarm definition, processing, control and management, response, testing, etc. Bruce A has two separate alarm annunciation systems. The MCR annunciation system consists of window annunciator, two computer-driven CRTs for the presentation of alarm messages (DCC-X and DCC-Y), and a facility of provide a printed record of all alarm conditions [128]. The field annunciation system consists of local annunicators. B-DG-06700-00001 provides some guidance for annunciation with the focus on characteristics of window annunciation and B-DG-06700-00004, Human Factors Design Guide for Computer Interfaces also provides guidance on annunciation, however, this guideline does not apply to the Digital Control Computer (DCC) or the special CRT-based displays in the MCR. While guidance is available for the development of alarm response (BP-PROC-00250), there is currently no Bruce A equivalent guidance to the guidance provided in NK29-DG-29-60300-001, Main Control Room and Field Panel Annunciation to address aspects of DCC alarms [129] . The lack of guidelines would suggest that any changes made to the annunciation system did not have guidelines, which may incorporate modern standards, applied to the changes. In addition, no review of the existing system against a modern guideline has been conducted to date.

As discussed in Safety Factor 1, Plant Design, Bruce A uses the Safety System Monitoring Computers (SSMCs) to present information to aid control room personnel during abnormal and emergency conditions in determining the safety status of the plant. The guidance provided in NUREG-0700 section on Safety Function and Parameter Monitoring System should apply to the SSMCs. The SSMCs were upgraded under Capital Project 34141. The Bruce A SSMC

Replacement Human Factors Engineering Summary Report, which provided input to the replacement, focused analysis on the differences between Bruce A and Bruce B but otherwise relied on the findings in B-REP-66468-0001, Human Factors Engineering Summary Report – Bruce B SSMC System Replacement Data General MP200 [130]. The analysis documented in this report referenced an earlier version of NUREG-0700. Furthermore, at the time, the project could not incorporate the human factors recommendation arising from this program. Despite having done an analysis with input from NUREG-0700, the final upgraded system did not incorporate recommendations that may have contributed to alignment with NUREG-0700 guidelines.

Soft Control Systems are used throughout Bruce A but are differentiated between soft controls that are used in the MCR such as the DCC-X and DCC-Y, Special CRT and SSMC, which have their own conventions as described in the previous sections and Soft Control Systems that are used outside of the MCR for local control and monitoring systems. B-DG-06700-00004, Human Factors Design Guide for Computer Interfaces [123] is the guidance that would be considered for the design of HFE aspects of Soft Control Systems outside of the MCR. B-DG-06700-00004 does not reference NUREG-0700 or any other guidelines so alignment with guidelines, standards, or codes could not be established for the guidance document or for the soft control systems that exist at Bruce Power.

Bruce Power's communication systems consists of a conventional telephone system, a public announcement system, radio system, maintenance and suit telephone system, and computer-based systems (e.g. email, messaging etc.). In addition, an approved design still exists for a pneumatic messenger system. NUREG-0700 does not provide any guidance on pneumatic messenger systems or computer-based systems and therefore is not applicable to these types of communication systems. Radio system modifications are in progress for Bruce A, Bruce B, and Centre of Site for Operations and Emergency Services under EC 62649. The expectation is that since these projects will be completed under BP-PROG-10.02, Engineering Change Control, which will involve Human Factors as a stakeholder. Upgrades to the Maintenance and Suit Communications Systems are also underway (EC 46251). However, this EC was classified as HF 'None'. No modifications are scheduled for the public address system or the conventional telephone system as both systems were installed and continue to be maintained by Bell Telephone [131]. At this point, it cannot be determined whether the existing communication systems align with the intent of applicable NUREG-0700 clauses.

Part III of NUREG-0700 contains guidelines for the review of workstations and workplaces. Currently, with the exception of providing guidance on the placement of display or control components, little guidance is provided on the design of workstations in the available Bruce Power design guidelines. However, DPT-PDE-00013 references NUREG-0700 as a source of information for guidance when Bruce Power guidance is lacking. In accordance with DPT-PDE-00013 [61], the Human Factors Analyst can provide NUREG-0700 guidance where applicable or through the governance in BP-PROC-00389, Conventional Safety Programs [48], use BP-SM-00015, Office Ergonomics [50], which helps to match the office workstation environment to the abilities of the worker. BP-SM-00015 was prepared in consideration of well established provincial guidelines. In general, Bruce Power meets the intent of NUREG-0700 section on Workstation Design.

Workplace Design at Bruce Power is governed by a multitude of documents including national building code and national labour code. Conformance to these codes and standards are governed by BP-PROC-00389 [48]. Specific guidance for work environments applicable to the Bruce A NGS can be found in, but not limited to, the following guidelines and safety manuals:

- B-DG-06700-00003, Human Factors Design Guide: Maintenance, Inspection and Testing [84]
- BP-SM-00063, Workplace Signs [132]
- BP-SM-00043, Working In Hot Environments [51]
- BP-SM-00039, Noise Measurement, Control and Hearing Conservation [133]
- BP-SM-00071, Industrial Lighting Requirements [134]

In general, Bruce Power meets the intent of the NUREG-0700 section on Workplace Design.

Part IV of NUREG-0700 has only one section. The section on Maintainability of Digital Systems covers guidance that is meant to improve maintenance personnel's ability to inspect, test, and service units of equipment, modules, components and parts. Important characteristics for maintenance personnel include instrument cabinets and racks, equipment packaging, fuses and circuit breakers, labeling and marking, adjustment controls, test points, and service points. Guidance for the Maintainability of Digital Systems can be found in:

- B-DG-06700-00003, Human Factors Design Guide: Maintenance, Inspection and Testing
- B-DG-06700-00005, Human Factors Design Guide for Manual Reactor Maintenance Tooling

B-DG-06700-00005 directly references NUREG-0700 and other guidance documents and B-DG-06700-00003 covers the majority of the topics in this NUREG-0700 Section. In general, Bruce Power meets the intent of the NUREG-0700 section on Maintainability of Digital Systems.

While this high level review illustrated that Bruce Power meets the intent of some aspects of NUREG-0700, there were a number of issues that could not be resolved with the information that was reviewed. These are reflected in the gaps presented in Table A1. All the gaps described in Table A1 are categorized as gaps in guidance.

Table A1: Gaps against NUREG-0700

NUREG-0700 Section	Gap Description
Part 1 Section 1 – Information Display Section 2 – User Interaction Management Section 3 – Controls	No guidelines identified for CRT based displays for Bruce A, even though such technologies are in use for the display of information. Therefore, it is not clear for engineering changes that are applied to such systems, what guidelines are to be used and the extent which the review conducted against NUREG-0700 applies to Bruce A. This gap also applies to Part 2, Soft Control Systems.
	Field components, particularly those that would be referenced in emergency procedures (i.e. AIMS), were not reviewed against NUREG-0700 or any modern standards or guidelines.
Part 2, Alarm Systems	Lack of design guidance for Bruce A annunciation systems.
	It is not clear whether the existing alarm system aligns with the intent of NUREG-0700 or other modern standards or guidelines.
Part 2, Safety Function and Parameter Monitoring System	Final upgraded SSMC system did not incorporate recommendations that may have contributed to alignment with NUREG-0700 guidelines.
Part 2, Soft Control Systems	B-DG-06700-00004, Human Factors Design Guide for Computer Interfaces does not reference NUREG-0700, nor does it reference any other guideline, standard, or code.
	As a result of B-DG-06700-00004, Human Factors Design Guide for Computer Interfaces not referencing any guideline, standard, or code for source of the guidance, it could not be established whether soft control systems are reviewed against NUREG-0700 or any other modern guideline or standard.
Part 2, Communication Systems	It is not clear whether the existing communication system aligns with the intent of applicable NUREG-0700 clauses or other modern standards or guidelines.

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

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

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

B.1. CNSC REGDOC-2.2.2, Personnel Training

In support of the review tasks listed in Section 5, a detailed assessment of REGDOC-2.2.2 has been performed in Table B1.

Table B1: CNSC REGDOC-2.2.2, Personnel Training

Article No.	Clause Requirement	Assessment	Compliance Category
2.	The training system developed and implemented by each licensee shall adhere to the following two fundamental principles: 1. Performance-oriented: Training is preparation for performance on the job. All instruction that is subject to this regulatory document shall focus on essential knowledge, skills and safety-related attributes required to meet job requirements and nuclear-safety-specific needs throughout the lifecycle of the facility. 2. Systematically developed: Training shall be defined, produced and maintained through an iterative and interactive series of steps, leading from the identification of a training requirement to the confirmation that the requirement has been satisfied.	The Worker Learning and Qualification program (BP-PROG-02.02) satisfies the worker qualification and worker training requirements of applicable Bruce Power Licenses and governing acts, codes and standards as referenced in BP-MSM-1 Sheet 0003, MSM - List of Applicable Governing Acts, Codes & Standards - Sheet 0003, commensurate with Bruce Power's business needs including commitments made in Bruce Power's Power Reactor Operating Licence (PROL) application and requirements included in the Bruce A Power Reactor Operating Licence (PROL 15.00/2015]. As described in BP-PROG-02.02, training programs based on the work performed by personnel shall be systematically developed and implemented so that the required competency is achieved and maintained. Any prerequisite education, experience, and training shall be identified. All training processes and content should comply with the training performance objectives and criteria (TPO&C) as stated in handbook B-HBK-09500-00003. BP-PROG-02.02 states that the procedures and job aids required to implement the Worker Learning and Qualification program shall allow the training elements that support Worker Qualifications, to be created, managed, and conducted using a Systematic Approach to Training (SAT) implemented. The Bruce Power training processes shall follow a Systematic Approach to Training to meet the requirements of B-HBK-09500-00003 R000, Training Performance Objectives and Criteria. Specific SAT requirements that allow this are documented in implementing procedures and handbooks. The	C

Article No.	Clause Requirement	Assessment	Compliance Category
		SAT methodology developed by Bruce Power satisfies the requirements for an iterative and interactive approach to the design of training. This is further illustrated in the assessment of other clauses in this regulatory document.	
3.	Licensees shall ensure workers who carry on licensed activities are qualified to do the work assigned to them through the use of a training system to systematically analyze, design, develop, implement, evaluate, document and manage new training and the revision of existing training, including continuing training. It shall be used whether the training is defined, designed, developed, implemented, evaluated, recorded and managed internally by licensees or externally through vendors or contractors. Requirements included in this section are to be applied in a manner that is commensurate with risk. All requirements shall apply but the associated training-related processes and procedures may vary depending upon the safety significance and complexity of the work being performed. In considering safety, factors to be examined include the relative importance to safeguards and security; the magnitude of any hazard involved; the lifecycle stage of the facility; the type of facility or licensed activity; the particular characteristics of the facility or licensed activity (e.g., remote location, densely populated areas with easy access to qualified workers); and any other relevant factors. This regulatory document will serve as a performance-based guideline for licensees holding Class II Nuclear Facilities and Prescribed Equipment licences or Nuclear Substances and Radiation Devices licences. Licensees shall: 1. identify all performance requirements of a job or duty area	In accordance with this clause and CNSC RD-204, Certification of Person working at Nuclear Power Plants, Bruce Power ensures that workers who carry out licensed activities are qualified to do the work assigned to them through the implementation of the training program outlined in BP-PROG-02.02, Worker Learning and Qualification. Certified personnel have the responsibility for the supervision of workers carrying out licensed activities. Training activities associated with certification have an independent stream of relevant procedures that govern the design, development, evaluation and management of personnel who are certified. The numbered items are addressed as follows: 1. Bruce Power identifies performance requirements of a job duty or area relating to a licensed activity by conducting job analyses as described in BP-PROC-00203, Training - Preparing a Job Analysis and BP-PROC-00510, Certification Training - Job Analysis for Certification Training Programs. Initial training and continuing training objectives are outlined in BP-PROG-02.02. 2. Defining general worker training, initial job training, and continuing training requirements for workers is one of the primary objectives of the training program as outlined in BP-PROG-02.02, Worker Learning and Qualification. The task analyses procedure that outlines the process for determining these training requirements are described in BP-PROC-00204, Training - Prepare a Task Analysis and BP-PROC-00511, Certification Training - Task Analysis for Certification Training Programs.	C

Article No.	Clause Requirement	Assessment	Compliance Category
	relating to licensed activities by conducting a job analysis to determine all of the tasks involved 2. define and document the necessary general worker training, initial job training and continuing training requirements for workers, based on a task analysis of the knowledge, and skills required to perform each task and the safety-related attributes required to perform their duties 3. ensure that appropriate training is designed, developed and implemented to meet the qualification requirements 4. ensure that trainers meet and maintain documented qualification requirements, particularly in the areas of subject matter expertise and instructional skills 5. ensure that formal evaluations are used to confirm and document that all trained workers are qualified to perform their duties 6. implement a training change-management process that will systematically analyze procedural and equipment changes, changes in job descriptions, and operating experience feedback (including facility and industry-wide events), in order to identify changes to the tasks and task lists and to assess potential training implications leading to training modifications 7. ensure continuing training is provided to workers as deemed necessary through the job and task analyses processes, and that it includes updates to training programs stemming from the change-	3. Bruce Power has a number of design and development procedures that are elaborated on in the assessments against guidance clauses that are specific to these activities (see clause assessments for section 5.2 and 5.3). 4. Trainers have training programs that were developed using the systematic approach to training that is implemented for all jobs at Bruce Power. Trainer qualifications are defined in the Training Qualification Document (TQD). Specifically TQD-00039, Trainers, Certification Instructors, and Certification Examiners Training and Qualification Description. This TQD has objectives, job analysis, and needs analysis associated with them. 5. Bruce Power has a suite of Trainee Evaluation procedures that encompass a variety of evaluation methods that are elaborated in the assessments against guidance clauses that are specific to the evaluation activities (see clause assessment for section 5.5). 6. Bruce Power's process for training change control is described in BP-PROC-00209, Training - Administer Training Change Control. 7. Continuing training is administered through BP-PROC-00653, Training - Administer Continuing Training. Each job family training qualification description identifies the continuing training that is needed. Any changes to continuing training is identified through training effectiveness evaluation and implemented through the training change control process described in BP-PROC-00209. 8. The process for training effectiveness evaluation is outlined in BP-PROC-00213, Training - Administer Training Evaluation.	

Article No.	Clause Requirement	Assessment	Compliance Category
	management process as identified through the training needs analysis process 8. evaluate training regularly and incorporate the results of the evaluations into a training improvement process 9. ensure that workers' records in support of training and qualifications are established and maintained 10. ensure that workers have a level of training related to nuclear safety corresponding to the duties of their position and employment, including but not limited to radiation safety, fire safety, onsite emergency arrangements, and conventional health and safety	9. Workers records are maintained through Bruce Power's Training Information Management System as described in detail in another clause assessment (see clause assessment for section 4.0). 10. The level of training required related to nuclear safety is determined through analyses as described in earlier statements of this assessment (see also clause assessments for section 5.1).	
4.	Licensees shall develop and manage documentation related to all phases of their training including analysis, design, development, implementation and evaluation. Licensees shall maintain records on the training and qualifications of all workers. These records shall be managed and controlled, and may be requested by CNSC staff at any time. Additionally, workers' supervisors and managers shall have immediate, unencumbered and readily available access to the workers' qualification records related to work being assigned or performed. The training record for each worker, including temporary workers and contractors, shall include all qualifications and certifications granted by or relied on by the licensee to fulfill requirements of this document and that are related to the duties of the worker at that facility. Records shall include expiration dates for time-sensitive qualifications and certifications, and all requalification or recertification requirements.	Bruce Power manages documentation related to all phases of their training through a number of document databases as well as other mechanisms. There is no single document that describes how all analyses, design, development, implementation and evaluation is conducted but instructions regarding documentation are embedded throughout training procedures. Training documentation for all phases of training including analysis, design, and development can be found through the following mechanisms (this list is not exhaustive): • All controlled training documents must follow BP-PROC-00068, Controlled Document Life Cycle Management and as such will be filed in accordance with this procedure. The exception being that migration of documents from BATMAN database into Controlled Documents is on-going. • The Training Data Management (TDM) database provides document number assignments (i.e. For Training Needs	C

Article No.	Clause Requirement	Assessment	Compliance Category
		Analysis (TNA), job analyses, and task analyses), and analyses templates. • Completed TNA documents are filed in accordance with RRA 00403, Training Needs Analyses and Request for Performance Analysis Services and Training (REPAST) Documents as described in BP-PROC-00175, Prepare a Training Needs Analysis or Repast Document. • Certification Training maintains its Job and Task Analyses in the Bruce Authorization Training Management (BATMAN) database • Certification Training Records are filed and retained in accordance with BP-PROC-00574, Certification Training - Filing and Retention of Certification Training Records. • Data used to define qualification structure is entered into the Training Information Management System (TIMS) and documented in a Training Qualification Description (TQD). The Training Information Management System (TIMS) is a corporate wide application that provides the training and qualification status of all personnel who operate, maintain and provide technical support services for the safe and efficient operation of the power generating stations. Line Management, and the Training Support and Services Division (TSSD) use the application and associated reporting mechanisms to maintain training programs, employee qualifications, training plans, capability profiles and training schedules. BP-PROC-00214, Training - Administer TIMS, outlines how access to the TIMS database is established and how information in the TIMS is	

Article No.	Clause Requirement	Assessment	Compliance Category
		managed. The following is a summary of the records that are available to all staff that have access to TIMS through the Bruce Power Intranet including temporary workers and the workers' supervisors: Qualification Registers: Returns Employee qualification information in one of two report formats, either by all the qualifications an employee is linked to or by qualification(s) and all the employees linked to that qualification. The register also provides information regarding the Employee Qualification Status as well as the expiration date for qualification. Qualification Matrix: Returns a list of all qualifications that a supervisor's employees are linked to, for which location, and their qualification status. Employee Credits: Returns a list of employee credits in one of two formats, either a list of all employees whom have a credit in a specific PEL or a list of all the PELS an Employee has. The credits are linked to specific qualifications. Required and Planned Training: This report enables the users to see any required or upcoming training. If a Program Element (PEL) has a requalification period it will show the expiry date.	
5.	The systematic approach to training (SAT) is a proven and highly successful education and training methodology, which licensees may adopt to meet the requirements in section 3.0 of this regulatory document. SAT is also widely known as the instructional systems design model (ISDM) or analysis, design, development, implementation and evaluation (ADDIE) model.	The statements in this clause are informational. There are no guidelines or requirements identified in this clause.	NA

Article No.	Clause Requirement	Assessment	Compliance Category
	A SAT-based training system provides interdependent functions consisting of analysis, design, development, implementation and evaluation. This cyclic process (see figure 1) allows training to be systematically analyzed, defined, designed, developed, implemented, evaluated, documented and managed – in order to not only meet operational and organizational requirements, but also to react quickly to changes in those requirements. Figure 1: Overview of a systematic approach to training		
5.1	The analysis phase is the foundation of any training course or training program and includes inputs from operational staff, end-users, subject-matter experts and training development experts. Its purpose is to specify the required outcome of the training in terms of essential on-the-job performance as defined by role documents, procedures or written instructions. The analysis should consider the following points: • rationale and purpose of training • scope of the training • target audience • training method • location of the training • timeframe for completion of the training The fundamental processes of the analysis phase are briefly described in the following paragraphs.	The description of consideration points for analyses are provided in the assessments for the various clauses. - Rationale, purpose, and scope of training as well as target audience (see clause 5.1.1, 5.1.2, and 5.1.4) - Training method (see 5.2.2, 5.2.3, 5.2.4, and 5.2.5) - Timeframe for completion of training (see 5.1.4) - Training location may be dictated by the requirements for training, especially considerations for the use of simulators and/or on-the-job training (see clause 5.2.1)	C
5.1.1	A training needs analysis (TNA) is often triggered by a performance gap or deficiency that has identified training as the solution. A TNA	Bruce Power prepares training needs analyses using BP-PROC-00175, Training - Prepare a Training Needs Analysis or REPAST	C

Article No.	Clause Requirement	Assessment	Compliance Category
	can be used to systematically assess job performance requirements against existing performance (gap analysis) and identify specific areas that require training. A TNA may also be used to assess skills and knowledge gaps created by engineering design and equipment changes, operational changes, revised procedures, and modifications to regulatory requirements.	Document. The TNA is used to support Training Change Requests (TCR) of all natures. A TNA shall be used if Line and Training Management are uncertain whether training is an appropriate intervention, or what specific intervention is appropriate. Guidance for the preparation and content in TNA is provided in Appendix C of the procedure. TNA shall be performed for any TCR associated with: - Any request for a change to a Cross-Functional Training Program or element. - Any significant intent change to an existing training program driven by any reason (e.g., plant design, business process or procedural changes that may pose a significant business risk or significantly impact worker task performance). - A worker performance deficiency that poses a significant business risk or has caused a significant business loss to Bruce Power. - Regulatory required training needs analysis.	
5.1.2	To identify all performance requirements of a job or duty area, a job analysis should be conducted to determine all of the tasks involved with all states of the nuclear facility, including normal operations, accident conditions and emergencies. The end result of a job analysis is a list of tasks that should be completed to perform the job correctly. Task difficulty, importance and frequency are considered to determine which tasks need to be part of training and to determine the initial and continuing training content. A task analysis is conducted to determine the method of task performance and associated knowledge, skills and safety-related attributes. While the	Bruce Power prepares job analyses using BP-PROC-00203, Training - Preparing a Job Analyses and BP-PROC-00510, Certification Training - Job Analysis for Certification Training Programs. The job analyses procedures outline a procedure, which includes guidance on collecting and recording job information, defining the scope, defining the analysis team, and considerations and activities for developing the task list.	C

Article No.	Clause Requirement	Assessment	Compliance Category
	knowledge and skills should be determined for each task, safety-related attributes need not be developed for each task but can be developed collectively and documented for a job or duty area.	Once a validated task list is generated, the task list is rated by at least two job incumbents as to the difficulty, importance, and frequency of each task using criteria identified in an appendix of the procedures. The task analyses procedures that outlines the process for determining these training requirements are described in BP-PROC-00204, Training - Prepare a Task Analysis and BP-PROC-00511, Certification Training - Task Analysis for Certification Training Programs. The task analyses procedures outlines the process for identifying the task details as well as the knowledge and skills required to perform the task. Duty areas associated with the task are also identified. Safety related attributes are collectively identified for a Training and Qualification Description (TQD). TQDs are the governing documents that provide an overview of the qualifications and training for a particular Bruce Power work group.	
5.1.3	Terminal learning objectives (TLOs) are statements of the tasks that the workers must be able to demonstrate after completing the training. TLOs should be measurable and define exactly when, what and how well the trainee must be capable of performing on the job upon completion of the training. A terminal learning objective should include the following: • Performance statement: states the task to be performed • Condition statement: describes conditions under which the performance must be completed • Standards: state the measurable criteria that describe how well the performance should be completed	Bruce Power has BP-PROC-00206, Preparing Learning Objectives, which is what is used to prepare TERMINAL objectives and ENABLING objectives. Terminal objectives are defined as a statement describing the trainee's expected performance on a specific task upon completion of training. A terminal objective shall contain at least one job-related condition, action, and standard. B-PROC-00206 is currently being revised to include guidance on writing objectives such that measurability and completion are included as criteria for a standard. The revision is scheduled to be completed by the end of June 2015.	C

Article No.	Clause Requirement	Assessment	Compliance Category
5.1.4	A target audience analysis determines the numbers and categories of workers to be trained and, where possible, the characteristics of the individuals who will receive the training (e.g., current job experience and prior background, experience, education and training). This information ensures that the training is designed, developed and implemented at the correct level, and assists with determining any necessary training prerequisites, including the minimum entry level education and training.	Bruce Power training program does not explicitly describe a target audience analysis, however, it does outline a process with respect to developing Training and Qualification Descriptions. This process is outlined in BP-PROC-00216, Prepare a Training and Qualification Description. The procedure outlines the expectations associated with the development of TQDs. The TQD content requirements relevant to this clause include providing the entry level criteria, the roles and accountabilities associated with the training program for the TQD, the various levels of qualifications necessary, list of qualifications, suggested schedule for completion of qualifications and a list of positions (job documents and assignments) of the employees who are required to be linked to each qualification. TQDs identify all specific qualifications and cross functional qualifications that are required. Employees with the appropriate occupation codes are linked to the required selection of qualifications from the TQD to perform their function by their line supervision. Linking employees to required qualifications generates the training demand. Additionally, BP-PROG-02 states that line managers are responsible for developing capability profiles to meet business objectives. Capability profiles define the minimum number of qualifications required by a gang or responsibility centre to accomplish its normal work program over the course of a year.	IC
5.2	The design phase should include the selection and description of the training and an environment that will enable the trainees to achieve the TLOs determined in the analysis phase. The design phase starts with the results of the analysis phase and ends with a plan for the development of the training. The design phase takes the output from the analysis phase and specifies how the information will be presented and how the knowledge, skills and safety-related attributes will be tested.	Bruce Power's design and development processes are governed by separate procedures applicable to non-certification training and procedures associated with certification training. With respect to the relationship between the analysis phase and the design phase, there is an explicit relationship identified in BP-PROC-00512, Certification Training – Training Design for Certification Training Programs.	C

Article No.	Clause Requirement	Assessment	Compliance Category
	The fundamental processes of the design phase are briefly described in the following paragraphs.	Task statements are produced as one of the outputs of job and task analyses. The task statement from the approved Job and Task Analyses shall be considered equivalent to a Terminal Learning Objective (TLO). The task statement implicitly contains all of the requirements of a TLO. The job-related condition(s) are embedded in the procedure (s), action(s) are embedded in the task statement which is linked to the task performance, and the standard(s) for performance which are governed by GRP-OPS-00038, Bruce A and B Operations Standards and Expectations. In BP-PROC-00216, Prepare a Training and Qualification Description, Section 4.2 describes the contents of a TQD. This section outlines the need to list all job analyses associated with the TQD with the intent to state which qualifications address which tasks in the job analyses. The qualifications taken from the analyses are used to populate Section 5.0 of the TQD and a training program overview is developed.	
5.2.1	As a result of the analysis phase, the target audience should have been broadly defined. During this phase, the trainee characteristics should be further described in terms of their entry-level knowledge, skills and safety-related attributes, and those characteristics likely to affect their responses to particular instructional activities. Information obtained in this process will guide subsequent decisions such as those regarding appropriate instructional sequences, methods and media, and help tailor the training to trainees' needs and learning characteristics.	Within Bruce Power, the audience is defined through the development of the Training Qualification Descriptions (TQD) with input from the job and task analyses. The TQD provides information with respect to entry level criteria, skills and training required by Bruce Power personnel to perform assigned tasks identified in a specific TQD independently. The TQD also identifies the training program structure and outlines the program elements (i.e. Course, exam, field checkout, job performance measure, administrative requirements and entry level requirements) required for each qualification. BP-PROC-00512, Certification Training - Training Design for Certification Training Programs outlines the design process for certification training programs.	C

Article No.	Clause Requirement	Assessment	Compliance Category
		An output of the analysis phase includes a validated task list. During the design phase, a key activity outlined in BP-PROC-00512 is selecting the task training relevant to each task in the validated task list. Experienced training and operations SMEs will analyze the task list and determine the most appropriate training setting and required level of training performance for each task. Training settings for certified candidate training are selected both at the Terminal Learning Objective (TLO) task level and at the knowledge Enabling Learning Objective (ELO) level. The selections of task training settings and of task minimum training performance will be recorded in the task-to-training matrix (started during the job analysis phase of Systematic Approach to Training [SAT]). Tasks from the list can be assigned ratings that will determine whether there will be simulator training and/or On-the-Job training. In addition, all tasks will be assigned training modules to meeting knowledge objectives. The modules typically consist of candidate materials, classroom instructor materials, and simulator instructor materials. A task assignment to a module means that the preponderance of the knowledge required to perform the task is covered in that module. The process identified in BP-PROC-00512 also outlines activities associated with: - designing a means for documenting performance during training implementation (i.e. Designing qualification cards), - developing, approving, and distributing training objectives (this entails mapping tasks and objectives to modules), - grouping and sequencing the modules based on learning objectives, and - specifying performance evaluations	
5.2.2	The instructional program design determines the knowledge, skills and safety-related attributes required to perform a task. These	Bruce Power has BP-PROC-00206, Preparing Learning Objectives, which is what is used to prepare TERMINAL objectives and	C

Article No.	Clause Requirement	Assessment	Compliance Category
	knowledge, skills and safety-related attributes lead to enabling objectives (EOs), which document the knowledge, skills and safety-related attributes. These EOs are then grouped and sequenced into the order most suitable for learning.	ENABLING objectives. Enabling objectives, according to this procedure, may contain conditions, actions, and standards as appropriate to communicate the performance expectation. The process for grouping and sequencing the objectives order most suitable for learning for certification training programs is described in BP-PROC-00512.	
5.2.3	EOs are the principal units of learning and constitute a major step towards achieving the associated TLOs. As sub-components of TLOs, EOs represent manageable units of work: units that are coherent in terms of logic, learning of work, and that have a suitable scope and are appropriate for testing learning progress. Like a TLO, an EO is composed of three essential parts: • Performance statement: an observable action normally stated as one action associated with a single verb. If the action is complicated or if more than one verb is used, then the EO needs to be broken down further into other EOs with simple actions. • Conditions statement: a description of the setting or conditions under which the task is to be performed. Ideally, the conditions should mirror those in the workplace where the operation is performed. • Standard: one or more measurable criterion stating the level of acceptable performance of the task in terms of quantity, quality or time limitations. It should answer questions such as “How many?”, “How fast?” or “How well?”	Bruce Power has BP-PROC-00206, Preparing Learning Objectives, which is what is used to prepare TERMINAL objectives and ENABLING objectives. The procedure outlines the requirements for both types of objectives to have the three essential parts stated within the objectives. Although, for all intents and purposes, terminal objectives are defined through task statements generated from task analyses as described in BP-PROC-00512, Certification Training – Training Design for Certification Training Programs.	C
5.2.4	A learning assessment plan describes the use of formal evaluations within the qualification program. The learning assessment plan determines how progress towards, and achievement of, the required performance is checked and verified. While an assessment should be based upon the performance defined in the TLOs or EOs, limiting factors (such as time) may not permit direct observation of the full	Bruce Power’s training program does not seem to explicitly call for learning assessment plans in the training design procedures reviewed. However, BP-PROC-00512, Certification Training – Training Design for Certification Training Programs outlines an activity to specify performance evaluations, which satisfies the intent of a learning assessment plan.	IC

Article No.	Clause Requirement	Assessment	Compliance Category
	range of desired performance. The assessment plan describes how a valid and reliable sample of trainee performance will be measured and evaluated.	Task performance for certification training programs at the "individual perform" level is evaluated using performance evaluations. Performance evaluations for certification training programs are implemented using the following processes: Comprehensive Test Scenarios (CTSs): This type of performance evaluation is used to evaluate trainee performance during simulator progress tests and milestone examinations. These documents are dynamic scenarios consisting of integrated sequences of malfunctions that simulate a succession of abnormal plant conditions, failures or upsets, and that require the candidate to demonstrate the generic abilities, including directing the station response team. These evaluations will be used during the simulator skills phase of certification training. Refer to BP-PROC-00569, Certification Training - Development and Administration of Comprehensive Simulator-Based Examinations for Initial Certification Training Programs, as a guideline to develop a CTS. Performance Evaluations (PEs): This form of evaluation is used to evaluate trainee competence in simulator and on-the-job training settings. For non-certification training, BP-PROC-00207, Prepare a Job Performance Measure (JPM) describes the process for developing job performance measures that identifies: - Terminal Objectives. - Training Session Directions. - Evaluation Session Directions.	

Article No.	Clause Requirement	Assessment	Compliance Category
		The JPM document may contain a separate section for a Pre-Task Knowledge Assessment for the training session. Enabling objectives shall be identified if a Pre-Task Knowledge Assessment is used. The JPM document may contain a separate section for a Post-Task Knowledge Assessment for the evaluation session. Enabling objectives shall be identified if a Post-Task Knowledge Assessment is used. Need SME Input: Are the TQDs more appropriate "backbone" for lesson assessment plan?	
5.2.5	The instructional strategy is the combination of media, methods and environment used in the delivery of training. The advantages and disadvantages of each instructional strategy, as applied to the TLOs and EOs, should be examined to ensure that the most effective solution is selected to produce graduates capable of performing tasks as indicated in the TLOs.	Bruce Power is in the process of developing a training qualification and program design procedure. As an interim measure B-HBK-09500-00009, Training – Qualification Design, was recently issued. A project is underway to develop and issue a procedure to replace the handbook. BP-PROC-01001, Training – Training Design, has been reserved, procedure to be issued before the end of 2015. Considerations for instructional strategy will be included in the development of this procedure.	C
5.2.6	On-the-job training (OJT) requirements should be considered when one or more of the TLOs may not be suitable for traditional instructional methods. If OJT is necessary, then OJT learning objectives, complete with performance statements, conditions and standards, should be produced. Subsequently, each OJT learning objective should be formally assessed using on-the-job evaluation.	BP-PROC-00512, Certification Training – Training Design for Certification Training Programs identifies the process for determining when On-the-Job training may be suitable for certification training. Often On-the-Job training is not done without equivalent simulator training.	C

Article No.	Clause Requirement	Assessment	Compliance Category
		Bruce Power implements On-the-Job training through BP-PROC-00211, Administer On-the-Job Training (OJT) and On-the-Job Evaluation (OJE) and through BP-PROC-00207, Training – Prepare a Job Performance Measure.	
5.2.7	The training development plan documents the decisions made during the design phase. Outcomes and decisions regarding items covered in sections 5.2.1 through 5.2.6 should be documented and used during the development phase.	BP-PROC-00512, Certification Training - Training Design for Certification Training Programs identifies that a training development plan will be produced as a part of the design phase. Training development plans for each facility and position-specific training program are developed. As a minimum, the development plan will include the grouped and sequenced module design documents as well as a simple milestone bar chart (e.g., Gantt chart) to indicate major development activities. The development plan will be reviewed on a regular basis with the Certification Training Section Managers and the Training Program Review Committee Chair to ensure program requirements are met.	C
5.3	The development phase involves the procurement or production of effective instructional materials in accordance with the training development plan. The fundamental processes of the development phase are briefly described in the following paragraphs.	This clause is informational only.	NA
5.3.1	Instructional materials should support the learning activities. Such items include instructor lesson plans, interactive courseware such as computer-based training and training aids of all types including equipment, references, job aids and testing materials. The instructional materials should include the following, where necessary: • Trainee manuals: These are reference handbooks to be	Bruce Power's process for the development of instructional materials are contained in the following procedures, which meet the expectations of the clause: - BP-PROC-00208, Training - Prepare Lesson Plans, Course Material, and Training Aids - BP-PROC-00201, Training - Prepare Questions & Answer Banks, Test Sample Plans, Test Plan Plans	C

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	used and often retained by the trainees. • Instructor guides: These are instructional specifications for use by the instructor during training preparation and delivery. They outline the specific training steps that must be used to satisfy the training development plan. • Handouts: These additional aids can supplement the trainee manuals in areas identified as difficult and/or particularly important. • Computer-based training or other media: These are to be used where they are the recommended solution based on the instructional analysis and the selection of the instructional strategy. • Question banks and some sample tests: When used during the training, these should include guidance on where and when they should be used.	- BP-PROC-0752, Training - Prepare and Administer Computer Based Training - BP-PROC-00513, Certification Training - Training Development for Certification Training Program - BP-PROC-00566, Certification Training - Standards and Methodology for Certification Training Progress Tests - BP-PROC-00568, Certification Training - Development and Administration of Comprehensive Written and Oral Examinations - BP-PROC-00569, Certification Training - Development and Administration of Simulator Based Examinations for Initial Certification Training Programs	
5.3.2	Assessment tests, which address the requirement for formal evaluation, cover both progress and final testing. In general, there are two types and both should be developed. Knowledge or cognitive assessments: Usually written, these tests can include multiple choice, multiple response, dichotomous or binary (e.g., yes/no; true/false), matching, resequencing, and open-ended questions. Performance or skill-based assessments: These are practical tests based on realistic scenarios of the most important and significant skills and safety-related attributes derived from the TLOs and EOs.	This clause is informational and it is clear from the assessment of previous clauses and the references to procedures in those clauses that Bruce Power develops knowledge-based assessments as well as performance or skill-based assessments.	C
5.3.3	To assess the effectiveness of the training and related materials, these materials should be reviewed by subject-matter experts, tested with individuals who are representative of the target training audience, and approved by the appropriate managers. The training and instructional materials should be revised according to the	Bruce Power provides governance for Pilot Deliveries. A Pilot Delivery, as described in BP-PROC-00208, is a trial or dry run of a course. Usually it is used to evaluate the adequacy of new or revised lesson plans, course materials and / or training aids.	C

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	findings of the trials.	BP-PROC-00208 provides guidance with respect to pilot deliveries as follows: "The Training Manager may approve a Lesson Plan and training material for specific deliveries, such as pilot deliveries, by writing the specific approval time period on the cover page(s). Pilot deliveries are conducted at the discretion of the Training Manager. Subject Matter Experts (SME) as required to perform "Technical Quality" reviews (FORM-11279). Training - Lesson Plan Training Quality Review Check Sheet." Pilot deliveries are also identified in BP-PROC-00513. BP-PROC-00513 states that "...effectiveness of the developed training materials should be tested in pilot training deliveries using a typical Instructor and group of students for whom it is intended and the material revised based on the evaluation feedback. If the training program schedules do not allow for this small group evaluation, then the first implementation of the developed materials should be closely monitored and evaluated for areas for improvement. The training materials shall then be revised based on the evaluation feedback."	
5.4	The implementation phase is to enable the trainees to successfully perform the tasks to the standards defined in the TLOs. This phase encompasses both the instructor preparation phase as well as the actual delivery of the training. It should include: • lesson plans based on the training development plan and the instructor guides prepared during the development phase	Bruce Power governance associated with the implementation phase is encompassed in over 20 procedures listed on Bruce Power's intranet. Procedures can be found for certification training and non-certification training implementation that cover initial training, continuing training, and remedial training. Only procedures that address the bulleted items in the clause are identified here: - The development of lesson plans is addressed by BP-PROC-00208, Prepare Lesson Plans, Course Material, and Training Aids. - Set up of the training environment is covered through the	C

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	• set-up of the training environment • continual monitoring to ensure that learning is taking place • arrangements for follow-on training, where necessary	implementation of BP-PROC-00212, Administer Training Delivery - Learning Governance Committee has a mandate to continually monitor that learning is taken place in accordance with government regulations and Bruce Power policy. This is outlined in the B-HBK-09500-00002, Learning Governance Oversight Committees Handbook. - Follow-on training in the form of continuing training and remedial training is outlined in: - BP-PROC-00568, Administer Continuing Training - BP-PROC-00572, Remedial Training for Certification Training Program - BP-PROC-00576, Conduct of Continuing Training Re-Certification Training	
5.5	The evaluation phase involves the assessment of the effectiveness and efficiency of the training as delivered and verification of whether the trainees have mastered the TLOs and acquired the competence needed to perform the job safely. The evaluation phase includes the following: • Formal trainee evaluation: The trainees' abilities to perform the tasks, as defined in the TLOs, should be measured through tests and assessments. This activity can be included as a process within the implementation phase. • Content and delivery: All course content and instructional strategies, methodologies and activities, including trainee evaluations, are monitored and assessed so that corrective actions can be taken if necessary. Sources of feedback include the trainees, the instructors, the support staff and the responsible managers and	Training effectiveness evaluation is governed by four main documents. These are: - B-HBK-09500-00003, Training and Performance Objectives & Criteria - B-HBK-09500-00005, Training Performance Objectives Evaluator Reference Manual - BP-PROC-00213, Training – Administer Training Evaluation - BP-PROC-00595, Training Fundamentals In addition to the governing documents, the bulleted points of this guidance clause are addressed through activities embedded in other procedures as well. As an example, instructions associated with change management (i.e. Change to TQDs, changes associated with qualifications, and program elements, training	C

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	supervisors. • Effectiveness: This means the graduates' ability to perform, in the workplace, the tasks for which they were trained. The primary sources of this information are the graduates and their supervisors. Additionally, information may be available through various sources ranging from needs assessments and lessons-learned reports to incident reports and rework statistics. Managers and supervisors should have continuous input to the training. • Change management: In accordance with the principles of a SAT methodology, inputs such as new or revised regulatory requirements, engineering design and equipment changes, operational changes, revised procedures, modifications and operating experience feedback (including facility and industry-wide events) should be regularly fed into the appropriate processes through the analysis phase.	material) are embedded throughout the training procedures and managed through the training documentation management mechanisms discussed in a previous clause (i.e. TIMS, BATMAN, Controlled Document Life Cycle procedure).	