FORM-14159 R000*

Periodic Safety Review - Final Document Review Traveler

Bruce Power

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Bruce Power Document Title:
Safety Factor 9 - OPEX and R&D

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

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CANDESCO	K-421231-00019	R00

Supplier Document Title:
Safety Factor 9 - OPEX and R&D

Accepted for use at Bruce Power by:	**Signature:**	**Date**
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Title: Safety Factor 9 - OPEX and R&D

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A Report Submitted to Bruce Power

June 30, 2015

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T. Kapaklili
J. Sobolewski</td><td>Approver:</td><td>Date:
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G. Buckley</td><td>Reviewer:
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<tr><td>Author:
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Acronyms and Abbreviations

AAR	After Action Report
AIA	Authorized Inspection Agency
ACE	Apparent Cause Evaluation
AFI	Area For Improvement
ANDE	Advanced Non-Destructive Examination
AR	Action Request
ASLF	Acres-Sargent & Lundy-Fox
BARSA	Bruce A Restart Safety Analysis
BP	Bruce Power
BRIMS	Bruce Reactor Inspection and Maintenance System
CAMEO	Corrective Action Management Effectiveness Oversight
CANDU	CANada Deuterium Uranium
CARB	Corrective Action Review Board
CE	Construction Experience
CFAM	Corporate Functional Area Manager
CHF	Critical Heat Flux
CIGAR	Channel Inspection and Gauging Apparatus for Reactors
CNS	Convention on Nuclear Safety
CNSC	Canadian Nuclear Safety Commission
COG	CANDU Owners Group
CSA	Canadian Standards Association
CSM	Collegial Screening Meeting
CSTA	Calandria-Shield Tank Assembly
CT	Calandria Tube
CTR	Calandria Tube Replacement
CWEST	Circumferential Wet Scrape Tool
DCN	Design Change Notice
DCR	Document Change Request
DM	Delivery Machine

EA	Environmental Assessment
EACE	Equipment Apparent Cause Evaluation
ECI	Emergency Coolant Injection
EFPH	Effective Full Power Hours
EFADS	Emergency Filtered Air Discharge System
EPRI	Electric Power Research Institute
ERCI	Equipment Root Cause Investigation
ESW	Emergency Service Water
FAIs	Fukushima Action Items
FASA	Focus Area Self Assessment
FLMP	Fluid Leak Management Program
FME	Foreign Material Exclusion
GET	General Employee Training
HMI	Human Machine Interface
HFESR	Human Factors Engineering Summary Report
IAEA	International Atomic Energy Agency
INPO	Institute of Nuclear Power Operations
INSAG	International Nuclear Safety Advisory Group
ISR	Integrated Safety Review
JHSC	Joint Health and Safety Committee
JIT	Just in Time
kEFPH	Thousand Effective Full Power Hours
LCH	Licence Conditions Handbook
LCMP	Life Cycle Management Plan
LISS	Liquid Injection Shutdown System
LTEP	Long Term Energy Plan (Ontario)
MCR	Major Component Replacement
MEL	Master Equipment List
MSM	Management System Manual
MODAR	Modal Detection and Repositioning
MoE	Ministry of the Environment (Ontario)
MoL	Ministry of Labour (Ontario)

MRM	Management Review Meeting
NDE	Non-Destructive Examination
NIEP	Nuclear Industry Evaluation Program
NORA	Nuclear Oversight and Regulatory Affairs
NRC	National Research Council
NSA	Nuclear Safety Assessment
NSCA	Nuclear Safety and Control Act
NSASD	Nuclear Safety Analysis and Support Department
OE	Operating Experience
OEF	Operating Experience Feedback
OER	Operating Experience Report
OFI	Opportunity for Improvement
OPEX	Operating Experience
PBQAP	Pressure Boundary Quality Assurance Program
PORC	Plant Operations Review Committee
PROL	Power Reactor Operating Licence
PSR	Periodic Safety Review
R&D	Research & Development
RCI	Root Cause Investigation
SBR	Safety Basis Report
SCA	Secondary Control Area
SCR	Station Condition Record
SER	Significant Event Report
SFCR	Single Fuel Channel Replacement
SFR	Safety Factor Report
SLAR	Spacer Location and Repositioning
SOER	Significant Operating Experience Report
SSC	Structure, System, and Component
SUI	Startup Instrumentation
SUU	Startup Unit
TBA	Technical Basis Assessments
TSSA	Technical Standards and Safety Authority

UDM	Universal Delivery Machine
US NRC	United States Nuclear Regulatory Commission
WANO	World Association of Nuclear Operators
WS+	West Shift Plus
WSM	Weekly Screening Meeting

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 whether there is adequate feedback of safety experience from nuclear power plants (both internal and external) and of the findings of research.

1.2. Description

The review is conducted in accordance with the Bruce A ISR Basis Document [1], which states that the review will identify operating experience reports and other information that may be important to nuclear safety at other plants owned by the operating organization, together with relevant experience and national and international research findings from nuclear and non-nuclear facilities both in Canada and in other States. It will be verified that this information has been properly considered within the plant's routine evaluation processes and that appropriate action has been taken.

2. Methodology of Review

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

- Return to service of Bruce Units 3 and 4 (circa 2001) [7];
- Life extension of Bruce Units 1 and 2 (circa 2006) [8] [9];
- Proposed refurbishments of Bruce Units 3 and 4 (circa 2008) [10] [11] [12]; and
- Safety Basis Report (SBR) and Periodic Safety Review (PSR) for Bruce Units 1 to 8 (2013) [2].

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

The Bruce A ISR Safety Factor review process comprises the following steps:

1. **Interpret and confirm review tasks:** As a first step in the Safety Factor review, the Safety Factor Report author(s) confirm the review tasks identified in the ISR Basis and repeated in Section 1.2 to ensure a common understanding of the intent and scope of each task. In some cases, this may lead to elaboration of the review tasks to ensure that the focus is precise and specific. Any changes to the review tasks are identified in Section 5 of the Safety Factor Report (SFR) and a rationale provided.
2. **Confirm the codes and standards to be considered for assessment:** The Safety Factor Report author(s) validates the list of codes and standards presented in the ISR Basis Document against the defined review tasks to ensure that the assessment of each standard will yield sufficient information to complete the review tasks. Additional codes and standards

are added if deemed necessary. If no standard can be found that covers the review task, the assessor may have to identify criteria on which the assessment of the review task will be based. The final list of codes and standards considered for this Safety Factor is provided in Section 3.

3. **Determine the type and scope of assessment to be performed:** This step involves confirming or modifying the assessment type for each of the codes and standards and guidance documents identified for consideration. The ISR Basis Document provides an initial assignment for the assessment type, selecting one of the following review types:
   - Programmatic Clause-by-Clause Assessments;
   - Plant Clause-by-Clause Assessments;
   - High-Level Programmatic Assessments;
   - High-Level Plant Assessments;
   - Code-to-Code Assessments; or
   - Confirm Validity of Previous Assessment.

   The final assessment types are identified in Section 3, along with the rationale for any changes relative to the assignment types listed in the ISR Basis Document.
4. **Perform gap assessment against codes and standards:** This step comprises the actual assessment of the Bruce Power programs and the Bruce A plant against the identified codes and standards. In general, this involves determining from available design or programmatic documentation whether the plant's design or programs meet the provisions of the specific clause of the standard or of some other criterion, such as a summary of related clauses. Each individual deviation from the provisions of codes and standards is referred to as a Safety Factor "micro-gap". The assessments, performed in Appendix A and Appendix B, include assessor's arguments conveying reasons why the clause is considered to be met or not met, while citing appropriate references that support this contention.
5. **Assess alignment with the provisions of the review tasks:** The results of the gap assessment against codes and standards are interpreted in the context of the review tasks of the Safety Factor. To this end, each assessment, whether clause-by-clause, high-level or code-to-code, is assigned to one or more of the review tasks (Section 5). Assessment against the provision of the review task involves formulating a summary assessment of the degree to which the plant or program meets the objective and provisions of the particular review task. This assessment may involve consolidation and interpretation of the various compliance assessments to arrive at a single compliance indicator for the objective of the review task as a whole.
6. **Perform program assessments:** The most pertinent self-assessments, audits and regulatory evaluations are assessed, and performance indicators relevant to the Safety Factor identified. The former illustrates that Bruce Power has a comprehensive process of reviewing compliance with Bruce Power processes, identifying gaps, committing to corrective actions, and following up to confirm completion and effectiveness of these actions. The latter demonstrates that there is a metric by which Bruce Power assesses the

effectiveness of the programs relevant to the Safety Factor in Section 7. Taken as a whole, these provide a cross section, intended to demonstrate that the processes associated with this Safety Factor are implemented effectively (individual findings notwithstanding). Thus, program effectiveness, if not demonstrated explicitly in the review task assessments in Step 5, can be inferred if Step 5 shows that Bruce Power processes meet the Safety Factor requirements and if this step shows there are ongoing processes to ensure compliance with Bruce Power processes.

7. **Identification of findings:** This step involves the consolidation of the findings of the assessment against codes and standards and the results of executing the review tasks into a number of definitive statements regarding positive and negative findings of the assessment of the Safety Factor. Positive findings or strengths are only identified if there is clear evidence that the Bruce A plant or programs exceed compliance with the provision of codes and standards or review task objectives. Each individual negative finding or deviation is designated as a Safety Factor micro-gap for tracking purposes. Identical or similar micro-gaps are consolidated into comprehensive statements that describe the deviation known as Safety Factor macro-gaps, which are listed in Section 8 of the Safety Factor Reports, as applicable.

3. Applicable Codes and Standards

This section lists the applicable regulatory requirements, codes and standards considered in the review of this Safety Factor. The list also includes any new codes or standards that came into effect after the completion of the 2013 PSR, as well as those that supersede codes or standards previously assessed. Regulatory codes and standards issued after the code effective date of August 31, 2014 were not part of the detailed review.

3.1. Acts and Regulations

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

As described in various IAEA documents, all signatories to the international Convention on Nuclear Safety are required to have an Operating Experience (OPEX) program.[2] Canada is a signatory and the enforcement of this requirement falls to the CNSC. The CNSC ensures that the requirement is passed to nuclear utilities indirectly through including Canadian Standards Association (CSA) N286 in the licences. In Bruce Power, the program for OPEX and Research & Development (R&D) is BP-PROG-01.06, Operating Experience Program [16].

3.2. Power Reactor Operating Licence

The list of codes and standards related to OPEX and R&D that are referenced in the Bruce Power Reactor Operating Licence (PROL) [17] and Licence Conditions Handbook (LCH) [18] noted in Table C-1 of the ISR Basis Document [1] are identified in Table 1.[3] The edition dates referenced in the third column of the table are the modern versions used for comparison.

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

Document Number	Document Title	Modern Version Used for ISR Comparison	Type of Review
CNSC S-99 (2003) [21]	Reporting Requirements for Operating Nuclear Power Plants	CNSC REGDOC-3.1.1 (2014) [22]	NR
CNSC RD/GD-99.3 (2012) [24]	Public Information and Disclosure	CNSC RD/GD-99.3, 2012 [24]	NR

[2] A portion of International Nuclear Safety Advisory Group INSAG-23 (IAEA 2008) [15] states:

"4. By signing the international Convention on Nuclear Safety (CNS), each Contracting Party commits to taking the appropriate steps to ensure that:

"... incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body; [and that] programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies".

All Contracting Parties have indicated in the review meetings of the CNS that they have such programmes in place. These programmes have been valuable. Nonetheless, events do recur and this gives INSAG reason to believe that the mechanisms for operating experience feedback are not as effective as they could be. INSAG concludes that significant safety benefits could be achieved by enhancing national and international OEF [Operating Experience Feedback] programmes.

[3] PROL 18.00/2020 [19] and LCH-BNGS-R000 [20] came into effect on June 1, 2015. However, PROL 15.00/2015 [17] and LCH-BNGSA-R8 [18] are the versions referred to in this ISR, as these were in force when the assessments in the Safety Factor Reports were performed.

Document Number	Document Title	Modern Version Used for ISR Comparison	Type of Review
CNSC RD-360 (2008) [4]	Life Extension of Nuclear Power Plants	CNSC RD-360 (2008) [4]	NR
CSA N286-05 [25]	Management System Requirements for Nuclear Power Plants	CSA N286-12 [26]	NR
Assessment type: Clause-by-Clause (CBC); Code-to-Code (CTC); High Level (HL); No Assessment Required (NR); Confirm Validity of Previous Assessments (CV)			

CNSC REGDOC-3.1.1: Table C-1 of the ISR Basis Document [1] calls for a code-to-code assessment of CNSC REGDOC-3.1.1 to CNSC S-99. CNSC S-99 (2003) [21], “Reporting Requirements for Operating Nuclear Power Plants”, was included in PROL 15.00/2015 and was the basis document the CNSC used to assess past refurbishments at Bruce A, as Bruce Power has had an obligation to meet this Regulatory Document since before 2008. CNSC REGDOC-3.1.1 [22], Reporting Requirements for Nuclear Power Plants, which replaced S-99 [21] in May 2014, is listed as condition 1.7 in PROL 18.00/2020 [19] and sets reporting requirements for nuclear power plants. Bruce Power switched over to CNSC REGDOC-3.1.1 at the beginning of 2015[4], as committed in a letter submitted to the CNSC [23]. Line-by-line compliance with this regulatory document is verified on an ongoing basis to ensure compliance with the PROL, and therefore it was not assessed as part of this Safety Factor.

CNSC RD/GD-99.3: Table C-1 of the ISR Basis Document [1] calls for a clause-by-clause assessment of CNSC RD/GD-99.3 Public Information and disclosure which establishes regulatory requirements for public information and disclosure for licensees. This regulatory document is included in the current licence and accordingly no further assessment of RD/GD-99.3 requirements is performed for this ISR.

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

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

also states that it is consistent with SSG-25, and therefore it is considered that the ISR envelops the guidelines in CNSC REGDOC-2.3.3.

CSA N286-12: 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" [27].

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 [28]. 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 [29]. 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

There were no additional Regulatory Documents identified in Table C-1 of the ISR Basis Document [1] considered for application to review tasks of this Safety Factor beyond those identified in the PROL [17] and LCH [18].

3.4. CSA Standards

There were no additional CSA standards identified in Table C-1 of the ISR Basis Document [1] considered for application to review tasks of this Safety Factor beyond those identified in the PROL [17] and LCH [18] (Table 1 above).

3.5. International Standards

International guidance documents considered for application to review tasks of this Safety Factor are included in Table 2.

Table 2: International Standards

Document Number	Document Title	Reference	Type of Review
IAEA SSG-25 (2013)	Periodic Safety Review for Nuclear Power Plants	[3]	NR
Assessment type: Clause-by-Clause (CBC); Code-to-Code (CTC); High Level (HL); No Assessment Required (NR); Confirm Validity of Previous Assessments (CV)			

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

3.6. Other Applicable Codes and Standards

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

4. Overview of Applicable Bruce A Station Programs and Processes

Table 3 lists the key Bruce Power documents related to implementation of the elements related to the use and feedback of OPEX and R&D.[5]

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

Table 3: Key Implementing Documents

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
BP-MSM-1: Management System Manual [30]	BP-PROG-01.06: Operating Experience Program [16]	BP-PROC-00062: Processing External and Internal Operating Experience [31]	
		BP-PROC-00137: Focus Area Self Assessment [32]	
		BP-PROC-00147: Benchmarking and Conference Activities [33]	
		BP-PROC-00892: Nuclear Safety Culture Monitoring [34]	
	BP-PROG-01.07: Corrective Action [35]	BP-PROC-00019: Action Tracking [36]	
		BP-PROC-00059: Event Response and Reporting [37]	
		BP-PROC-00060: Station Condition Record Process [38]	
		BP-PROC-00252: Control of Nonconforming Items [39]	
		BP-PROC-00412: Trending, Analyzing, and Reporting of SCRs [40]	

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
		BP-PROC-00506: Effectiveness Reviews [41]	
		BP-PROC-00518: Root Cause Investigation [42]	
		BP-PROC-00519: Apparent Cause Evaluation (ACE) [43]	
		BP-PROC-00644: Common Cause Analysis [44]	
	BP-PROG-06.03: CNSC Interface Management [45]	BP-PROC-00165: Reporting to Regulatory Agencies [46]	
	BP-PROG-10.01: Plant Design Basis Management [47]	BP-PROC-00363: Nuclear Safety Assessment [48]	
BP-MSM-1 Sheet 2: MSM Approved Reference Chart Authorities and Responsibilities - Sheet 0002 [49]			

4.1. Operating Experience

This section describes the processes where there is an opportunity (and requirement) to collect internal and external OPEX both nuclear and non-nuclear for use in every aspect of Bruce A operation. Section 5 of this report, and particularly Section 5.3.3, describes the application of OPEX to solving everyday problems and enhancing safety and production efficiency.

Bruce Power's program for OPEX is described in its implementing documents BP-PROG-01.06 [16] and BP-PROC-00062 [31], which are based on CSA Standards and World

Association of Nuclear Operators (WANO), Institute of Nuclear Power Operations (INPO) and IAEA recommendations. The program covers both internal and external operating experience. The OPEX program and Corrective Action Program BP-PROG-01.07 [35] are closely inter-connected.

For reference, BP-PROG-01.06 refers to the following IAEA, INPO and WANO documents as inputs (guidance).

- IAEA Safety Guide NS-G-2.11, A System for the Feedback of Experience from Events in Nuclear Installations;
- INPO 10-006, Operating Experience (OE) and Construction Experience (CE) Program Description;
- INPO 05-005, INPO Guidelines for Performance Improvement at Nuclear Power Stations;
- WANO GL 2003-01, Guidelines for Operating Experience at Nuclear Power Plants
- WANO WPG02, OPEX program guideline; and
- WANO OPEX Program - reference manual.

Two principal corporate values in BP-MSM-1, Bruce Power Management System Manual [30] espouse the fundamental principles of OPEX, namely

> *"5.4 Benchmarking and Operating Experience*
>
> *We seek out leading practice and determine how to apply it at Bruce Power to enable continuous improvement.*
>
> *The "Operating Experience" process provides for evaluating and disseminating in house and industry operating experience information. This information is sought by and supplied to appropriate personnel for consideration and initiation of actions to prevent adverse conditions to improve performance with respect to plant safety, reliability, economy and profitability.*
>
> ***5.5 Assessments***
>
> *In addition to Event Review Boards and the Nuclear Safety Review Board which provide oversight, we use a combination of assessments and audits to confirm that work activities meet the stipulations of the Management System, evaluate the Management System and confirm the integrity of plant conditions. Assessments include:*
>
> - *Self Assessments.*
> - *Internal and External Audits and Surveillance Activities*
> - *Annual State of the Functional Area Assessment*
> - *Performance Assessments and Accountability Reviews*
> - *Technical Assessments."*

Furthermore, BP-MSM-1 [30] provides the management directive to support these values that unequivocally commits Bruce Power to collecting, assessing, tracking and disseminating internal and external OPEX:

> *"Operating Experience*

Bruce Power shall use Operating Experience from within Bruce Power and worldwide to identify, evaluate, and apply lessons learned in order to prevent adverse conditions or to improve performance with respect to plant safety, reliability and cost.

Bruce Power shall communicate internal experience from the Bruce Site to others in the nuclear industry in order to improve plant safety, reliability, and commercial performance of the nuclear industry around the world."

Plant Maintenance Management

Bruce Power shall focus on predictive and preventive maintenance to support enhanced equipment reliability and improved safety operational performance.

Maintenance strategies shall be continually refined on a basis of improved technologies, Operating Experience (OPEX) and feedback from activities associated with plant reliability integration. Work selection, prioritization and response shall be guided by risk informed decision making."

Implementing documents are considered in this review to show the means by which OPEX is woven into the fabric of Bruce Power's business.

This Safety Factor also includes the collection, production, and use of Research and Development (R&D). Fundamentally, R&D is OPEX also, so could be considered to be generically wound up in OPEX. This Report uses this interpretation except when dealing with programs that are explicitly identified as Research or Research and Development, such as in Section 4.4, which also deals briefly with the governance aspects of R&D.

BP-PROG-01.06, Operating Experience Program [16] is the OPEX Program taking direction from CSA N286-05. The goal of this program is to implement processes at Bruce Power to meet the requirements of the CSA Standard by making improvements via processing Internal and External Operating Experience information, conducting Focus Area Self Assessments, Benchmarking others, and by attending industry Conferences and Workshops.

The generation and processing of OPEX relies significantly on the Corrective Action Program. Section 4.2 discusses the connection to the Station Condition Record (SCR)/CAP process.

4.1.1. BP-PROC-00062, Processing External and Internal Operating Experience

BP-PROC-00062, Processing External and Internal Operating Experience [31] is the workhorse implementing procedure. This procedure identifies the processes used to accomplish the two Program goals, one for external and one for internal: a) To use external operating experience information to identify, evaluate and apply lessons learned to improve plant safety, reliability and commercial performance through improvements to processes, procedures, training and system/equipment design, and b) Communicate internal experience from the Bruce Site to others in the Nuclear Industry in order to improve nuclear plant safety, reliability and commercial performance around the world.

The procedure requires respondents to avoid dismissing information from other reactor types or situations, and to answer the challenge of whether a parallel event could occur at Bruce. This is a precursor for Nuclear Safety Culture, which is a central principle of OPEX – continuous awareness of the need for learning to apply to daily activities contributes to a successful OPEX program and hence to an enhanced Safety Culture.

BP-PROC-00062 [31] then provides detailed instructions on how to extract and process incoming and outgoing OPEX. The processing of internal or external events is administered using the Station Condition Record (SCR) process and the Corrective Action Program. OPEX processes interface with the SCR/CAP processes as required. Submission of SCRs (BP-PROC-00060), Action Tracking (BP-PROC-00019), and Root Cause Investigations (BP-PROC-00518) are associated processes where the impact of either positive or negative OPEX (lessons learned) would be recorded. These are further discussed in Section 4.2.

BP-PROC-00062 [31] also refers to two weekly communications meetings conducted with/by the Bruce Power OPEX unit where OPEX is screened and actions assigned:

1. COG Weekly Screening Meeting (WSM) - A weekly teleconference meeting administered by COG. Participants share lessons learned in the subject areas of reactor safety, radiation safety, industrial safety, environmental safety, and plant reliability that may provide benefits for the others. Participants include Bruce Power, on-shore and off-shore CANDU owners/operators, WANO, and AECL.
2. Collegial Screening Meeting (CSM) - This meeting screens all incoming OPEX from the COG Weekly Screening Meeting (WSM). Performance Improvement Coordinators (CAPCOs) represent their line and in so doing, determine applicability and accept actions to perform evaluations on appropriate incoming OPEX. The Senior Advisor, OPEX administers this process and records the results in a database.

Section 4.2.3, Pre-Job Briefings and OPEX Just in Time (JIT) Briefings, describes an important application arising from BP-PROC-00062 [31]. It states that "it is a management expectation that relevant OPEX be reviewed in Pre-Job Briefings. Supervisors have a responsibility to ensure the OPEX they discuss is relevant to the work to be performed. …" It allows Supervisors and Managers to emphasize key lessons learned that are applicable to the activity. Relating an actual previous event to a current work activity provides an opportunity to discuss the following:

- How that event can happen in the same circumstance.
- Actions to prevent a similar event.
- Barriers to prevent a similar event.
- Contingencies to take if a similar event occurs.
- How these lessons will improve or maintain a strong Nuclear Safety Culture today.

In this context, the pre-job briefing forms [50][51][52] include direct references to OPEX to be checked off. The OPEX program offers JIT OPEX briefings on a wide range of topics to assist supervisors and managers to assist with this process.

4.1.2. BP-PROC-00137, Focus Area Self Assessment

BP-PROC-00137 [32], Focus Area Self Assessment provides guidance in identifying and documenting lessons learned from internal sources to continuously improve performance by identifying weaknesses, strengths, threats and opportunities to make improvements to Processes/ Procedures, Training, or System/Equipment Design. It specifies the requirements and describes the process for collecting business intelligence through Comprehensive Focus Area and Quick Hit Focus Area Self- Assessments.

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

Nuclear Safety Culture is important to OPEX because a sustained focus on collecting and referring to OPEX in daily work routines requires awareness from all levels of staff, and is a requirement from the OPEX program document, BP-PROG-01.06 [16].

4.1.3. BP-PROC-00147, Benchmarking and Conference Activities

BP-PROC-00147 [33], Benchmarking and Conference Activities, provides requirements for identifying and documenting lessons learned from external sources to continuously improve performance by making improvements to Processes/Procedures, Training, or System/Equipment Design.

It specifies the requirements and describes the process for gathering business intelligence through the following means:

- Benchmarking of external (non-Bruce Power) facilities, which can be accomplished in various ways such as site visits, telephone interviews, or internet research;
- Attendance of Conferences, Workshops or Industry Working Groups (hereafter referred to as Conferences (note this inclusive definition stimulates gathering OPEX from multiple sources called “Conferences” and broadens the scope of BP-PROC-00147 beyond its title)).

The procedure provides guidelines both for collecting information from external sources and also hosting benchmarking missions at Bruce Power. There are explicit instructions for follow up (for example and of primary importance, SCRs which will direct the observations through the OPEX screening).

Benchmarking and conference activities foster the use of diverse information sources to understand performance gaps and implement corrective actions to improve performance.

4.1.4. BP-PROC-00892, Nuclear Safety Culture Monitoring

BP-PROC-00892 [34], Nuclear Safety Culture Monitoring provides the framework to monitor nuclear safety culture between formal assessment activities, in particular to have mechanisms to identify and correct potential gaps in nuclear safety culture. The approach is collegial and supports the development of a common understanding of safety culture within senior and middle levels of leadership at the nuclear power stations and describing the traits and attributes of the desired safety culture. This monitoring and adjustment process facilitates the desired behaviours of a learning organization – one that places nuclear safety as its overriding priority and relentlessly seeks ways to continuously improve itself.

This process provides an approach for monitoring nuclear safety culture using the framework described in INPO 12-012, Traits of a Healthy Nuclear Safety Culture [53] and based on the approach described in NEI 09-07, Revision 1, Fostering a Strong Nuclear Safety Culture (November 2010). This supports assuring that Bruce Power meets the WANO Performance Objective for Nuclear Safety Culture (SC.1) and associated criteria: The organization's core values and behaviours reflect a collective commitment by all nuclear professionals to make nuclear safety the overriding priority.

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

4.1.5. BP-PROC-00363, Nuclear Safety Assessment

BP-PROC-00363, Nuclear Safety Assessment [48] describes the collection and use of OPEX in Nuclear Safety Assessment. In its description of "4.4.2 Operational Support" it states it uses "The process to identify, evaluate and apply lessons learned from operational issues, both from within Bruce Power and from the industry, is defined in BP-PROC-00062, Processing External and Internal Operating Experience. Evaluation and application of lessons learned from operational issues may require NSA [Nuclear Safety Assessment]". And in "4.1.4 Results from Research and Development or Analysis", it accepts the responsibility that "Issues may arise due to findings from Research and Development activities being performed on behalf of Bruce Power and the industry. Issues may also arise due to findings from ongoing industry analysis programs, both within and outside Bruce Power. Furthermore, issues can also emerge from proactive reviews of operating and design configurations where established operating limits and conditions may need to be more precisely defined. These issues are assessed and documented in Station Condition Records per BP-PROC-00062, Processing External and

Internal Operating Experience." In this context, OPEX would be generated or addressed as part of the SCR process (see Section 4.2).

4.2. Corrective Action

Corrective Action processes are embedded with requirements to collect and/or disseminate OPEX.

Bruce Power processes related to Corrective Action are governed by the Corrective Action Program BP-PROG-01.07 [35] and related implementing procedures BP-PROC-00019 [36], BP-PROC-00060 [38], BP-PROC-00252 [39], and BP-PROC-00412 [40]. The Corrective Action Program is based on CSA Standards, including references and several other industry guides identified in Section 5.0 of reference BP-PROG-01.07 [35]. A Corrective Action Review Board (CARB), composed of senior management, performs a review of all significant events at Bruce Power.

BP-PROG-01.07 [35], Corrective Action identifies and eliminates or mitigates adverse conditions that could negatively impact nuclear safety (including reactor safety, radiation safety, industrial safety and environmental safety), business loss or corporate reputation. Adverse conditions and non-conformances are to be promptly identified, documented and reported. For most events, significant events and significant conditions adverse to quality, the causes are determined and corrective action is taken to correct, and where appropriate, prevent their recurrence. Corrective actions taken to address identified causes are tracked to completion. Effectiveness is verified for actions taken to prevent recurrence. Adverse conditions are trended and periodically analyzed for adverse trends. Corrective actions are implemented to address adverse trends where warranted. Periodic assessment of the effectiveness of the program is done based on the results and recommendations obtained from verifications and audits. BP-PROC-00060 is the implementing procedure (described below) which maps SCRs onto the OPEX database.

4.2.1. BP-PROC-00019, Action Tracking

BP-PROC-00019 [36], Action Tracking provides an integrated online means of tracking actionable events and ensuring actions are taken to respond to each action item. An Action Request (AR) may be initiated as a result of a reported problem, a licensing requirement, an internal procedure or any other event that requires a response in a timely manner. This procedure governs how Action Tracking is used at Bruce Power to ensure accountability, data integrity and audit requirements. The process owners, as defined by the AR types, specify requirements for their processes such as requests for due date extensions and oversight for completion of those assignments. AR types are the responsibility of the process owners.

4.2.2. BP-PROC-00059, Event Response and Reporting

BP-PROC-00059 [37], Event Response and Reporting has a process specifically supporting OPEX. It defines the process for preliminary response and reporting to internal contacts and external agencies, to ensure compliance with both Bruce Power and Regulatory requirements for reporting OPEX. This procedure describes the process of Incident Response and Reporting which consists of the following major steps:

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

External agency reporting is discussed further under BP-PROG-06.03, CNSC Interface Management, in Section 4.3 of this Safety Factor Report under Compliance Reporting. It is a means of communicating OPEX to external co-operating utilities and institutions. This program has a check box under Appendix B form, Design Deficiencies to identify a deficiency not covered by Operating Experience.

4.2.3. BP-PROC-00060, Station Condition Record Process

BP-PROC-00060 [38], the Station Condition Record (SCR) Process is used to document adverse conditions, investigation results and corrective actions related to people, plant, environment and process. The SCR process is used by staff, including contractors, to document adverse conditions, investigation results and corrective actions related to people, plant, environment and process. For investigations into events where there is the likelihood of regulatory charges or commercial litigation where legal privilege needs to be maintained are handled separately. The procedure refers to BP-PROC-00062 for the primary requirements on OPEX, but does provide criteria for categorizing SCRs, including a dedicated category (Significance Level 3) with seven classification tags (labels) specifically for OPEX.

In the classification of OPEX, a consistent reporting and evaluation process for identified adverse conditions, including but not limited to non-conformances, undesirable impacts on nuclear safety, business loss, and corporate reputation is accomplished by ensuring the following:

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

For nonconformances (typically a documentation deficiency) which could but have not yet resulted in a nonconforming item (typically a deficiency in an SSC), BP-PROC-00060 applies rather than BP-PROC-00252, Control of Nonconforming Items. An SCR is required, but the Tagging and Segregation steps do not apply. In this case, it is very important to control the nonconformance to ensure that no nonconforming item is produced. The means taken to control the nonconformance should be described in the SCR.

4.2.4. BP-PROC-00252, Control of Nonconforming Items

BP-PROC-00252 [39], Control of Nonconforming Items describes the process used to identify, document, segregate, evaluate and disposition nonconforming items. Adherence to this procedure ensures items that do not conform to specified quality requirements are controlled to prevent further processing, use or installation, pending disposition by the authorized personnel. Personnel involved in this process are adequately free of cost and schedule considerations. This procedure describes the generic corporate process for identifying, controlling and evaluating nonconforming items.

4.2.5. BP-PROC-00412, Trending, Analyzing, and Reporting of SCRs

BP-PROC-00412 [40], Trending, Analyzing, and Reporting of SCRs determines whether performance is improving, declining or stagnant; and corrective actions are initiated to address adverse performance before a break-through event occurs. Trend identification entails reviewing and analyzing the data in SCRs to identify these trends and assigning and recommending corrective actions and investigations to mitigate adverse trends. This procedure has specific instructions[6] to screen the SCR data for OPEX trends, such as not used, not used effectively, not gathered, or benchmarking opportunities overlooked. Significance levels are assigned to alert management to important trends, and above a significance threshold, trends are identified for a Common Cause Analysis, BP-PROC-00644 [44] (see Section 4.2.9).

4.2.6. BP-PROC-00506, Effectiveness Reviews

BP-PROC-00506 [41], Effectiveness Reviews define the process for performing effectiveness reviews of corrective actions and Corrective Action Management Effectiveness Oversight (CAMEO). The effectiveness review process is used to determine whether or not a corrective action was effective. This is important for many Safety Factors, but particularly so for OPEX, because OPEX counts heavily on the SCR process for its own effectiveness.

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

4.2.7. BP-PROC-00518, Root Cause Investigation

BP-PROC-00518 [42], Root Cause Investigation, is used to identify the root cause of an event (which includes accidents) and incidents so proper corrective action is initiated to prevent the future reoccurrence of similar events and incidents. It defines the process for performing a Root

[6] For example, this procedure has a screening label for "Issues caused by failure to identify, correct identified causes, or identify or properly implement Operating Experience. It includes failure by personnel to be cognizant of generic industry issues and of advances in technology." This addresses aspects of the review tasks for this Safety Factor – e.g., established process, universal deployment, or effectiveness.

Cause Investigation (RCI) and an Equipment Root Cause Investigation (ERCI). Central elements of the investigation are a) the collection of OPEX, b) the assessment of why internal OPEX did not prevent the recurrence of the event, and c) the filing of an SCR if the existing internal OPEX was not effective at preventing the event. The procedure offers the OPEX Advisors an OPEX web page as resources. A specific responsibility to evaluate the health of the RCI and OPEX programs is assigned to all CARB members. The procedure has a flow chart for the RCI team to deal with an OPEX-preventable event targeted at Performance Improvement.

4.2.8. BP-PROC-00519, Apparent Cause Evaluation

BP-PROC-00519 [43], Apparent Cause Evaluation (ACE) defines the process for performing an Apparent Cause Evaluation (ACE) and an Equipment Apparent Cause Evaluation (EACE). The ACE/EACE processes are used to identify the likely cause of an event and propose corrective actions that strengthen barriers or reduce the frequency or reduce the severity of similar events. The procedure has specific instructions on gathering and using OPEX to determine the nature of the event and immediate causes, or otherwise evaluating the event. It refers to the Bruce Power OPEX web page for instructions (the web page indicates widespread deployment of OPEX principles). It has instructions to initiate an SCR when an opportunity to use existing OPEX (internal or external) was not effective in preventing the event under evaluation.

The ACE/EACE processes may not prevent recurrence but the availability and use of pertinent OPEX could reduce the probability of recurrence.

4.2.9. BP-PROC-00644, Common Cause Analysis

As noted in Section 4.2.5, trends (including OPEX) above a threshold significance level are identified for Common Cause Analysis to provide an additional level of assessment. BP-PROC-00644 [44], Common Cause Analysis, is used on adverse trends so corrective action can be taken to reduce the probability of the adverse trend continuing. It provides instructions for performing Common Cause Analysis. Although intended for analyzing adverse trends linked to the Corrective Action Program, the methodology described can be used to analyze data from other sources as well. A Common Cause Analysis is completed by an individual or team of individuals within the timeframe specified by the Management Review Meeting (MRM), normally 35 days from MRM assigning the analysis.

4.3. Compliance Reporting

Bruce Power’s operating licence requires it to report specific detail regarding design, operation, and analysis findings to the CNSC. Compliance reporting requirements are described in CNSC REGDOC-3.1.1. As noted in Section 3.2, OPEX findings different in nature or probability from those previously reported are one aspect that the standards require to be reported, with defined timelines for reporting. In the past few years, the topics of these reports are reported publically on the internet[7], either in the utilities' web sites or the CNSC's.

Internal Bruce Power processes that support these reporting requirements are in references BP-PROC-00165 [46] and BP-PROC-00059 [37].

BP-PROG-06.03 [45], CNSC Interface Management defines the overall business need, functional requirements, constituent elements and key responsibilities associated with managing the interface between Bruce Power and the Canadian Nuclear Safety Commission. BP-PROG-06.03 [45] was recently updated to confirm the need for compliance against CNSC REGDOC-3.1.1 which is a source of OPEX ([45] Section 4.5 item 3). As noted in Section 4.2, this Program has a check box to indicate a deficiency not covered by Operating Experience.

BP-PROC-00165 [46], Reporting to CNSC – Power Reactor Operating Licences describes the information that the CNSC requires of a licensee who operates a nuclear power plant, and how, when and to whom the information is to be provided. It establishes standardized practices, format and content for unscheduled and scheduled formal and as appropriate content for reports to the CNSC per REGDOC-3.1.1 [22].

4.4. Research

While the term OPEX appears to focus on "Operating" Experience, results learned from new research or methodologies can also lead to items to be shared with the nuclear community and lessons learned, and the enhancement of nuclear safety or improvement of margins. In fact, the term OPEX is used with this much broader meaning, and includes Research.

The governance for Research and Development activities in Bruce Power begins with the roles and responsibilities listed in BP-MSM-1 Sheet 2 [49]. Quotes from the document in the following table demonstrate the extensive scope of R&D to be undertaken at Bruce Power:

Primary Responsibility Organization Element	Description of R&D Responsibility
Engineering, Fitness for Service Assessment, Section Manager	Provide technical oversight and direction of research and development programs in the above areas[8], including the use of research results. Provide liaison with external organizations, including participation in **CANDU Owners Group, Research and Development Technical Committee, Industry Working Groups and Canadian Standard Association** committees.

[7] Per Section 4.1 of BP-PROG-09.02 [54], Stakeholder Interaction: "Publicly posting on brucepower.com, on a quarterly basis, a listing of CNSC regulatory event reports."
[8] fuel channels, feeders steam generators/preheaters, calandria, fuel design, fuel performance, fuel manufacturing (current and future)

Primary Responsibility Organization Element	Description of R&D Responsibility
Engineering, Risk and Severe Accident Analysis, Section Manager	Advise the Department Manager in the application and development of analysis codes and methodology, taking into account industry research and development findings. Provide **technical oversight and direction of research and development i**n the area of severe accident phenomena and the use of research results. Coordinate the development, validation and maintenance of models and computer codes required for severe accident analysis and containment integrity beyond design basis, including the establishment of the reference data sets.
Law & Emergency Management, Emergency Planning & Programs (Continued), Department Manager	Be responsible for EPS Division Programs in the following areas: … Projects (Capital Projects, Small Projects/CEWR, RAC/IMC/ITAC, Life Cycle Planning, Define User Requirements, Needs Analysis & Prioritization, Project Impact & Resource Requirements, **Research & Development**).
Nuclear Oversight & Regulatory Affairs, Integration, Department Manager	Providing **scientific analysis and strategy** to various stakeholders. Making recommendations on strategy, policies, compliance and communications. Representing Bruce Power externally to stakeholders and government/regulatory authorities, **at international scientific conferences,** providing clear evidence and persuasive arguments in support of the Company's direction. Providing internal scientific advice in area of expertise to all key managers up to and including the CEO. Disseminating **scientific manuscripts in peer reviewed journals and provide written briefings of relevant applications and decisions**. Tracking and communicating trends, and provide analysis of regulatory and market policies relevant to the business plan and goals.

5. Results of the Review Tasks

The ISR Basis Document [1] does not identify specific review tasks for this Safety Factor. Rather, it states that the review will identify operating experience reports and other information that may be important to nuclear safety at other plants owned by the operating organization, together with relevant experience and national and international research findings from nuclear and non-nuclear facilities both in Canada and in other States. It will be verified that this information has been properly considered within the plant's routine evaluation processes and that appropriate action has been taken.

The specific Safety Factor 9 review tasks are taken directly from Clause 5.107 of SSG-25 [3], as follows:

1. Verify that arrangements are in place for the feedback of experience relevant to safety from other nuclear power plants and from relevant non-nuclear facilities;
2. Review the effectiveness of such programmes for the timely feedback of operating experience and for their output;
3. Review the processes for assessing and, if necessary, implementing research findings and findings from operating experience relevant to safety.

The emphasis of the tasks for Safety Factor 9 is on external experience. However, the Bruce station is in a unique position that there are two stations with fundamentally the same design, but quite different in equipment, design requirements, and therefore nuances in operation. In this context, Bruce B is an external plant to Bruce A, operated "by the same operating organization".

As a member of the global nuclear community, Bruce Power seeks and shares operating experience and actively participates in numerous bodies that create or recommend best industry practices or standards. This includes attending relevant conferences and workshops and participating in benchmarking missions to identify strengths, as well as performance and process gaps between Bruce Power and its industry peers. These activities are directed by the Performance Improvement department and governed by BP-PROC-00147 (see Section 4.1.3), which describes the process for gathering business intelligence through benchmarking and conferences. BP-PROG-01.06 and BP-PROC-00062 further define how to identify and capture lessons learned from internal and external operating experience. In 2014, 101 Benchmarking/Conference Reports were completed, resulting in 64 actions.
Bruce Power also provides representatives for numerous committees that shape industry practices or standards, such as the CSA Group, Electric Power Research Institute, CANDU Owners Group and WANO/INPO.

The sections that follow provide examples of this deployment of resources to OPEX driven activities.

5.1. Verify that Arrangements Are in Place for Feedback of Experience Relevant to Safety

Review task 1 is verified by inspection of the processes identified in Section 4. The sequence is as follows. The licence provides the mandatory requirement to have a Management System Manual (MSM) and that MSM has a principal value to subscribe to an Operating Experience program. The enabling program is described by BP-PROC-01.06. The main implementing procedure is BP-PROC-00062, which describes the collection, organization, and dissemination of the OPEX. It is used extensively in concert with the SCR and Action Tracking processes, for which BP-PROC-00060 [38] is the head node. Related activities are investigations, reporting, and monitoring safety culture, which are described in detailed procedures identified in Section 4.

It is noted that Appendix A of BP-PROG-01.06 [16] needs to be updated, as it refers to the long defunct Bruce Power POLICY series, despite multiple audits. A Document Change Request (DCR) has been submitted to incorporate this change.

5.2. Review of Program Effectiveness for Timely Feedback of OPEX

Review task 2 is addressed by consideration of Section 7, which describes regular and persistent effectiveness reviews. These effectiveness reviews are focused on continuous improvement of the process. Both procedures and audits dwell on timeliness.

Section 7 demonstrates that there is a strong OPEX program at Bruce Power, which is used extensively. In the reviews in Section 7, there was a recurring theme that actions raised in audits and assessments are sometimes closed before completion. However, a review by Bruce Power in response to this observation showed this to be limited and addressed by an ongoing managed process that has received increased emphasis recently. There were 307 CARB and MRM effectiveness reviews listed of which 227 were deemed effective. There were 80 that were not deemed effective and all of those had actions reopened and corrective action plans entered with an SCR to track them to ensure effectiveness. This is a standard part of the Bruce Power process and actions get reopened due to non-effectiveness. Actions are not closed without completing the work. The incidents cited in the audits reviewed in Section 7 followed the process as expected if the effectiveness review found that the original actions were ineffective.

5.3. Review of Processes for Assessing and Implementing Research and OPEX Findings

Review task 3 is addressed by citing examples of Research and Development projects (Section 5.3.1), staff culture and qualification (Section 5.3.2) and providing examples of application of OPEX in plant programs (Section 5.3.3), in both design and operation.

5.3.1. Research

Bruce Power is heavily invested in Research and Development to support ongoing operations. This occurs in many different areas and disciplines. For example, Bruce Power summarized its extensive involvement in Research and Development activities in a response [55] to the CNSC Inspection on Condition Assessments [56]:

“R&D is a key area in Bruce Power's OPEX processes. Bruce Power participates in and conducts industry workshops, conferences, newsgroups, forums, training sessions, lessons-learned meetings, and R&D sessions, and maintains information exchange with the industry and international community, regulators, vendors, contractors, designers, research organizations, and employees.

OPEX is required to be accessed during the life cycle management process and the many sources of OPEX to be reviewed when preparing the Technical Basis Assessments (TBA) and Life Cycle Management Plans. This includes accessing Research and Development reports from sources such as EPRI, INPO, and COG”. …

As mentioned above, Bruce Power participates in a significant array of research and development activities with other organizations. Co-operative interactions related to research with CANDU Owners Group (COG), Electric Power Research Institute (EPRI), WANO, IAEA, ASME, INPO, CSA, NRC (National Research Council), Canadian Nuclear Society and others are well known inside Bruce Power and throughout the industry. Moreover, Bruce Power performs research in conjunction with the Ontario Ministry of the Environment and Climate

Change, and attends workshops to acquire OPEX (e.g., Radiological Effluents and Environmental Workshop). However, no definitive governance was found for the objectives and mandate, other than tangential references in BP-MSM-1 Sheet 2 and BP-PROG-09.02. This is identified as gap SF9-1 in Table 5.

5.3.1.1. Participation in CANDU Owners Group

Bruce Power provides a report to the CNSC annually on COG R&D activities (e.g., [57], [58], [59], [60]) and also participates in an annual industry forum to discuss the results with the CNSC.

Each year there is a thorough report and the general topics are fairly stable year to year. Table 4 provides the COG major R&D Programs for 2014/2015. Each of the programs is divided into working groups to which Bruce Power contributes resources. All of this work helps satisfy the Benchmarking and Conference Activities Procedure.

Table 4: COG Major R&D Programs, 2014/2015

Number	Title	Areas[9]	#WP[10]
COG 14-9105	Fuel Channels R&D Program, 2014/2015 Operational Plan	7	77
COG 14-9205	Safety and Licensing R&D Program 2014/2015 Operational Plan	15	92
COG 14-9405	Chemistry, Materials and Components R&D Program, 2014/2015 Operational Plan	8	82
COG 14-9505	Industry Standard Toolset Program, 2014/2015 Operational Plan	20[11]	72
COG 14-9305	Health, Safety & Environment R&D Program, 2014/2015 Operational Plan	10	43

[9] Project Areas or Disciplines.
[10] Active Work Packages per 2014/2015 Plan.
[11] 18 codes divided into 4 major disciplines: a) Containment and Severe Accident, b) Thermal hydraulics, c) Physics, and d) Fuel and Fuel Channels.

Bruce Power frequently participates in R&D via COG, but for Bruce-specific initiatives, it can and does proceed with research on its own or in concert with other parties. The Critical Heat Flux (CHF) testing for Bruce's 37M fuel project is an example of R&D in the nuclear technology area (in association with Stern Laboratories). Another example is the production and introduction of new fuel carriers (at AECL Sheridan Park and Stern Laboratories) is an example of development work to minimize fuel defects in Bruce B. Still another is the continuing environmental research into the impact on whitefish in the vicinity of the station that has been undertaken in cooperation with the Saugeen Ojibway nation [61].

The Calandria-Shield Tank Assembly (CSTA) is an example of a major in-house research project. This project was looking for innovative ways to shorten the outage time for replacement of the calandria as a plug in module, rather than in-place refurbishment.

In addition to the annual report on COG R&D Activities, there is an annual status report on significant safety issues. References [62], [63], [64], and [65] represent the last four years reports. These safety issues involve both experimental and/or analytical research; some programs of mutual interest are cofunded by the CNSC.

5.3.1.2. Participation in Canadian Standards Association

Bruce Power participates actively in the Canadian Standards Association in the codification of existing practices and in the advancement of standards. In addition to the fundamental purpose, it provides an opportunity for developing awareness of new technologies from other committee participants. It represents a considerable commitment, but it is consistent with operating a major enterprise, as well as undertaking design, procurement, installation and commissioning.

A snapshot in January 2015 showed that Bruce Power had direct representatives on 53 of the 62 CSA nuclear committees or subcommittees. There was a sum of 89 person-committee representatives; up to 5 participants in one committee, with an average of 1.7 persons per committee for the 53 committees where Bruce Power was represented. Some individuals contributed to multiple committees; for example one individual participated in as many as 8 forums. There were 52 unique individuals exposed to the CSA Standards committees. As part of its continuous improvement efforts, a position was created within Nuclear Oversight and Regulatory Affairs to provide more formal oversight to the company's CSA Group activities. Appendix D lists the committees and the number of Bruce Power representatives on each.

5.3.1.3. Research Summary

This description introduces the extent of R&D activities that Bruce Power undertakes. It is consistent with operating a major facility. The review task has an emphasis on having processes in place to undertake and co-ordinate research, and assimilate it into standards and procedures at Bruce Power.

5.3.2. Fundamental Behaviours and Training

Bruce Power has a set of fundamental behaviours [66] to [77] that apply to most technical jobs. A review of these procedures shows that OPEX is mentioned in most of them, and often in the context of Nuclear Safety Culture. For engineering [70], there are specific job tasks for Section Managers to use OPEX as part of their "Communications and Advice" role, and for Workers in their "Critical Thinking" role. Chemistry [71] was the only one that mentioned the INPO "Must-know OPEX" documents [78] to [81] directly, although this series of documents is part of the training curriculum at Bruce Power. Relevant material from the INPO Must Know OPEX documents should be systematically incorporated in Bruce Power's Fundamentals documents.

Training is required to promote Nuclear Safety Culture and continuous awareness, which is discussed in Section 5.3.2.1.

5.3.2.1. Continuous Awareness and Indoctrination

Bruce Power has advanced the deployment of OPEX awareness significantly over the past few years. In addition to specialized training for staff directly involved in OPEX and SCR processing, all staff have an introduction to OPEX as part of their General Employee Training (GET) and have continuing training according to their job function. This is documented in the training department TDQ-00010 R004, General Employee Training, Training and Qualifications Description, October 2014 [82]. Specifically it states that:

> *"6.2 Continuing General Employee Training*
>
> *…*
>
> *On an annual basis, the GET CRC shall recommend topics for inclusion in GET Continuing Training that focus on maintaining and enhancing employee knowledge and capabilities. In particular, it shall include discussions about the following topics when applicable:*
>
> - *Degraded human performance.*
> - *Plant modifications or equipment changes that impact employees' daily activities.*
> - ***In house and industry operating experience** or regulatory changes.*
> - *Special plant operations or maintenance activities of importance to general employee audiences … "*

This training regimen shows Bruce Power's commitment to ensuring employee awareness and use of OPEX.

5.3.3. Major Design and Design Change Initiatives

As repeated throughout this report, the objective of the Bruce Power Operating Experience Program is to define the processes used to identify and capture lessons learned from sources within Bruce Power, and external to Bruce Power, in order to continuously improve performance by making improvements to Processes/Procedures, Training, or System/Equipment Design. This fosters a healthy nuclear safety culture in all aspects including reactor safety, radiation safety, industrial safety and environmental safety management. This is particularly important when a complex design initiative is being undertaken. This section enumerates some of those design initiatives and summarizes the use of OPEX at Bruce Power in the assessment of these major projects. This demonstrates the effective use of OPEX at Bruce Power.

The reports reviewed in Sections 5.3.3.1 to 5.3.3.12 provide examples of the success of the OPEX process, in that the focus of each is on the useable information gained through application of the process.

5.3.3.1. Fukushima Impacts

One of the most ubiquitous pieces of OPEX in recent times, inside or outside the global nuclear industry, is the nuclear event at Fukushima, Japan. Observation of actual consequences galvanized the nuclear industry to act to be capable of responding successfully to a beyond design basis event in the future. About 4 years have passed and it has consumed (deservedly) a huge amount of attention and could for decades. The industry was able to respond because it already had a foundation of knowledge and tools based on previous events, through analysis and observation of the plant responses to transients and upsets, and through ongoing R&D (e.g., hydrogen behaviour in containment).

Following the Fukushima event there were hundreds of event sequences and operator and plant behaviours (OPEX) published by prestigious organizations like WANO, IAEA, INPO, EPRI and United States Nuclear Regulatory Commission (US NRC), in addition to the CNSC and COG. Reference [83] describes some of the contributions from WANO during the event and immediately following the event, and lists some of their OPEX reports. Significant Operating Experience Report SOER 2013-2, Post-Fukushima Daiichi Nuclear Accident Lessons Learned [84] is an example. This SOER, based on INPO 11-005 Addendum, Lessons Learned from the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station, provides recommendations that WANO members' operating nuclear facilities should follow and the associated schedule for WANO members[12].

The CNSC marshaled a full Canadian response to the incident in concert with the Canadian nuclear industry. Immediately following the event, the CNSC conducted a reactive inspection at Bruce Power [85][86] based on lessons learned, and It published the Fukushima Action Plan which spawned 36 Fukushima Action Items (FAIs) [87]. As reported in Section 7 of Safety Factor 2, Bruce Power has responded to the FAIs with design, mitigating equipment, and operating procedure revisions to be able to cater to this type of event for a CANDU plant. Bruce Power continues to report semi-annually on progress [88][89][90]. The status table attached to the latest report [90] indicates 31 of 36 actions are closed plus one is "Not Applicable". Of the 31 "previously closed", there are approximately10 new CNSC actions tracking completion and one action has been transferred to a previous 2009 action.

This piece of OPEX demonstrates both the production of OPEX and its immediate use to make changes to provide the ability to respond to BDBAs in a reactor of a different type.

[12] All commercial nuclear station operators world-wide are members of WANO.

5.3.3.2. West Shift Plus

Bruce A fuel channel life and degradation mechanisms are managed in accordance with the Fuel Channel Life Cycle Management Plan (B-PLAN-31100-00001 R03 [R005][13]). Of all the degradation mechanisms that affect Fuel Channel life, elongation is the most limiting in Unit 3. Other mechanisms are not predicted to limit life prior to 210 thousand effective full power hours (kEFPH). It is a code requirement to avoid channel elongation causing the fuel channel to go off-bearing.

A review in the form of a calculation note [91] was issued to document the review of operational experience in support of West Shift (WS+), a major program intended to offset the lifetime elongation of the fuel channel. The aim of the review was to identify and implement lessons learned from similar events at Bruce A and Bruce B and other CANDU plants worldwide.

The COG Screened Events database and Bruce Power SCR database were reviewed from January 1990 to December 2010 for events from previous West Shift programs. The Bruce Power SCR database contains events from Bruce A Units 1 to 4 and Bruce B Units 5 to 8. The COG Screened Events database contains events from all CANDU reactors and world view events from various sources (i.e., CNSC, IAEA, INPO, US NRC, WANO, and Vendors).

This report provided 18 OPEX inputs that would affect the West Shift on a range of topics from PT/Calandria Tube (CT), welding, feeder clearances, records keeping, and doses to workers which were used in the development and implementation of WS+.

5.3.3.3. Feeder Conceptual Engineering

NK21-REP-33126-00071, OPEX Review Report for Bruce A Unit 4 MCR Feeder Conceptual Engineering [92] describes preparations to replace the Feeders and other components in Unit 4 under an MCR program. The replacement feeders needed to be designed to comply with modern codes and standards, incorporate design improvements made to the feeder piping and supports as CANDU technology has evolved, and to address Operating Experience. As part of this Conceptual Engineering phase, an OPEX summary was required to identify and review known design-related issues for feeder piping and feeder supports in CANDU reactors.

The objectives of this report were to:

- Search OPEX databases from CANDU organizations (COG, WANO, BNGS, PLGS, DNGS, PNGS, KANUPP, etc.) and summarize relevant findings.
- Document and understand the failure and degradation mechanisms of feeder piping in CANDU reactors.
- Compile a list of lessons learned and design-related mitigating actions for feeders, so these can be considered in the conceptual, preliminary and detailed engineering phases of MCR program at Bruce Unit 4.

[13] Revision numbers in square braces indicate the current revision number. R003 was the revision used for the OPEX assessment.

The COG screened events database and Refurbishment OPEX Management database containing events from all CANDU reactors and worldwide organizations were searched using a list of keywords for issues applicable to the MCR Feeder Piping/Support design.

The following sources of OPEX were examined in this report:

- Bruce Feeder Life Cycle Management Plan (LCMP)
- Bruce SCR Database Review
- COG OPEX Database Review
- Subject Matter Expert Input

Topics covered in the findings of this report included input for items such as piping materials, bend radii, cracking, clearances and fretting, chafing shields, hangers and supports issues, and seismic spacers and dampers, to name a few.

5.3.3.4. Annulus Gas Modification

The report NK21-REP-34980-00010, Modification to Annulus Gas System - OPEX Review Report [93] documents the results of a search of a) the Bruce SCR database, b) OPEX database, and c) INPO OPEX database.

The report identified 5 items in the Bruce SCR database (from SCRs in 1998 to 2003), 2 in the OPEX database (one from Darlington in 2002), and 1 from the INPO database (from 1986).

Unfortunately, this review from 2009 was too early to capture the events of circa 2011-2012 where there were multiple issues with annulus gas systems at Bruce. No updated report was found (based on a title search) and apparently no specific OPEX was available to indicate the impact of clearances on gas streams passing through the end fittings.

5.3.3.5. Refurbishment Lessons Learned

At the end of the Units 3 and 4 Return to Service, Bruce Power assembled the various lessons learned from members of the Restart Team. The senior Bruce Power VP previously in charge of Units 3 and 4 Restart subsequently summarized this information for industry participants in a keynote address to the 2004 Canadian Nuclear Society Conference (outgoing OPEX) [94].

The Units 3 and 4 project collected OPEX information from Bruce Power participants and also contractors working on major support projects such as BARSA (Bruce A Restart Safety Analysis). These reports have been archived in Bruce Power's legacy documentation system (e.g., [95]) for use by future projects. The lessons learned included both technical and organizational information (such as the interaction among Bruce Power and contractors and consortia of contractors).

During the Units 1 and 2 Return to Service (Refurbishment), Bruce Power added to this database [96] through lessons learned on the refurbishment, plus augmented it by polling previous participants in the Units 3 and 4 Restart. This database was used during the Units 1 and 2 Refurbishment and is available for future refurbishments.

5.3.3.6. Fischer and Porter Controller Replacements

Two OPEX reports deal with replacement of ageing/obsolete Fischer and Porter controllers - a) NK21-REP-60458-00002, OPEX Report for Bruce A Fischer and Porter Controller Replacement [97], and b) NK21-REP-60458-00009, Operating Experience Report for Bruce A Fischer and Porter Controller Replacement (Long Term Solution) [98].

The first report [97], generated a summary of an OPEX review to investigate the experience operators have in replacing obsolete analog controllers. The Fischer and Porter controllers were deemed obsolete (spare parts) starting in the early 2000s. The chosen replacement was then found to be unsuitable/unreliable.

The databases searched included Bruce Power's internal SCR database (Bruce A and Bruce B), as well as COG, WANO, JIT and INPO OPEX databases, plus Worley Parsons internal OPEX. The COG search covered databases from the following plants and organizations: Bruce Power, Cernavoda Romania, Darlington, Embalse, Gentilly, Pickering, Pt Lepreau, Qinshan, Wolsong, OPG, OPGN, Cameco, EPRI, Kinectrics and US DOE. At the same time the authors investigated possible replacement controllers from manufacturers such as Honeywell, Emerson Process Management, Siemens Energy and Automation, Rockwell Automation, Ivensys Foxboro, Yokogawa, Rosemount, Smar and Endress & Hauser. The search for replacements involved both nuclear and non-nuclear application providers.

The second report [98] had basically the same objective, to find a replacement for the F&P controller that was obsolete and failing regularly with limited spare parts. Again, there was a focus on defining a replacement for the F&P devices and the ABB devices which were emerging as unsatisfactory. The OPEX searches were conducted with essentially the same databases as for the previous report, except INPO was not accessed.

Of the 77 records identified searching the Bruce Power SCR database to attempt to itemize issues not to be repeated, few useable items were found. Many of the items were related to logistical reports, such as incorrect model installed, scope changes, etc., not associated with the equipment performance itself. Of the three useable results, one was incorrect adjustment of a range limiting potentiometer, and the other two had insufficient information to reach a conclusion.

For the 250 hits for ABB controllers, there were items that revealed generic issues such as displays that were radioactive and also containing Mercury (hazard), propensity to spuriously switch to manual mode and absent alarms from some functions, failure caused by DCC transfer of control, display failures, failures caused by power cycling, internal battery failures, and so on. The search confirmed the troublesome history of the devices.

A search of the COG database also showed pertinent examples where the controller failure/mal-output led to other unwelcome items such as SDS trips. Similarly, searching for the ABB controllers yielded useful information on hardware items such as shorting caused by the backplate and a stuck pushbutton leading to an unintended boiler level change.

These two reports demonstrate the use of previously collected OPEX to avoid repeating selection of poor performance characteristics.

5.3.3.7. Bruce Units 1 and 2 Startup Instrumentation

Bruce A Units 1&2 restart required a new in-core Start-up Instrumentation (SUI) system because the existing in-core SUI system uses BF3 detectors which cannot be used in refurbished Units 1 and 2 reactors for initial fuel loading because high gamma radiation (γ > 1000 R/h) in the calandria which would have caused BF3 detectors to fail and lose their sensitivity for low neutron flux monitoring. The proposed design adopted Fission Chambers/Counters as in-core detectors which can detect very low neutron thermal flux. The SUI system consisted of Start-up Unit (SUU) and Start-up Instrumentation. SUU is a mechanical guide tube assembly inserted through the view -port. An Operating Experience Review (OER) was performed to identify any issues relating to the current design to ensure they were addressed in the modification. As adopting the fission counters/chambers as in-core detectors in a refurbished core was being done for the first time, the suitability of such modification to SUI was provided in a separate AMEC NSS report for Bruce Power. The purpose of the OPEX report [99] was to document operating experience with regard to the original and current designs.

The COG Screened Events database and the Bruce Power SCR database were reviewed in September 2008. The Bruce Power SCR database contains events from Bruce A units 1 to 4 and Bruce B units 5 to 8. The COG Screened Events database contains events from all CANDU reactors and worldwide events from various sources (i.e., IAEA, WANO, and Vendors).

There were 140 search records for NuSCI 63716 and 13 records were determined to be relevant; there was 0 search record for NuSCI 31739, 0 records for fission counter; there were 3 search records for VIEWING PORT, 19 records for fission chamber, 191 records for Start-Up Instrumentation, 1731 records for SUI, 32 records for BF3, 24 records for in -core detector, and none of them was related to the proposed modification.

Based on the OPEX records received, the report describes the confirmation of issues with BF3 detectors in high gamma fields, and provided information on some other characteristics of the fission chambers that enabled a new set of design requirements to be produced.

The redesigned SUI was used successfully for both Units 1 and 2 startups.

5.3.3.8. Bruce Units 1 and 2 Secondary Control Area

As part of the plant design requirements upgrade, Bruce Power was required to design and install a Secondary Control Area (SCA) as part of the Unit 1 & 2 return to service project. This SCA has the ability to control, shut down, cool down and monitor the reactor performance in the event that the main control room becomes uninhabitable. Another SCA, in room R3-116, was provided as part of the Unit 3 & 4 restart project to perform a similar function. The Units 3 & 4 SCA project was larger in scope as Containment, Emergency Coolant Injection (ECI) supply, Emergency Filtered Air Discharge System (EFADS) and other common systems were included.

Per the Engineering Change Control process for modifications to systems at Bruce Power, an Operating Experience Review (OPEX) was to be conducted during the preparation of the Modification Outline. The Modification Outline was prepared and two Design Change Packages

(DCP3268 and DCP3269) were identified for the project. The OPEX review was conducted [100] and the results were documented in the Modification Outline.

Subsequent to the issuing of the Design Change Notices (DCNs) for the project, a Design Review was held for the SCA project. The review was documented in report B-REP-63760-10Jul2009: Secondary Control Area Final Design Review Report Bruce A Units 1 & 2 Restart Project. An action was placed on Acres-Sargent & Lundy-Fox (ASLF) to prepare an OPEX report to expand upon the SCRs which are currently listed in the Modification Outline, clearly describing how they have been implemented in the design.

This report documents 28 OPEX issues (SCRs and ARs) that affect the SCA and makes recommendations for outstanding issues.

5.3.3.9. Bruce Units 3 and 4 Containment Vault Crane

This OPEX report, NK21-REP-76111-00001, OPEX Report Bruce A Unit - 3 & 4 Containment Vault Crane [101], is unique because it has also been assigned a TBA (Technical Basis Assessment) category in PassPort.

The condition of the Unit 3 and Unit 4 vault cranes has been deteriorating for a number of years due to the age and obsolescence of components. These cranes perform a critical role during outages and any failure can result in a significant delay to outage schedule and critical path. For this reason any failure of these cranes is unacceptable, and their condition must be improved in order to improve reliability.

In preparation for the upgrade of the vault cranes in Units 3 and 4, a search for OPEX associated with the operation and the upgrade of the cranes in the other units was conducted. The information was reviewed and evaluated.

The primary objective of OPEX was to “Use external operating experience information to identify, evaluate and apply lessons learned to improve plant safety, reliability and commercial performance through improvements to processes, procedures, training and system /equipment design”.

This report addresses OPEX pertaining to plant reliability and commercial performance, while the design of the crane itself is pertinent to plant and personnel safety.

There were five ARs discovered that were pertinent to the reliability issue of the cranes. There was a detailed analysis and Lesson Learned from each of the five. Quality Issues with important components (e.g., push buttons) assisted with avoiding a costly delay. An important lesson learned related to engagement of all the stakeholders and communications between technical staff and others, such as Supply.

The distinctive element of this “TBA” OPEX Report compared to others reviewed in this Safety Factor Report was that detailed lessons learned were itemized for each observation.

5.3.3.10. Calandria Tube – LISS Gap Inspection Tooling

NK29-REP-31911-00001, OPEX Report: CT-LISS Gap Inspection Tooling [102] is the first of two Bruce B OPEX reports included as Bruce A “external” OPEX. According to information in the report, this tool has also been used at Bruce A.

As part of the research mandate of COG, a life assessment of in-service calandria tubes was carried out. It was noted that the sag rate of calandria tubes with respect to the Liquid Injection Shutdown System (LISS) and Horizontal Flux Detector tubes will eventually result in contact. The postulated lead channels were noted to be in rows 'F and 'S' at Bruce B (with the highest power channels in these rows being the most likely candidates for leading contact).

It was concluded that calandria tube sag measurement and CT-LISS clearance measurements were required as inputs to determine both the number of potential Calandria Tube Replacement (CTR)/ Single Fuel Channel Replacement (SFCR) targets as well as the potential to reduce the number of channel replacements.

The report also notes the postulated Effective Full Power Hours after a Pressure Tube Rupture until the Calandria Tube (CT) is once again nearing CT-LISS contact.

The CT-LISS tooling was originally developed to perform inspections of CT to LISS nozzle gaps within three CTs from the view port. However, many of the smallest expected gaps are located further than 3 CTs from the view port. To be able to obtain measurements at these worst case gaps, a new inspection tool was required that could be installed through both an Adjuster Absorber guide tube and a Shut-Off Rod guide tube, such that the inspection tool could be positioned closer to the critical targets

NK29-REP-31911-00001 [102] addresses the Engineering Change Control requirement for an OPEX review.

There were many Lessons Learned in this OPEX review, such as lessons involving additional care in specifying the equipment materials, the setup and alignment procedures, stronger attention to foreign material exclusion (FME), and better communication between the supplier (Candu Energy Inc.) and Bruce Power.

5.3.3.11. Replacement of Even Side Class 1 250 VDC Battery Banks

NK29-REP-55100-00007, OPEX Report - Replacement of Even Side Class 1 250 Vdc Battery Banks [103] summarizes the findings of the OPEX review performed to support the Design Change Notice (DCN) to replace the Class I batteries at Bruce B. Specifically, there was a search for the experience of nuclear operators as it applies such a replacement.

The search was for experience with the existing batteries 55100-BY1, 55100-BY2, NuSCI number 55100, and battery manufacturers such as GNB, Enersys, Exide, C&D, and YUASA.

The databases searched included Bruce Power's internal SCR database (Bruce A and B), as well as COG, WANO and INPO OPEX databases. Also, the Nuclear US NRC source was searched for experiences with these types of batteries in other nuclear stations around the world.

The Bruce Power SCR database, as well as COG, WANO and INPO, identified multiple findings of low voltage cells, small cracks on upper corners of the jar (casing) where the jar meets the cover. During a seismic event, it is unknown how the cracks would affect electrolyte leakage and may contribute to battery failure. Other failures would be deformed battery cells, battery bank degradation, vital battery loss of capacity, etc.

Assessment of the search revealed that C&D and GNB manufacturer's recorded a lower number of failures (11, 14 respectively) compared to Enersys.

The US NRC OPEX collection also indicated battery failures reports/bulletins for failures such as solvent-induced case cracking, degraded cell, corrosion within the battery, and cracking of the battery jar.

The WANO database provided no additional information other than that already shared through COG.

Overall, this report achieved the objective of providing OPEX to determine what the failure modes might be and what manufacturers' reliability rates are.

5.3.3.12. HF OPEX Summary Report for Bruce Reactor Inspection and Maintenance System (BRIMS)

The Bruce Reactor Inspection and Maintenance System (BRIMS[14]) uses a combination of current existing tools, modified existing tools and new tooling. The report, B-REP-30530-00001, Human Factors OPEX Summary Report for BRIMS [104] records the results and assessment of searches of the following OPEX databases:

- SCR,
- COG, and
- WANO

regarding existing tooling including, but not limited to:

i) Channel Inspection and Gauging Apparatus for Reactors (CIGAR);

ii) Spacer Location and Repositioning (SLAR);

iii) mini-SLAR, Replica;

iv) Non-Destructive Examination (NDE); and

v) Universal Delivery Machine (UDM), which is the current delivery method prior to the BRIMS project at Bruce B.

[14] BRIMS is a system of tooling and processes currently under development with the objective of delivering the full suite of fuel channel inspection and maintenance activities including the Fuel Channel Inspection tool (a merger of CIGAR and Advanced Non-Destructive Examination [ANDE]), SLAR, Replica, CWEST and Modal Detection and Repositioning (MODAR) to be used at Bruce A and B in an efficient and fully integrated manner, using a common delivery platform.

Additionally, a review of any relevant investigation reports or incident reports from investigations into previous errors or problems with the use of any of the tools was conducted in the SCR/COG searches.

The OPEX sections from the Circumferential Wet Scrape Tool (CWEST) Human Factors Engineering Summary Report (HFESR) in B-REP-06700-00004 were also reviewed.

As the BRIMS design is similar in features to the mini-SLAR system, outage activities from A1241 for the current mini-SLAR system were observed to capture relevant OPEX from current system users.

Additionally, interviews were conducted with similar system users, field operations and maintenance personnel who have experience utilizing the current tooling for fuel channel inspection and maintenance.

There were 2258 SCRs, 260 COG events and 100 WANO events which yielded 150 items that were applicable to the BRIMS project [104]. The report contains a detailed table of the OPEX search and dispositions.

Overall trends found in the OPEX reviews included: maintenance, installation, configuration issues, vault layout, physical equipment issues, physical interferences, alignment issues onto channel, loss of power, loss of control system, storage area issues, maintenance area issues, outage logistics, procedures, training, communications, documentation, tool and Delivery Machine (DM) communications, software, radiation protection, factory acceptance testing, medically treated incidents, physical layout, transportation, movement, cabling, troubleshooting, workspace issues, human machine interface (HMI) controls and indication. All of the OPEX findings were presented to the project team for recommendations and dispositions proceeding into the detailed design phase of the BRIMS project.

This OPEX review shows the depth of OPEX information and diversity of observations that can be achieved for new or refined uses of tools.

5.3.3.13. OPEX Guidance for Design and Deployment of 37M Fuel

The consequences of making errors during the introduction of a new fuel type are obvious – interfacing systems such as fuel handling, reactor physics issues, thermal hydraulic issues, and fuel channel interactions are a few of many parameters to consider.

During the deployment of 37M fuel, the fuel designers considered about 50 parameters. There was an OPEX report for each parameter, leading to a successful design, fabrication, testing and launch campaign, with no incidents.

5.3.4. Compliance Reporting

As noted in Section 4.3, Bruce Power is bound by its licence [17] to “notify and report in accordance with CNSC regulatory document S-99 entitled: Reporting Requirements for Nuclear Power Plants” noting that CNSC S-99 has since been superseded by CNSC REGDOC-3.1.1 [22]. One of the provisions of CNSC REGDOC-3.1.1 (and S-99) was that the licensee is required to report on items it finds may be different in nature or probability than previously stated. OPEX screening is one source of such reports. One sequence that occurred in the last two years or so demonstrates the effectiveness of the OPEX process. In Reference [105], the CNSC wrote to Bruce Power enquiring whether the OPEX program had responded to a Darlington S-99 report where the COG OPEX database had been populated with an event that had concluded that there could be gaps in the shift complement in terms of handling a BDBE. In its response [106], Bruce Power clarified that the database entry was preliminary and that while Bruce Power had been aware of the event through the regular COG OPEX weekly meeting(s), no detailed information was available so it was premature to engage in speculation. The event had been marked for follow-up by Bruce Power and in the response committed to providing an After Action Report (AAR) on the findings of minimum shift complement arising from the Huron Challenge Severe Accident Management Exercise. Bruce Power provided that AAR in [107], where it also provided a detailed licensing basis for minimum shift complement.

5.4. Summary

The foregoing examples are a small sample of the effective use of OPEX at Bruce Power. They demonstrate the deployment and use of OPEX in meeting all three review tasks described in Section 5.

Bruce Power typically meets the requirements of review tasks applicable to OPEX and R&D, although gap SF9-1 has been identified.

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 2: Actual Condition of SSCs” in Section 5.10, addresses the use of available internal and external OPEX information including COG, WANO and the SCR databases to evaluate the operating history of SSCs.
- “Safety Factor 4: Ageing” in Section 4.2, assesses the continuing equipment reliability improvement including the technical basis assessment which considers internal and external ageing degradation.
- “Safety Factor 5: Deterministic Safety Analysis” in Section 5.2, reviews the current state of deterministic safety analysis including the use of relevant OPEX in the Safety Report and Safety Report Improvement plan.
- “Safety Factor 6: Probabilistic Safety Analysis” in Section 5.3, reviews the sufficiency of scope and applications for the probabilistic safety analysis which includes regular updates to the model to incorporate accumulated significant changes stemming from various sources including operating experience.

7. Program Assessments and Adequacy of Implementation

Section 7 supplements the assessments of the review tasks in Section 5, by providing information on four broad methods used to identify the effectiveness with which programs are implemented, as follows:

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

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

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

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

7.1. Self-Assessments

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

The self-assessments:

- Identify internal strengths and best practices;
- Identify performance and/or programmatic gap(s) as compared to targets, governance standards and "best in class";
- Identify gaps in knowledge/skills of staff;
- Identify the extent of adherence to established processes and whether the desired level quality is being achieved;

- Identify adverse conditions and Opportunities for Improvements (OFI); and
- Identify the specific improvement corrective actions to close the performance/programmatic gap.

7.1.1. SA-HP-2011-01, Screening and Evaluating External OPEX

The objective of FASA SA-HP-2011-01 was to evaluate the process used to screen external OPEX for applicability at Bruce Power and, create corrective actions to learn from that external experience, as per BP-PROC-00062. It provided insight into where the OPEX screening and evaluation process is working well and where it is not. The outcome was that areas were identified where OPEX screening could be improved, especially in the context of adherence to the need to assimilate and distribute OPEX. These presented improvement opportunities.

Section 4.4 of BP-PROC-00062 deals with Screening and Evaluating External OPEX.

While the FASA does not assess the respondents' knowledge of the following sources of external OPEX, the auditors confirm that the sources are part of the OPEX evaluation process:

- Nuclear: COG, WANO, INPO, U.S. NRC, IAEA, and EPRI.
- Non-nuclear: Ministry of Labour (MoL), Ministry of the Environment (MoE), Canadian Oil and Gas Industry, U.S. Department of Energy, U.S. Chemical Safety Board, British Oil and Gas industry.

The positive aspect of this observation is that these are common endorsed external sources for the Bruce Power OPEX.

The FASA keyed on the same procedures as on the Bruce Power OPEX website's list of governing documents, namely:

- CSA N286-05
- BP-PROG-01.06
- BP-PROC-00062
- IAEA NS-G-2.11
- WANO PO&C
- WANO GL-2003-01

7.1.2. SA-NSAS-2010-03, Use of OPEX in Fuel Channels Life Cycle Management & Life Extension of Fuel Channels

The objective of FASA SA-NSAS-2010-03 was to determine whether fuel channel OPEX is being reviewed and used in a timely manner in Life Cycle Management Plans and fuel channel life extension. This was a Nuclear Safety Analysis and Support Department (NSASD) FASA, because NSASD provides support for fuel channel life cycle management.

The timely identification of fuel channel issues is critical to ensuring operation to end of life. A FASA reviewing the current processes for identification and use of fuel channel OPEX and interaction with the industry is beneficial in ensuring that all issues are being identified in a timely manner, and appropriate mitigation strategies are being developed.

The FASA was based on review of the existing Fuel and Fuel Channel management process for identification, communication and disposition of fuel channel issues. The Fuel Channel Life Cycle Management Plan (FCLCMP) and major fuel channel life extension work were also reviewed to determine whether OPEX had been identified in the fuel channel life cycle management process and used in a timely manner.

The FASA concluded that, in terms of the use of OPEX, the existing processes for Fuel Channel Life Cycle Management and Life Extension of Fuel Channels were found to be robust and reliable. A wide range of industry OPEX was identified and shared in a timely and consistent manner in a number of different forums. The FASA observed that it would be beneficial to share these good practices and lessons learned within NSASD to improve the effectiveness of OPEX use in other technical areas/groups within NSASD. Therefore, one action for opportunity for improvement was to roll out to NSASD staff good practices and lessons learned in use of OPEX for Fuel Channel Life Cycle Management to assist colleagues in understanding the benefits of OPEX.

There were no negative findings.

The FASA described 6 good characteristics (strengths) of the NSASD Fuel Channel group, largely based on communications, such as participation in industry meetings (CSA and COG), subscription to Newsletters, and Informal Meetings with Industry Partners.

7.1.3. SA-PI-2014-02, External OPEX Applicability Responses

The objective of this self-assessment was to assess the adequacy of improvements made in response to the 2010 Bruce A WANO Peer Review OE.4-1 area for improvement (AFI); namely with the evaluation of SOER and Significant Event Report (SER) related items.

The specific scope of the assessment was "… for Bruce A to assess its previous 2 years performance with the 'BP-PROC-00062 - Processing External and Internal OPEX - R013' standard for evaluating significant external OPEX (SOERs and SERs)."

A performance review of each component of the significant external operating experience (SOER and SER) evaluation process was conducted, gathering observations and feedback from leaders, supervisors, and workers involved in each of the various phases of the SOER evaluation process. The results of the assessment noted positive characteristics in all 7 review areas. It also revealed several opportunities to improve performance and efficiency with the SOER evaluation process.

There were no adverse findings requiring an SCR. Actions have been captured under AR #28426354 to track completion of the opportunities for improvement in a managed process. BP-PROC-00062 was reissued 10NOV2014 in accordance with the recommendations.

7.1.4. SA-PI-2013-02, OPEX - Utilization of Significant Internal OPEX

The objective of FASA SA-PI-2013-02 was to determine:

- Which products were provided from internal significant events, to assist corporate and station management oversight of Lessons Learned, and

- Which trending or aggregate reviews of significant investigations takes place in order for Bruce Power to identify trends of root causes, organizations, and corrective actions identified in root cause evaluations over time.

The report has a detailed assessment of which items are causing resets of performance indicators (e.g., reactor trips) for both Bruce A and Bruce B. The top five contributors were seen to be comparable for the two stations.

The FASA concluded that individual events evaluated by Root Cause Investigations (RCIs) already have Lessons Learned Briefings published for them. Since the creation of this FASA purpose statement, SCR-28382306 was raised on a lack of a process for communicating Lessons Learned from lower level events involving HU clock resets, ER clock resets, or ERBs. Therefore, they now have Internal Lessons Learned Briefings published for them, as well. Therefore, management is aware of and can use the results of these individual events. The potential for improvement was classified as “None”.

The report adds that Bruce A and B also produce quarterly Performance Assessment reports that look at overall trends of all SCRs at each station to identify the most often identified issues. However, these reports do not currently review trends and results from the most significant events (RCIs) by themselves, in order to examine the causes that are causing the company the most significant problems evaluated by the Corrective Action Program. The report concludes that this information needs to be made available in order to inform Management of the amount and trends of issues identified by RCIs, and/or validate other inputs to business decision making processes which occur at the VP and EVP level, or possibly even higher. Adverse conditions are in regards to:

- No Root Cause Investigation trending, and
- RCIs are not distinguished from other SCR data (so trending is not available).

The identified SCR # 28405724 was raised to have the Senior Advisor, OPEX begin to trend RCIs and meet with the Performance Improvement Peer Team to establish the parameters for reporting (performance metric, report format, reporting frequency).

7.1.5. SA-PI-2012-02, OPEX Training Materials

The explicit scope of FASA SA-PI-2012-02 was “Training and tools available to assist with OPEX external screening and evaluation process including interviews of selected Performance Improvement Coordinators and OPEX Subject Matter Experts.”

A process review and interviews with personnel involved in external OPEX screening were completed to determine the knowledge level and quality of training tools available. An interview of an OPEX Advisor peer at Darlington Nuclear Station and review of the Darlington external OPEX screening process was completed to benchmark Bruce Power’s process with that of a peer.

The review and interviews revealed that the process is straightforward and simple; therefore specific training would not provide an improvement in OPEX screening results.

Three opportunities for improvement were identified:

- Consider increasing the amount of time allowed to screen and evaluate external OPEX to increase the number of responses and quality of the evaluation;
- Pilot the exclusive use of AOPA[15] assign requests to evaluate external OPEX by one screening organization (Engineering); and
- Link Performance Improvement Coordinators to introductory level CANDU technical training to enable them to assist with the screening process.

There were no adverse conditions identified within the scope of this FASA, i.e., there were no issues associated with training for screening of external OPEX.

7.2. Internal and External Audits and Reviews

The objective of the audit process as stated in BP-PROG-15.01 [108] is threefold:

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

The objective is achieved by providing a prescribed method for evaluating established requirements against plant documentation, field conditions and work practices. The process describes the activities associated with audit planning, conducting, reporting, and closing-out. The results of the independent assessments are documented and reported to the level of management having sufficient breadth of responsibility for resolving any identified problems (as stated in Section 5.14.2 of [25]).

7.2.1. Internal Audits

7.2.1.1. AU-2011-00010, Performance Improvement

The objective of AU-2011-00010 [109] was to assess the elements of the following programs in the Performance Improvement Department: BP-PROG-00.07 R009 “Human Performance Program”, BP-PROG-01.06 R010 “Operating Experience Program”, and BP-PROG-01.07 R008 “Corrective Action” for completeness and implementation. The following focuses on the latter two. This was the routine audit required every three years.

The audit team conducted document and database reviews and interviewed the Corporate Functional Area Manager (CFAM). CAPs from SCRs, initiated as a result of previous related

[15] AOPA is an SCR screening label for the OPEX classification. It is “OPEX applicability review (non SOER and select list)” per BP-PROC-00060 and BP-PROC-0062.

audits, were reviewed and a search of programmatic SCRs related to the Performance Improvement programs was completed.

The audit concluded that “overall the programs within Performance Improvement are well documented and thorough (Strength)”.

BP-PROG-01.07 R008 was compared to the Pressure Boundary Quality Assurance Program (PBQAP) Section 15 “Control of Nonconforming Items", and Section 16 “Corrective Action”. There were some differences between the PBQAP and the Corrective Action Program implementing procedures which were listed in Adverse Condition No. 1.

There are non-adherences of the program documents to the requirements of BP-PROC-00774 R001 “Program Requirements”. There are also non adherences of implementing procedures to BP-PROC-00166 R019 “General Procedure and Process Requirements”. These were listed in Adverse Conditions 2 and 3, Adverse Condition No. 4.

Eighteen SCRs related to OPEX were reviewed.

No significant OPEX related to the Performance Improvement Programs was found in the COG OPEX database.

The adverse conditions were:

- Pressure Boundary Program requirements for control of nonconforming items, and corrective action, were not always aligned or are missing from the Corrective Action Program and its implementing procedures. Differences between the Pressure Boundary Program and implementing procedures could result in non-compliance to the program. ARs submitted and accepted;
- Performance Improvement programs BP-PROG-00.07 R009, BP-PROG-01.06 R010, and BP-PROG-01.07 R008 contained non-adherences to BP-PROC-00774 R001, “Program Requirements”;
- Performance Improvement implementing procedures for BP-PROG-00.07 R009, BP-PROG-01.06 R010, and BP-PROG-01.07 R008 contained non-adherences to BP-PROC-00166 R019, "General Procedure and Process Requirements"
- Some Performance Improvement program elements were not described in implementing procedures. Lack of instruction for program elements in implementing procedures may result in reduced effectiveness of the program.

ARs were submitted and accepted for all 4 Adverse Conditions.

In addition to the periodic audit, the auditee requested a comparison of BP-PROG-01.07 R008, and WANO GL 2001-07, “Principles for Effective Self Assessment and Corrective Action”. The corrective action aspects were reviewed, and yielded 9 gaps between the BP Program and the WANO Guidance.

Overall, the audit concluded that the OPEX aspects were sound. It also provided direction in improving the alignment and consistency of the documentation.

7.2.1.2. AU-2013-00018, Fluid Leak Management Program

AU-2013-00018 [110] was performed at the request of the Bruce B Plant Manager as part of an effectiveness review for an SCR follow up action. The management of fluid leaks at the stations was evaluated against BP-PROC-00673 R001, Fluid Leak Management Program (FLMP) requirements and referenced procedures.

The audit made use of OPEX (Benchmarking Trip to McGuire Plant in 2009, a Unit 7 Leak Incident, and SCR Searches). In addition, the Audit used an EPRI NUMAC guideline on Fluid Sealing Technology.

The audit concluded that BP-PROC-00673 R01 is not fully integrated with interfacing procedures resulting in incomplete or conflicting instructions. It identified opportunities for improvement of FLMP that would lead to improved performance in detecting, prioritizing, and resolving leaks and spills, as well as improving employee morale and workplace culture. Actions have been defined in the referenced ARs and will be undertaken in a managed process, with oversight provided by Nuclear Oversight and Regulatory Affairs (NORA) to ensure effectiveness. In addition, this audit demonstrated the use of benchmarking through collection of OPEX from external organizations.

7.2.1.3. AU-2010-00024, Root Cause Investigation Audit

The objective of AU-2010-00024 [111] was to evaluate compliance with BP-PROC-00518 R002 Root Cause Investigation of the Bruce Power Corrective Action Program, BP-PROG-01.07 R008, and to determine its effectiveness. The audit assessed the Root Cause Investigations completed, or in progress, from June 2008 to the time of the audit, January 2010. It is pertinent because Root Cause Investigations are part of the input stream for OPEX (via SCRs raised in the process).

The audit team observed a CARB Meeting and conducted interviews of Performance Improvement Department personnel. They also performed reviews of procedures, Station Condition Records, Action Tracking assignments and Root Cause Investigation records.

The audit concluded that instructions provided in BP-PROC-00518 R002, Root Cause Investigation, were not always clear and there were procedural misalignments with the governing document and other interfacing or reference procedures. As a result, the purpose of BP-PROC-00518 R002 was not always achieved with respect to consistency and comprehensiveness, as a number of non-compliances were observed. The RCI process was not always effective at initiating required RCIs and completing identified RCIs in a timely manner.

In the OPEX area, the audit observed that industry best practice for Root Cause Investigations is 28-30 days. This time line has been adopted by Bruce Power; however, it has not been enforced. Excessive completion times for RCI conduct has been previously identified as an AFI by WANO (i.e., AR#28181670) and questioned by the Nuclear Safety Review Board. This has an impact on the timeliness of the OPEX but the OPEX process *per se* was not an element of the review.

The audit issued the following Adverse Conditions:

- Root Cause Investigations are not completed in a timely manner
- Root Cause Investigations are not always initiated as per requirements established In BP-PROC-00060 R016
- Non-compliances with BP-PROC-00518 R002 - Root Cause Investigations Procedure, Section 4.6.5, Joint Health and Safety Committee (JHSC) Presentation
- BP-PROC-00518 R002 - Root Cause Investigations (RCI) Procedure does not always provide clear Instructions to ensure consistent and comprehensive RCI conduct
- Non-compliances with BP-PROC-00518 R002 - Root Cause Investigations Procedure Section 4.3, Develop Corrective Action Plan
- Root Cause Investigation Process Records are not clearly identified and appropriately managed resulting in noncompliance with CSA N286-05 requirements
- Root Cause Investigation Procedure does not conform to Bruce Power requirements.

All adverse conditions and corresponding SCRs were accepted by the Performance Improvement Department for follow up in a managed process.

7.2.1.4. AU-2010-00007, S-99 Reporting

AU-2010-00007 [112] is about S-99 reporting, and is relevant to OPEX because these reports generate OPEX data points and are passed on to external agencies (e.g., COG). With the replacement of S-99 by CNSC REGDOC-3.1.1 on January 1, 2015, and the parallel nature of the two regulations, this audit still applies to the reporting function in general.

The surveillance evaluates the compliance of a sample of S-99 reportable events to the S-99 Reporting Standard and Bruce Power's reporting processes. Events contained in privileged root cause reports are included in the sampling. The surveillance is a follow-up to an audit conducted in 2007 and evaluates the effectiveness of corrective actions taken in response to the identified adverse conditions.

Sample S-99 events requiring root cause investigation were analyzed for adherence to reporting guidelines. No issues were noted within the 5 reports reviewed.

A previous audit, AU-2007-00032 generated two adverse condition SCRs which were analyzed for completion and effectiveness of corrective actions.

Adverse Condition #1 related to the fact that the body of BP-PROC-00059 R016, Event Response and Reporting had been updated but the Appendix had not, leaving the situation that the body of the procedure called for the Duty Manager to be responsible for immediate reporting whereas the Appendix still said the Shift Manager (or SAT) could submit the immediate report. Preliminary and Detailed S-99 reports were found to be prepared and submitted to the CNSC by personnel other than the required Duty Manager so the previous audits action was complete but ineffective.

Adverse Condition #2 is related to security, and as such is excluded from this Safety Factor Report.

No Opportunities for Improvement were identified. Two SCRs addressed the Adverse Conditions.

7.2.1.5. AU-2009-00026, CAMEO Review SCR B-2006-07441, Service Water OPEX

In 2006, WANO released Significant Event Report (SER) 2006-2 on the subject of degradation of emergency service water (ESW) system piping which caused the August 2004 circumferential rupture of an inspection hatch "neck" on a train of the ESW system at Vandellos-2 NGS. This finding resulted in the generation of Bruce Power SCR B-2006-07441 to address WANO SER 2006-2 "Degradation of Essential Service Water Piping", as is required by BP-PROC-00062. This was a follow-up audit [113] to determine the effectiveness of the implementation of this OPEX.

The subsequent CAP identified 8 corrective actions and, at the time of the audit, 6 of the actions were identified as COMPLETE. It looked at the 6 corrective actions marked complete and a "report-card" format was used to simplify the status reporting of the actions reviewed. The audit concluded that 3 of the 6 actions associated with AR #28043406 were not completed as indicated. This resulted in a 50% assignment completion rate and an indeterminate effectiveness rate.

SCR B-2009-05074 "Ineffective corrective actions associated with SCR B-2006-07441 OPEX WANO SER 2006-2" was entered into the SCR system. The audit noted that the SCR could be closed out for trending if the incomplete assignments were re-opened. The pertinent aspect of this audit is not whether the OPEX made it to field but whether processes were followed correctly (effectiveness). It is an example of the screening of external OPEX to generate a Bruce Power review, and to generate follow up actions. That worked, even if the execution required follow-up. In the meantime, the NORA Audit oversight has been put in place to ensure follow-up. As described at the end of Section 5.2, the Oversight audits have resulted in all of the ineffective actions being reopened for completion.

7.2.1.6. AU-2013-00005, RV Field Repairs

AU-2013-00005 [114] is the annual report on Relief valves in the general time frame for Audits in the Safety Factor and as such, it provides additional OPEX points. This same audit was used for Safety Factor 2, Condition Assessment. As mentioned in Safety Factor 2, relief valves support the operating limits for systems and are therefore pertinent to safe operation.

The previous audits in this series with the year identified in the serial number are shown in the following:

Number	**Title**
AU-2010-00037	Bruce A RV Field Repairs
AU-2011-00007	RV Field Repairs
AU-2012-00007	RV Field Repairs
AU-2013-00005	RV Field Repairs

These audits support BP-PROG-11.01 Plant Reliability Integration and meets the requirements of ANSI NB-23 National Board Inspection Code to evaluate Relief Valve (RV) field repair activities each year.

Bruce PROLs require a sustained pressure boundary program to carry out the pressure boundary activities for the nuclear facility in accordance with the requirements of CSA N285.0. In turn, CSA N285 requires the servicing of pressure-relief valves (Class 1, 2 & 3) to be based on ANSI/NBBI National Board Inspection Code (NBIC). NBIC Part 3 specifies Audit Requirements as: Upon issuance of a Certificate of Authorization, provided field repairs are performed, annual audits of the work carried out in the field shall be performed. The audit was to include, but not be limited to, performance testing, in accordance with NBIC Part 3, 4.5, of valve(s) that were repaired in the field.

The pressure relief valve program, accepted by the Authorized Inspection Agency (AIA) is required by CSA N285.0, as well as the station's Operating Policies and Principles. The program accepted by the Technical Standards and Safety Authority (TSSA) is BP-PROC-00078, Quality Program Manual for Testing and Repair of Pressure Relief Valves which requires annual audit of field repairs. “Field repair” is any repair conducted outside of the fixed repair shop location. The program also states that additional audits of testing and repair activities shall be conducted periodically.

Section 3, OPEX, of the audits deals with evaluating the effectiveness of previous audits. Adverse condition SCRs from the last three years' audits were evaluated for Completion and Effectiveness per the requirements of BP-PROC-00635 R007.

- From the 2010 series, 1 of the 5 Adverse Conditions was classified as complete and effective; 2 were complete but ineffective and the remaining 2 were incomplete and therefore ineffective.
- From the 2011 series, 1 of the 8 Adverse Conditions is still awaiting a CAP review, 4 were complete and effective, 1 was classified complete but ineffective and the remaining 2 were incomplete and ineffective.
- For 2012, of the 9 Adverse Conditions, 4 CAP reviews were completed and deemed complete as stated, 3 CAPs were evaluated as not likely to be effective without additional actions, 1 was incomplete and deemed ineffective, and the remaining was incomplete with effectiveness to be determined during the 2014 review.

The audit evaluated both nuclear and non-nuclear pressure relief valve program related activities at both stations. It encompassed a selection of work scheduled by the Passport work management process at Bruce A & B during the audit's conduct period. Additional reviews were conducted specific to Relief Valve Field Repairs. Observations included sampling of completed, ongoing and planned work, and records initiated after November 1, 2012.

The Bruce Power Relief Valve Quality Program field repair activities were found to be in compliance with the related Code requirements. However, some non-compliances with process procedures requirements and established Bruce Power expectations were observed. None of the identified non-compliances resulted in negative field consequences.

The testing and repairing of relief valves observed were performed in accordance with the Quality Program Manual, using calibrated tools, and following approved procedures. Applicable Code requirements were observed to be adequately established and effectively implemented.

Overall the RV shops at Bruce A and Bruce B were observed to be in good condition, clean and orderly. All sampled M&TE calibrated assets were found properly stored and within calibration due dates. The audit team noted the strong ownership of staff and supervision that directly implement the Relief Valve Quality Program. All staff was forthcoming and helpful (good culture).

Relief valve activities and work that was taking place during the conduct of the audit within the maintenance shops and in the field, including reviewed records of work already completed, were found to meet most of the program requirements.

Four adverse conditions and two opportunities for improvement were identified as a result of the audit.

- RV Quality Program Documentation Inadequacies
- Unclear RV Assessor Qualification Requirements
- Ineffective Corrective Actions to identified problems[16]
- RV UTC Trace Information Misalignments.
- OFI - Coordination of Audit Field Observations with scheduled in-situ RV activities
- OFI - Establishment of PRD Program Health Reporting Requirements.

This audit used OPEX to evaluate the effectiveness of previous audits, and in doing so added another OPEX data point to the Audits OPEX. The audit team initiated one SCR per item so the follow-up would occur in a managed process.

7.2.2. External Audits and Reviews

In addition to the regular internal audits, Bruce Power has had an independent nuclear industry evaluation of their nuclear oversight program [108] and a NORA improvement initiative where NORA continuously reviews the effectiveness of their Oversight against the WANO Performance Objectives and Criteria to learn the lessons from WANO 1 Stations around the world [115][116].

[16] Ineffective actions were reopened, see Section 5.2.

7.2.2.1. Nuclear Industry Evaluation Program Evaluation

The 2014 Nuclear Industry Evaluation Program (NIEP) evaluation of Bruce Power [117] found the Programs were effective in meeting the Nuclear Oversight Audit and Supply Chain Quality Services requirements. This assessment concluded that all of the 6 areas audited (operations, chemistry, engineering, equipment reliability, human performance and training) were effective. Within those 6 areas, 75 factors were satisfactory, although 9 areas that were satisfactory had recommendations, 3 had a deficiency and 1 was a strength. The deficiencies were in ensuring the reports were filed on time, to review the Nuclear Procurement reports on Suppliers, and the frequency of the Plant Operations Review Committee (PORC) meetings. The filing of reports was the key deficiency with respect to Safety Performance as it delays the raising of the Action Requests and their actions to complete the audit report deficiencies. The other two items did not impact Safety Performance. Each deficiency and recommendation was entered as an Action Request for follow-up in the Corrective Action and Action Tracking Programs.

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

7.2.2.2. NORA Assessment

The following few points demonstrate the scope of the NORA assessment. In the opening segment of its inaugural report [115], the NORA oversight team made the following observations:

- During Q2 2014 the Bruce A Nuclear Oversight Group worked on two large assessments:
    - The first one was on work process efficiency. This assessment involved the entire BA NORA team and included field observations and interviews across Control, Civil, Mechanical and Fuel Handling Maintenance sections. A problem development sheet was issued and insights are outlined in Section 2.3 [of the assessment].
    - The second assessment was a joint assessment with the Bruce B team on the Equipment Health Initiative. This commenced in June and is expected to be debriefed and finalized in July. Results from this assessment will be reported in the Q3 report.
- In addition to these large assessments that involved the whole team, some smaller assessments were conducted. Mirroring some of the assessments conducted during the Bruce B outage in Q1, NORA examined work in progress reviews and contractor safety. Rapid OPEX from the Bruce B deaerator FME cap event resulted in the BA NORA team

providing oversight of the A1431 Outage FME plans. Deviations from best practices and procedures were immediately noted and corrected.

The Report provided insight into the functioning of the NORA team and the culture it engendered: “It is noteworthy that the entire organization from the shop floor workers to upper management have been very open and honest with the BA NORA team. This has contributed positively to the depth of insights gained during the assessments this quarter”.

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.

7.3.1. CNSC Inspection, Bruce Units 1 and 2 IIP 47 (OPEX)

This CNSC Inspection for OPEX for the Units 1 and 2 Return to Service focused on training. The item was raised as IIP 47 from the corresponding Integrated Safety Review. Implicit in the acceptance of the IIP 47 was the acceptance of the remainder of the OPEX program (in circa 2004). IIP 47 was discussed in three correspondence letters as follows:

1. NK21-CORR-00531-08638, Action Item 110719: Bruce A Units 1 and 2 Return to Service: IIP[17] Completion Inspection - OPEX Program BRPD-2011-R-010 [118]

   This is the opening transmittal letter stating a compliance inspection had been completed in response to Units 1 and 2 IIP 47. The objective of IIP 47 was “…To ensure that internal and external operations experience is communicated to, and acted upon by, Bruce Power staff.” Readers will note this closely parallels the second review task in Section 5 of this Safety Factor Report. The CNSC inspectors noted that:

   > *“Although it was noted that the improvement to the OPEX program has been implemented, Bruce Power's training qualification document, TQD-00043 [119], does not contain the correct information or reflect actual practice.”*

   The CNSC agreed with the central assertion that internal and external OPEX was being communicated to and acted upon by Bruce Power staff.

   The nature of the non-compliance was that the TQD-00043 was not aligned with BP-PROC-00062 and did not reflect practice such that one qualification requirement should be removed.

[17] Bruce Units 1 and 2 Return to Service, IIP 47.

2. NK21-CORR-00531-08673, Action Item 110719: Bruce A Units 1 and 2 Return to Service: IIP Completion Inspection - OPEX Program BRPD-2011-R-010 [120]

   Bruce Power's response transmitting the updated document citing a review of BP-PROC-00062 indicated that some additional requirements should be removed.

3. NK21-CORR-00531-08746, Action Item 110719: Bruce A Units 1 and 2 Return to Service: IIP Completion Inspection - OPEX Program BRPD-2011-R-010 [121]

   The final letter was a simple statement from the CNSC accepting the updated TDQ-00043 as meeting the objective and closing the action.

In summary, the Bruce Power OPEX program was found to be acceptable with the correction of a mismatch of a training requirement from the actual situation, which has been completed.

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.

Bruce Power monitors a number of OPEX performance indicators, including the following:

- OPEX website usage
- Number of events reported
- Timeliness of event reporting
- External OPEX screening and action rate for Operations, Maintenance, Engineering, Radiation Protection, Industrial Safety and Work Management
- External OPEX screening in other support areas or programs, including Fire Protection and Emergency Preparedness, OPEX, Training, Environment, Chemistry, Supply Chain and Projects
- Bruce Power items posted to COG
- Actions taken by other COG members on Bruce A OPEX
- External OPEX "other industry" items screened.

8. Summary and Conclusions

The overall objective of the Bruce A ISR is to conduct a review of Bruce A against modern codes and standards and international safety expectations and provide input to a practicable set of improvements to be conducted during the Major Component Replacement in Units 3 and 4, and during asset management activities to support ongoing operation of all four units, that will enhance safety to support long term operation. The specific objective of the review of this Safety Factor is to determine whether there is adequate feedback of safety experience from nuclear power plants (both internal and external) and of the findings of research. This specific objective has been met by the completion of the review tasks specific to OPEX and R&D.

The review demonstrates that Bruce Power's OPEX Program and its implementation provides for adequate feedback of safety experience from nuclear power plants (both internal and external) and of the findings of research in support of continued safe and reliable operation. In addition, the review demonstrates that Bruce Power does not confine itself to utilizing OPEX from nuclear power plants only, but makes use of OPEX from any industrial process plants. Moreover, research activities are being pursued and results are used to enhance nuclear safety and equipment performance and reliability. This is regarded as a strength in Bruce Power's OPEX Program.

Table 5 summarizes the key issues arising from the Integrated Safety Review of Safety Factor 9.

Table 5: Key Issues

Issue Number	Gap Description	Source(s)
SF9-1	Bruce Power participates widely in external conferences, symposia, research projects, but no specific governance was found that fosters this participation other than tangential references in BP-MSM-1 Sheet 2 and BP-PROG-09.02.	Section 5.3.1

The overall conclusion is that, with the opportunity for improvement noted in Table 5, Bruce Power's programs meet the requirements of the Safety Factor related to OPEX and R&D.

9. References

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

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

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

[4] CNSC RD-360, Life Extension of Nuclear Power Plants, CNSC, February 2008.

[5] NK21-CORR-00531-03839, Bruce A Environmental Assessment Study Report, Bruce Power Letter, F. Saunders to P. Webster, December 7, 2005.

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

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

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

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

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

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

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

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

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

[15] IAEA INSAG-23, Improving the International System for Operating Experience Feedback, 2008.

[16] BP-PROG-01.06-R014, Operating Experience Program, Bruce Power, July 2014.

[17] NK21-CORR-00531-11272, Nuclear Power Reactor Operating Licence, Bruce Nuclear Generating Station A (PROL 15.00/2014), May 1, 2014.

[18] NK21-CORR-00531-11391, Bruce Nuclear Generating Station A Nuclear Power Reactor Operating Licence: Licence Conditions Handbook (LCH-BNGSA-R8), June 4, 2014.

[19] PROL 18.00/2020, e-Doc 4723908, Nuclear Power Reactor Operating Licence, Bruce Nuclear Generating Station A and Bruce Nuclear Generating Station B, June 1, 2015.

[20] LCH-BNGS-R000, e-Doc 4659316, Bruce Nuclear Generating Station A and Bruce Nuclear Generating Station B Power Reactor Operating Licence, June 1, 2015.

[21] CNSC S-99, Reporting Requirements for Nuclear Power Plants, CNSC, March 2003.

[22] CNSC REGDOC-3.1.1, Reporting Requirements for Operating Nuclear Power Plants, CNSC Regulatory Document, May 2014.

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

[24] CNSC RD/GD-99.3, Public Information and Disclosure, CNSC Regulatory Document/Guidance Document, March 2012.

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

[26] CAN/CSA N286-12, Management System Requirements for Nuclear Power Plants, CSA, June 2012.

[27] NK21-CORR-00531-11494, Response to Bruce Power Letter, CSA N286-12 - Management System Requirements for Nuclear Facilities, Action Item 1307-4697, CNSC Letter, K. Lafrenière to F. Saunders, July 24, 2014.

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

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

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

[31] BP-PROC-00062-R014, Processing External and Internal Operating Experience, Bruce Power, January 2014.

[32] BP-PROC-00137-R014, Focus Area Self Assessment, Bruce Power, June 2014.

[33] BP-PROC-00147-R015, Benchmarking and Conference Activities, Bruce Power, August 2014.

[34] BP-PROC-00892-R001, Nuclear Safety Culture Monitoring, Bruce Power, September 2014.

[35] BP-PROG-01.07-R010, Corrective Action, Bruce Power, August 2013.

[36] BP-PROC-00019-R009, Action Tracking, Bruce Power, October 2012.

[37] BP-PROC-00059-R021, Event Response and Reporting, Bruce Power, September 2014.

[38] BP-PROC-00060-R026, Station Condition Record Process, Bruce Power, July 2014.

[39] BP-PROC-00252-R011, Control on Nonconforming Items, Bruce Power, January 6, 2015.

[40] BP-PROC-00412-R006, Bruce Power Procedure, Trending, Analyzing, and Reporting of SCRs, August 2014.

[41] BP-PROC-00506-R007, Effectiveness Reviews, Bruce Power, May 2013.

[42] BP-PROC-00518-R007, Root Cause Investigation, Bruce Power, July 2014.

[43] BP-PROC-00519-R009, Apparent Cause Evaluation (ACE), Bruce Power, August 2014.

[44] BP-PROC-00644-R003, Common Cause Analysis, Bruce Power, August 2012.

[45] BP-PROG-06.03-R005, CNSC Interface Management, Bruce Power, December 18, 2014.

[46] BP-PROC-00165-R011, Reporting to CNSC – Power Reactor Operating Licences, Bruce Power, August 2014.

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

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

[49] BP-MSM-1-Sheet-0002-R014, MSM Approved Reference Chart Authorities and Responsibilities, Bruce Power, July 2014.

[50] FORM-11024-R025, Pre-Job Briefing and Post-Job Debriefing Checksheet, Bruce Power.

[51] FORM-11378-R004, Technical Pre-Job Brief, Bruce Power.

[52] FORM-11430-R010, Operator Pre-Job Briefing and Post-Job Review Checksheet, Bruce Power.

[53] INPO 12-012-R001, Traits of a Healthy Nuclear Safety Culture, Institute of Nuclear Power Operations, April 2013 (Addendum I, II).

[54] BP-PROG-09.02-R005, Stakeholder Interaction, Bruce Power, June 2014.

[55] NK21-CORR-00531-11262, CNSC Type II Inspection - Condition Assessments, Bruce Power Letter, F. Saunders to K. Lafrenière, April 29, 2014.

[56] NK21-CORR-00531-11054, CNSC Type II Inspection - Condition Assessments, CNSC Letter, R.Lojk to F. Saunders, January 17, 2014.

[57] NK21-CORR-00531-08672, 2011 Annual COG Research and Development Reporting, Bruce Power Letter, F. Saunders to K. Lafrenière, May 31, 2011.

[58] NK21-CORR-00531-09566, 2012 Annual COG Research and Development Reporting, Bruce Power Letter, F. Saunders to R. Lojk, June 25, 2012.

[59] NK21-CORR-00531-10469, 2013 Annual COG Research and Development Reporting, Bruce Power Letter, F.Saunders to R.Lojk, June 26, 2013.

[60] NK21-CORR-00531-11339, 2014 Annual COG Research and Development Reporting, Bruce Power Letter, F. Saunders to K. Lafrenière, June 16 2014.

[61] NK21-CORR-00531-10464, Saugeen Ojibway Nation / Bruce Power Whitefish Research, CNSC Letter, R. Lojk to F. Saunders, May 1, 2013.

[62] NK21-CORR-00531-08724, CANDU Category III Safety Issues: Annual Update, Bruce Power Letter, F. Saunders to G. Rzentkowski, June 30, 2011.

[63] NK21-CORR-00531-09436, CANDU Category III Safety Issues: Annual Update, Bruce Power Letter, F. Saunders to G. Rzentkowski, June 22, 2012.

[64] NK21-CORR-00531-10454, CANDU Category III Safety Issues: Annual Update, Bruce Power Letter, F. Saunders to G. Rzentkowski, June 27, 2013.

[65] NK21-CORR-00531-11347, CANDU Category III Safety Issues: Annual Update, Bruce Power Letter, F.Saunders to G.Rzentkowski, June 25, 2014.

[66] BP-PROC-00561-R002, Operator Fundamentals, Bruce Power, June 2014.

[67] BP-PROC-00562-R003, Bruce Power Fundamentals - Document and Process Requirements, Bruce Power, July 2012.

[68] BP-PROC-00580-R004, Maintenance Fundamentals, Bruce Power, July 2013.

[69] BP-PROC-00581-R001, Radiation Protection Department Fundamentals, Bruce Power, May 2013.

[70] BP-PROC-00582-R003, Engineering Fundamentals, Bruce Power, July 2014.

[71] BP-PROC-00588-R003, Chemistry and Environment Fundamentals, Bruce Power, October 2014.

[72] BP-PROC-00589-R003, Outage Fundamentals, Bruce Power, December 2012.

[73] BP-PROC-00595- R002, Training Fundamentals, Bruce Power, November 2014.

[74] BP-PROC-00598-R002, Emergency Measures Fundamentals, Bruce Power, November 2010.

[75] BP-PROC-00704-R003, Nuclear Oversight Fundamentals, Bruce Power, April 2011.

[76] BP-PROC-00819-R000, Radiation Protection Worker Fundamentals, Bruce Power, June 2013.

[77] BP-PROC-00900-R000, On-Line Work Management Fundamentals, Bruce Power, March 2013.

[78] INPO 12-001, Must-Know Operating Experience: Maintenance, Institute of Nuclear Power Operators, SOER 10-2, January 2012.

[79] INPO 12-002, Must-Know Operating Experience: Chemistry, Institute of Nuclear Power Operators, SOER 10-2, January 2012.

[80] INPO 12-003, Must-Know Operating Experience: Operations, Institute of Nuclear Power Operators, SOER 10-2, January 2012.

[81] INPO 12-005, Must-Know Operating Experience: Engineering, Institute of Nuclear Power Operators, SOER 10-2, January 2012.

[82] TQD-00010-R004, General Employee Training: Training and Qualifications Description, Bruce Power Training Division, September 2014.

[83] International Energy Agency, WANO presentation, 2014 Workshop, http://www.iea.org/media/workshops/2014/nuclearroadmapupdate/session4wanobnieaneaworkshop.pdf, accessed via website, February 2014.

[84] WANO SOER 2013-2-R001, Post-Fukushima Daiichi Nuclear Accident Lessons Learned, World Association of Nuclear Operators, Significant Operating Experience Report, August 2013.

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

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

[87] NK21-CORR-00531-09307, Opening of Fukushima Action Items (FAIs) on Bruce Power, CNSC Letter, G. Rzentkowski to F.Saunders, February 17, 2012.

[88] NK21-CORR-00531-10685, Periodic Safety Review Status of Fukushima Action Plan and CNSC Action Items, Bruce Power Letter, F.Saunders to R.Lojk, August 30, 2013.

[89] NK21-CORR-00531-11379, Bruce Power Progress Report No. 5 on CNSC Action Plan - Fukushima Action Items, Bruce Power Letter, F.Saunders to K. Lafrenière, July 15, 2014.

[90] NK21-CORR-00531-11688, CNSC Review of Bruce Power's Update #5 on Fukushima Action Items, CNSC Letter, K. Lafrenière to F.Saunders, October 31, 2014.

[91] NK21-REP-00772-00003-R002, OPEX Review for U3 M\31100a Fuel Channel Modification for West Shift Plus Configuration, Bruce Power Report, February 2011.

[92] NK21-REP-33126-00071-R000, OPEX Review Report for Bruce A Unit 4 MCR Feeder Conceptual Engineering, Bruce Power Report, July 2014.

[93] NK21-REP-34980-00010-R000, Modification to Annulus Gas System - OPEX Review Report, Bruce Power Report, May 2009.

[94] R. Mottram Presentation, Bruce A Restart Project 3 and 4 Lessons Learned, 25th Annual Conference of the Canadian Nuclear Society, Toronto, June 6-9, 2004.

[95] NK21-03500-P, BARSA Closeout Lessons Learned, Bruce Power, January 2004.

[96] PMC 3.4.008-R002, Lessons Learned, Bruce Power PMC, August 2010.

[97] NK21-REP-60458-00002-R000, OPEX Report for Bruce A Fischer and Porter Controller Replacement, Bruce Power Report, March 2012.

[98] NK21-REP-60458-00009-R000, Operating Experience Report for Bruce A Fischer and Porter Controller Replacement (Long Term Solution), Bruce Power Report, July 2013.

[99] NK21-REP-63716-00003-R000, OPEX Review for Bruce Power Units 1 & 2 Restart Start-Up Instrumentation, Bruce Power Report, June 2009.

[100] NK21-REP-63760-00003 R000, OPEX Review for Bruce Power Units 1 & 2 Secondary Control Area, Bruce Power Report, July 2010.

[101] NK21-REP-76111-00001-R000, OPEX Report Bruce A Unit - 3 & 4 Containment Vault Crane, Bruce Power Report, August 2013.

[102] NK29-REP-31911-00001-R000, OPEX Report: CT-LISS Gap Inspection Tooling OPEX, Bruce Power Report, September 2013.

[103] NK29-REP-55100-00007-R000, OPEX Report - Replacement of Even Side Class 1 250 Vdc Battery Banks, Bruce Power Report, May 2012.

[104] B-REP-30530-00001, Human Factors OPEX Summary Report for BRIMS, April 2013.

[105] NK21-CORR-00531-10030, Review of CANDU Owners Group (COG) Screened Events Database Number 50379, SCR D-2011-10902, CNSC Letter, R. Lojk to F. Saunders, November 9, 2012.

[106] NK21-CORR-00531-10064, Review of CANDU Owners Group (COG) Screened Events Database Number 50379, SCR D-2011-10902, Bruce Power Letter, F. Saunders to R. Lojk, December 19, 2012.

[107] NK21-CORR-00531-10457, Action Item 080702: Licensing Basis for Minimum Shift Complement, Bruce Power Letter, F. Saunders to R. Lojk, May 31, 2013.

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

[109] AU-2011-00010, Performance Improvement, Bruce Power, October 2011.

[110] AU-2013-00018, Fluid Leak Management Program, Bruce Power, January 2013.

[111] AU-2010-00024, Root Cause Investigation Audit, Bruce Power, January 2010.

[112] AU-2010-00007, S-99 Reporting, Bruce Power, December 2010.

[113] AU-2010-00026, Forced Outage Management, Bruce Power, June 2010.

[114] AU-2010-00005, EMS Environmental Compliance Audit, Bruce Power, September 2010.

[115] B-AQR-02-2014, 2014-Q2 Nuclear Oversight Quarterly Report, Bruce Power Nuclear Oversight and Regulatory Affairs, July 2014.

[116] B-AQR-03-2014, 2014-Q3 Nuclear Oversight Quarterly Report, Bruce Power Nuclear Oversight and Regulatory Affairs, October 2014.

[117] B-REP-01915-0001-15MAY2014, Nuclear Industry Evaluation Program (NIEP) Audit of Bruce Power May 12-15, 2014, Ontario Power Generation letter, M. Delong to F. Saunders, June 2014.

[118] NK21-CORR-00531-08638, Action Item 110719: Bruce A Units 1 and 2 Return to Service: IIP Completion Inspection - OPEX Program BRPD-2011-R-010, CNSC Letter, F. Saunders to K. Lafrenière, April 2011.

[119] TQD-00043 R002[18], Performance Improvement, Bruce Power Training and Qualifications Description, May 2011.

[120] NK21-CORR-00531-08673, Action Item 110719: Bruce A Units 1 and 2 Return to Service: IIP Completion Inspection - OPEX Program BRPD-2011-R-010, Bruce Power Letter, F. Saunders to K. Lafrenière, May 24, 2011.

[121] NK21-CORR-00531-08746, Action Item 110719: Bruce A Units 1 and 2 Return to Service: IIP Completion Inspection - OPEX Program BRPD-2011-R-010, CNSC Letter, K. Lafrenière to F. Saunders, June 9, 2011.

[122] NK21-CORR-00531-11656, Amendments to Bruce A and Bruce B Power Reactor Operating Licences - Implementation of REGDOC-3.1.1. Reporting Requirements for Nuclear Power Plants, Bruce Power Letter, F. Saunders to M. LeBlanc, October 28, 2014.

[18] Resulting version, Revision initially reviewed must have been R001. Current version in PassPort is R003 from December 12, 2014.

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

No codes or standards relevant to Safety Factor 9 were subjected to high-level assessment. This Appendix is retained only for consistency with the Appendix numbering scheme in all other Safety Factor Reports.

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

No codes or standards relevant to Safety Factor 9 were subjected to a clause-by-clause assessment. This Appendix is retained only for consistency with the Appendix numbering scheme in all other Safety Factor Reports.

Appendix C – List of FASAs, Audits and Inspections (2008-2014)

This appendix lists the Potential FASAs, Audits and Inspection Correspondence in the period nominally from 2008 to 2014-09-01. This Appendix is to be read in concert with Section 7 of the main report.

C.1. FASAs

FASA Number	FASA Title
SA-CAP-2008-02	OPEX incorporation in Training
SA-CAP-2009-01	Inclusion of OPEX into Maintenance Procedures
SA-PE-2009-05	WANO AFI SOER 99-1 Rec 3 Loss of Grid
SA-BPMS-2010-04	Benchmarking Process
SA-COM-2010-01	Drafting Office Benchmark – Master Equipment List (MEL) Tag Out Project
SA-NSAS-2010-03	Use of OPEX in Fuel Channels Life Cycle Mgt & Life Extension of Fuel Channels
SA-SAC-2010-16a	Commissioning Readiness FASA for BP-PROG-01.06, 01.07 & 00.07
SA-SAC-2010-16b	Commissioning Readiness FASA for BP-PROG-01.06, 01.07 & 00.07
SA-SAC-2010-16c	Commissioning Readiness FASA for BP-PROG-01.06, 01.07 & 00.07
SA-HP-2011-01	Screening and Evaluating External OPEX
SA-PI-2012-02	OPEX Training Materials
SA-BPL-2013-01	Corporate Benchmarking FASA
SA-EPS-2014-06	Assess Employee Awareness and Safety Culture re Extreme Events
SA-PI-2013-02	OPEX - Utilization of significant Internal OPEX
SA-PI-2013-08	External OPEX applicability responses
SA-PI-2014-02	External OPEX applicability responses
SA-PI-2015-01	Effectiveness of OPEX Implementation
SA-RA-2014-01	S-99 Preliminary Reporting Timeliness
SA-RPR-2013-02	COG RP Benchmark Assessment Evaluation Matrix

C.2. Audits

Number	Title
AU-2009-00012	CAMEO Review SCR B-2007-08565
AU-2009-00025	Benchmarking Effectiveness Surveillance
AU-2009-00026	CAMEO Review SCR B-2006-07441
AU-2010-00007	S99 Reporting Surveillance
AU-2010-00019	Restart Maintenance and Maintenance Programs
AU-2010-00024	Root Cause Investigation
AU-2010-00027	PHT Feeder Management
AU-2010-00037	Bruce A RV Field Repairs
AU-2011-00007	RV Field Repairs
AU-2011-00010	Performance Improvement
AU-2011-00028	Performance and Condition Monitoring
AU-2012-00007	RV Field Repairs
AU-2013-00005	RV Field Repairs
AU-2013-00018	Fluid Leak Management Program

C.3. CNSC Inspections

Doc #[19]	Title
-06987	QUARTERLY FIELD AND CONTROL ROOM INSPECTIONS FOR BRUCE A AND B
-07665	QUARTERLY FIELD SURVEILLANCE INSPECTIONS FOR BRUCE A AND B
-07705	OPERATING EXPERIENCE (OPEX) ISSUES RELATING TO THE OPERATION OF LARGE OIL-FILLED TRANSFORMERS IN NPPS - QUESTIONNAIRE
-07764	QUARTERLY SUMMARY INSPECTION REPORT FOR THE COMPLETED FIELD SURVEILLANCE INSPECTIONS FOR BRUCE A AND B
-07789	OPERATING EXPERIENCE (OPEX) ISSUES RELATING TO THE OPERATION OF LARGE OIL-FILLED TRANSFORMERS IN NPPS - QUESTIONNAIRE
-07902	QUARTERLY FIELD SURVEILLANCE INSPECTIONS FOR BRUCE A AND BRUCE B
-07941	CONFIDENTIAL - ANNUAL COG RESEARCH AND DEVELOPMENT REPORTING

[19] All Document numbers preceded by NK21-CORR-00531

Doc #[19]	Title
-07979	BRPD-2010-AB-001, BRUCE A AND B GENERATING STATIONS FOURTH QUARTER RESULTS FROM CNSC FIELD SURVEILLANCE INSPECTIONS
-08156	FIRST QUARTER 2010 FIELD INSPECTIONS FOR BRUCE A AND B BRPD-2010-AB-005
-08407	QUARTERLY FIELD INSPECTIONS FOR BRUCE A AND B BRPD-2010-AB-012
-08438	BRUCE A UNITS 1 & 2 RETURN TO SERVICE: TYPE 2 COMPLIANCE INSPECTION REPORT - BRPD-2011-R-002 FOLLOW UP ON S-99 EVENT B-2011-28232206
-08537	QUARTERLY FIELD INSPECTIONS FOR BRUCE A AND B BRPD-2010-AB-014
-08638	ACTION ITEM 110719: BRUCE A UNITS 1 AND 2 RETURN TO SERVICE: IIP COMPLETION INSPECTION - OPEX PROGRAM BRPD-2011-R-010
-08672	2011 ANNUAL COG RESEARCH AND DEVELOPMENT REPORTING
-08673	ACTION ITEM 110719 - BRUCE A UNITS 1&2 RETURN TO SERVICE: IIP COMPLETION INSPECTION - OPEX PROGRAM BRPD-2011-R-010
-08724	CANDU CATEGORY III SAFETY ISSUES: ANNUAL UPDATE
-08746	ACTION ITEM 110719: BRUCE A UNITS 1 & 2 RETURN TO SERVICE: IIP COMPLETION INSPECTION - OPEX PROGRAM
-08749	FOURTH QUARTER FIELD SURVEILLANCE INSPECTION FOR BRUCE A AND B BRPD-2011-AB-006
-08956	QUARTERLY FIELD INSPECTIONS FOR BRUCE A AND B BRPD-2011-AB-012
-09184	BRUCE A AND B GENERATING STATIONS QUARTERLY FIELD INSPECTION REPORT BRPD-2011-AB-015 - ACTION ITEM 1107-2949
-09267	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT BRPD-2011-AB-019
-09436	CANDU CATEGORY III SAFETY ISSUES: ANNUAL UPDATE
-09565	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT BRPD-AB-2012-005
-09566	2012 ANNUAL COG RESEARCH AND DEVELOPMENT REPORTING
-09826	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q1 BRPD-AB-2012-008 ACTION ITEM 1207-3510
-10080	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q2, BRPD-AB-2012-014
-10247	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q3, BRPD-AB-2012-017
-10454	CANDU CATEGORY III SAFETY ISSUES: ANNUAL UPDATE
-10469	2013 ANNUAL COG RESEARCH AND DEVELOPMENT REPORTING

Doc #[19]	Title
-10539	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q4, BRPD-AB-2013-005
-10731	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q1 BRPD-AB-2013-010 - ACTION ITEM 1307-4270
-10930	ACTION ITEM 1307-4270: RESPONSE TO BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q1 BRPD-AB- 2013-010
-11018	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q2 BRPD-AB-2013-015
-11194	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q3 BRPD-AB-2014-001
-11243	ACTION ITEM 1307-4270: BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q1 BRPD-AB-2013-010"
-11311	ACTION ITEM 1307-4270: BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q1 BRPD-AB-2013-010
-11319	CNSC TYPE II COMPLIANCE INSPECTION - S99 REPORTING
-11339	2014 ANNUAL COG RESEARCH AND DEVELOPMENT REPORTING
-11347	CANDU CATEGORY III SAFETY ISSUES: ANNUAL UPDATE
-11354	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q4 OF 2013-14 BRPD-AB-2014-003
-11383	ACTION ITEM 1307-4270: BRUCE A AND BRUCE B QUARTERLY FIELD INSPECTION REPORT BRPD-AB-2013-010
-11507	ACTION ITEM 2014-07-5293: CNSC TYPE II COMPLIANCE INSPECTION REPORT: BRPD-AB-2014-006 - S-99 INSPECTION
-11551	BRUCE A AND B QUARTERLY FIELD INSPECTION REPORT FOR Q1 OF 2014-15 BRPD-AB-2014-008
-11613	Bruce A and Bruce B Quarterly Operations Report - Second Quarter of 2014

Appendix D – Bruce Power – Canadian Standards Association Nuclear Program Membership (January 2015)

Number	CSA Committee Name	Number of BP Reps
NSSC	**Strategic Steering Committee**	2
N285A TC	**Pressure Retaining Components and Systems**	1
N285B TC	**Periodic Inspections** of CANDU Nuclear Power Plant Components, *Includes N285.5*	4
N285.4 TSC	Periodic inspection of CANDU nuclear power plant components	
N285.5 TSC	Periodic inspection of CANDU nuclear power plant containment components	2
N285.7 TSC	Periodic inspection of nuclear power plant pressurized conventional systems	
N285.8 TSC	Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors	3
N286 TC	**Management Systems for Nuclear Facilities**	1
N286.7 TSC	Quality assurance of analytical, scientific, and design computer programs	1
N286.x TSC	Configuration management for reactor facilities (NPPs and small reactors)	
N299 TSC	Quality assurance program requirements for supply of items and services for nuclear power plants	
N287/N291 TC	**Concrete Containment / Safety Related Structures**	1
N287.1 TSC	General requirements for concrete containment structures for nuclear power plants	1
N287.2 TSC	Material requirements for concrete containment structures for CANDU nuclear power plants	
N287.3 TSC	Design requirements for concrete containment structures for nuclear power plants	1
N287.4 TSC	Construction, fabrication and installation requirements for concrete containment structures for CANDU nuclear power plants	1
N287.5 TSC	Examination and testing requirements for concrete containment structures for nuclear power plants	1
N287.6 TSC	Pre-operational proof and leakage rate testing requirements for concrete containment structures for nuclear power plants	1
N287.7 TSC	In-service examination and testing requirements for concrete containment structures for CANDU nuclear power plants	1
N287.8 TSC	Aging management of concrete containment structures for nuclear power plants	1
N291 TSC	Design requirements for safety-related structures for nuclear power plants (2016 title)	1

Number	CSA Committee Name	Number of BP Reps
N288 TC	**Environmental Radiation Protection**	1
N288.1 TSC	Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities	2
N288.2 TSC	Guidelines for calculating the radiological consequences to the public of a release of airborne radioactive material for nuclear reactor accidents (2015 title)	1
N288.3.4 TSC	Performance testing of nuclear air-cleaning systems at nuclear facilities	2
N288.4 TSC	Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills	2
N288.5 TSC	Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills	2
N288.6 TSC	Environmental risk assessments at Class I nuclear facilities and uranium mines and mills	2
N288.7 TSC	Groundwater protection programs at Class I nuclear facilities and uranium mines and mills	2
N288.8 TSC	Guidelines for establishing and implementing environmental action levels to control emissions from nuclear facilities	1
N289 TC	**Seismic Design**	1
N289.1 TSC	General requirements for seismic design and qualification of CANDU nuclear power plants	1
N289.2 TSC	Ground motion determination for seismic qualification of nuclear power plants	
N289.3 TSC	Design procedures for seismic qualification of nuclear power plants	1
N289.4 TSC	Testing procedures for seismic qualification of nuclear power plant structures, systems, and components	
N289.5 TSC	Seismic instrumentation requirements for nuclear power plants and nuclear facilities	1
N290A TC	**Reactor Control Systems, Safety Systems, and Instrumentation**	5
N290.1 TSC	Requirements for the shutdown systems of nuclear power plants	2
N290.2 TSC	Requirements for emergency core cooling systems of nuclear power plants	3
N290.3 TSC	Requirements for the containment system of nuclear power plants	2
N290.4 TSC	Requirements for reactor control systems of nuclear power plants	2
N290.5 TSC	Requirements for electrical power and instrument air systems of CANDU nuclear power plants	1
N290.6 TSC	Requirements for monitoring and display of nuclear power plant safety functions in the event of an accident	
N290.7 TSC	Cyber security for nuclear power plants and reactor facilities	2
N290.8 TSC	Technical specification requirements for nuclear power plant components	3
N290.12 TSC	Human factors in design for nuclear power plants	2

Number	CSA Committee Name	Number of BP Reps
N290.13 TSC	Environmental qualification of equipment for CANDU nuclear power plants	2
N290.14 TSC	Qualification of digital hardware and software for use in Instrumentation and Control applications for nuclear power plants	2
N290B TC	**Reactor Safety and Risk Management**, *currently drafting N290.16 BDBA standard*	2
N290.11 TSC*	Requirements for reactor heat removal capability during outage of nuclear power plants	2
N290.15 TSC*	Requirements for the safe operating envelope of nuclear power plants	1
N290.17 TSC	Probabilistic safety assessment for nuclear power plants	
N290.18 TSC	Periodic safety review for nuclear reactor facilities	1
N292 TC	**Radioactive Waste Management**	2
N292.1 TSC	Wet storage of irradiated fuel and other radioactive materials	1
N292.2 TSC	Interim dry storage of irradiated fuel	1
N292.3 TSC	Management of low- and intermediate-level radioactive waste	2
N292.5 TSC	Guideline for the exemption or clearance from regulatory control of materials that contain, or potentially contain, nuclear substances	2
N293 TC	**Fire Protection for NPP**	3
N294 TC	**Decommissioning of Nuclear Facilities**	1
N393 TC	**Fire Protection for Facilities that Process, Handle or Store Nuclear Material**	1
N1600 TC	**General Requirements for Nuclear Emergency Management Programs**	2