Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

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SUPPLEMENTAL/COMPLÉMENTAIRE

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A Licence Renewal

Un renouvellement de permis

Ontario Power Generation Inc.

Ontario Power Generation Inc.

Pickering Nuclear Generating Station

Centrale nucléaire Pickering

Commission Public Hearing – Part 2

Audience publique de la Commission – Partie 2

Scheduled for:

25-29 June 2018

Prévue pour :

25-29 juin 2018

Submitted by:

CNSC Staff

Soumise par :

Le personnel de la CCSN

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Summary

This CMD presents supplemental information about the following matters of regulatory interest with respect to Ontario Power Generation Inc.:

- Renewal of the Power Reactor Operating Licence (PROL) for the Pickering Nuclear Generating Station (NGS)
- CNSC staff responses to issues identified through the public interventions
- Updates on developments within certain Safety and Control Areas and regulatory focus areas since the Part 1 Hearing

The following actions are requested of the Commission:

- Issue, pursuant to section 24 of the *Nuclear Safety and Control Act*, a Pickering NGS PROL authorizing OPG to carry out the activities listed in Part IV of the proposed licence from September 1, 2018 to August 31, 2028.
- Accept the following new station-specific conditions included in the proposed licence requiring OPG to:
  - Implement the results of the Periodic Safety Review
  - Maintain Units 2 and 3 in the safe storage phase
  - Before hydrogen equivalent concentrations exceed 120 ppm, demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm
  - Implement and maintain plans for the end of commercial operations of all Pickering units

Résumé

Le présent CMD présente de l’information sur un ensemble de questions d’ordre réglementaire concernant Ontario Power Generation Inc.:

- Renouvellement du permis d’exploitation d’un réacteur de puissance (PERP) pour la centrale nucléaire de Pickering
- Réponses du personnel de la CCSN aux préoccupations soulevées dans les interventions du public
- Mises à jour sur les développements dans certains domaines de sûreté et de réglementation et domaines d’intérêt réglementaire depuis la partie 1 de l’audience

La Commission pourrait considérer prendre les mesures suivantes :

- Délivrer, conformément à l’article 24 de la *Loi sur la sûreté et la réglementation nucléaires*, un PERP pour la centrale de Pickering autorisant OPG à exercer les activités énumérées à la Partie IV du permis proposé, du 1er septembre 2018 au 31 août 2018.
- Accepter les nouvelles conditions propres à la centrale incluses dans le permis proposé et obligeant OPG à :
  - Mettre en œuvre les résultats du bilan périodique de la sûreté
  - Maintenir les tranches 2 et 3 dans un état de stockage sûr
  - Démontrer, avant que les concentrations équivalentes d’hydrogène ne dépassent 120 ppm, que la résistance aux fractures des tubes de force sera suffisante pour permettre l’exploitation sûre au-delà de 120 ppm

- Authorize OPG to operate the Pickering NGS Units 5-8 fuel channels up to a maximum of 295,000 EFPH.
- Authorize the delegation of authority as set out in section 6.11 of CMD 18-H6.

The following items are attached:

- The proposed PROL 48.00/2028
- The draft Licence Conditions Handbook

  - Mettre en œuvre et tenir à jour des plans pour la fin de l’exploitation commerciale de toutes les tranches de Pickering
- Autoriser OPG à exploiter les canaux de combustible des tranches 5-8 de Pickering jusqu’à un maximum de 295 000 HEPP.
- Autoriser la délégation de pouvoirs énoncée à la section 6.11 du CMD 18-H6.

Les pièces suivantes sont jointes :

- Le PERP proposé 48.00/2028
- L’ébauche du Manuel des conditions de permis

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Signed/signé le

12 June 2018

Gerry Frappier, P. Eng

Director General

Directorate of Power Reactor Regulation

Directeur général de la

Direction de la réglementation des centrales nucléaires

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TABLE OF CONTENTS

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EXECUTIVE SUMMARY

In August 2017, Ontario Power Generation (OPG) submitted an application for the renewal of its Pickering Nuclear Generating Station (NGS) Power Reactor Operating Licence (PROL). The current PROL expires on August 31, 2018. OPG has requested the licence to be renewed for a period of 10 years.

CNSC staff presented its assessment of the application and OPG's past performance as well as conclusions and recommendations to the Commission in CMD 18-H6, at the Part 1 Hearing held April 4, 2018.

Members of the public were invited to intervene on this matter as part of the CNSC public hearing process. Of the 156 interventions received, 82 expressed concerns. CNSC staff have broadly categorized the more frequently stated concerns as follows:

- Aging of major components
- Environmental Assessment under the *Nuclear Safety and Control Act*
- Tritium-related issues
- Emergency preparedness standards
- Provisions under the Provincial Nuclear Emergency Response Plan
- Waste and decommissioning strategies
- End of commercial operation and the 10-year licence
- Fukushima actions related to containment integrity
- Nuclear liability

The purpose of this supplemental CMD is to provide the Commission with CNSC staff's position on the main issues that have been raised in the public interventions. A small number of developments that occurred since the Part 1 Hearing are also described.

In addition, staff have revised Licence Condition (LC) 15.3 based on Commission feedback. The Licence Conditions Handbook (LCH) has been revised to clarify the compliance verification criteria for LC 15.3 as well as to provide implementation dates for several regulatory documents and to correct inaccuracies.

The information provided in this supplemental CMD does not change the overall CNSC staff conclusions and recommendations provided in CMD 18-H6. CNSC staff conclude that OPG is qualified to carry out the activities listed in the proposed licence, and has made and will continue to adequately provide for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

CNSC staff recommend the Commission to:

1. Renew the Pickering NGS PROL, and associated LCH, authorizing OPG to carry out the activities listed in Part IV of the licence from September 1, 2018 to August 31, 2028.

2. Accept the station-specific conditions included in the proposed licence requiring OPG to:
   - Implement the Integrated Implementation Plan;
   - Maintain Units 2 and 3 in the safe storage phase;
   - Before hydrogen equivalent concentrations exceed 120 ppm, demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm;
   - Implement and maintain plans for the end of commercial operations of all Pickering units;
   - Implement and maintain a Cobalt-60 program for activities described under Part IV of the licence; and
   - Limit the activities of import and export to the nuclear substances occurring as contaminants in laundry, packaging, shielding or equipment.
3. Authorize OPG to operate the Pickering NGS Units 5-8 fuel channels up to a maximum of 295,000 EFPH.
4. Authorize the delegation of authority as set out in section 6.11 of CMD 18-H6.

Referenced documents in this CMD are available to the public upon request.

PART ONE

This Commission Member Document (CMD) is presented in two parts.

Part One includes:

1. An overview of the matter being presented;
2. A summary of the subjects raised in the public interventions;
3. Updates on other matters of regulatory interest that are relevant to this submission;
4. Updates to the proposed licence and significant revisions of the Licence Conditions Handbook;
5. Overall conclusions and recommendations; and
6. Addenda material that complements items 1 through 3.

Part Two provides a revised proposed licence to replace the proposed licence provided in CMD 18-H6. The revised draft Licence Conditions Handbook is also provided.

1. OVERVIEW

1.1 Highlights

In August 2017, OPG submitted an application, including supplemental information [1-9], for the renewal of its Pickering NGS Power Reactor Operating Licence (PROL). The current PROL expires on August 31, 2018. OPG has requested the licence to be renewed for a period of 10 years.

CNSC staff presented its assessment of the application and OPG's past performance as well as conclusions and recommendations to the Commission in CMD 18-H6 [10]. The CMD was presented at the Part 1 Hearing held April 4, 2018.

Members of the public were invited to intervene on this matter as part of the CNSC public hearing process. The deadline for intervenor submission was May 7, 2018. Of the 156 interventions received, 82 expressed concerns. CNSC staff have broadly categorized the more frequently stated concerns as follows:

- Aging of major components
- Environmental Assessment under the *Nuclear Safety and Control Act*
- Tritium-related issues
- Emergency preparedness standards
- Provisions under the Provincial Nuclear Emergency Response Plan
- Waste and decommissioning strategies
- End of commercial operation and the 10-year licence
- Fukushima actions related to containment integrity
- Nuclear liability

The purpose of this supplemental CMD is to provide the Commission with CNSC staff's position on the main issues that have been raised in the public interventions. A small number of developments that occurred since the Part 1 Hearing are also described.

In addition, staff have revised Licence Condition (LC) 15.3 based on Commission feedback. The Licence Conditions Handbook (LCH) has been revised to clarify the compliance verification criteria for LC 15.3 as well as to provide implementation dates for several regulatory documents and to correct inaccuracies. Changes made to the LC 15.3 and the LCH are described in more detail in Section 3. The updated proposed PROL is included in Part 2 of this CMD along with the revised draft LCH.

CNSC staff CMD 18-H6 provided the Pickering NGS safety performance ratings for each of the 14 Safety and Control Areas (SCAs) from 2013-2016. Table 1 below includes the ratings for 2017, and shows that OPG continued to meet or exceed regulatory expectations in all SCAs. The conclusions of CNSC staff with regards to the licensee performance remain the same as previously reported.

Table 1: Pickering NGS safety performance ratings 2013-2017

Safety and Control Area	2013	2014	2015	2016	2017
Management System	SA	SA	SA	SA	SA
Human Performance Management	SA	SA	SA	SA	SA
Operating Performance	SA	SA	FS	FS	FS
Safety Analysis	SA	SA	FS	FS	FS
Physical Design	SA	SA	SA	SA	SA
Fitness for Service	SA	SA	SA	SA	SA
Radiation Protection	FS	FS	FS	SA	SA
Conventional Health and Safety	SA	SA	FS	FS	FS
Environmental Protection	SA	SA	SA	SA	SA
Emergency Management and Fire Protection	SA	SA	SA	SA	SA
Waste Management	SA	SA	FS	FS	FS
Security	FS	FS	SA	SA	SA
Safeguards and Non-Proliferation	SA	SA	SA	SA	SA
Packaging and Transport	SA	SA	SA	SA	SA

SA = Satisfactory; FS = Fully Satisfactory

During the current licence period there were no serious process system failures and special safety systems met their unavailability targets. Environmental releases as well as doses to workers and the public were well below regulatory limits. Risks to the public and workers have been kept low, and in CNSC staff’s view, should remain low over the next proposed licence period.

2. SUMMARY OF ISSUES RAISED BY INTERVENORS AND RECENT DEVELOPMENTS

There were no formal requests from the Commission arising from the Part 1 Hearing on April 4, 2018. CNSC staff analyzed public interventions and identified a number of broad based issues expressed by the intervenors. These are discussed in this section. The main subjects raised in the public interventions are grouped below by CNSC Safety and Control Areas (SCA).

Updates are also provided on a number of developments within certain SCAs since the Part 1 Hearing, specifically:

- Resolution of outstanding regulatory concerns regarding revised Environmental Risk Assessment ;
- Acceptance of the revised Derived Release Limits;
- Update on developments with the Provincial Nuclear Emergency Response Plan; and
- Summary of key findings from OPG’s emergency exercise held in December 2017.

2.1 SCA Fitness for Service

Issues raised by intervenors within the Fitness for Service SCA primarily focused on the aging management of fuel channels and feeders. A few interventions questioned the continued operation of fuel channels and feeders beyond their originally assumed design life.

CNSC staff position:

The CNSC does not permit the operation of systems, structure and components (SSC) at nuclear power plants that do not meet the design requirements. Licensees are required to take corrective actions (such as repairs or replacements of components) if it is determined that at some point during the intended operating life of the plant an SSC will no longer meet its design requirements.

CNSC staff monitor the implementation of, and assess results from, the licensee’s programs intended to provide verification of the condition of SSCs. CNSC staff verifies that design requirements are met and safety margins are preserved. Actions are imposed on the licensee to address any weaknesses in the licensee programs based upon Canadian and international experience.

Under its Nuclear Management System framework, OPG has a number of engineering programs to monitor and control the condition of Nuclear Power Plant SSCs. These programs establish a strategy of preventative maintenance, inspection, testing, surveillance, and monitoring as necessary to ensure systems and equipment perform in accordance with their design requirements. Detailed Life Cycle Management Plans (LCMP) are developed for major components and updated annually to capture new information from the inspections, engineering assessments, research and OPEX.

The Pickering Periodic Inspection Programs (PIPs) for pressure boundary components have been developed in accordance with CSA Standard N285.4 *Periodic inspection of CANDU nuclear power plant components*. The purpose of periodic inspections is to provide assurance that the systems, structures and components remain fit for service to prevent unreasonable risk to workers, the public and the environment.

The PIP program includes:

- Establishing sample sizes to verify the general condition of components and piping;
- Examination of the selected components and piping using appropriate examination methods and procedures;
    - If degradation is not detected, monitoring examinations continue at the frequency specified in the standard,
    - If degradation is detected, the examination frequency is adjusted in accordance with the rate of degradation and the sample size is expanded,
- Evaluation of the examination findings in accordance with the criteria in the standard and, if necessary, detailed evaluations using fitness-for-service guidelines to demonstrate that the structure integrity requirements are met.

The PIP documents are revised by the licensee to reflect the examination findings and updates to the standards. CNSC staff have determined through multiple compliance verification activities, that OPG has adequate PIPs for pressure boundary systems to verify the components and piping condition.

As required by REGDOC-2.3.3, the Periodic Safety Review (PSR), carried out by OPG during 2016-2018, included two key assessments related to this subject:

- A design review to compare the original Pickering design approach to the modern design practices; and
- A review of the current condition of SSCs important to safe operation to evaluate the remaining operating life for SSCs.

These reviews are reflective of the CNSC expectation of the continuous safety enhancements and allow determining whether the adequate safety margins will be maintained throughout the plant operational life.

CNSC staff conducted technical reviews of OPG’s reports submitted during the PSR, in particular the reports on condition assessments and aging management, and confirmed that OPG has capacity to maintain the fitness for service of the SSCs important to safety. The results of the PSR have been incorporated into the Integrated Implementation Plan (IIP). A proposed Licence Condition will require the licensee to implement the IIP thus making it part of the facility licensing basis. A change in the IIP committed actions would require Commission’s approval.

Fuel Channels

The condition assessment of pressure tubes showed the acceptance criteria continue to be met for all degradation mechanisms. With respect to the longitudinal creep, OPG inspects the pressure tubes in Pickering reactors and has demonstrated that sufficient safety margins exist for continued safe operation. For the diametral creep, Pickering pressure tubes are expected to remain below the design allowable limit by the end of commercial operation. In regards to deuterium ingress and total hydrogen concentration, Pickering pressure tubes will continue to meet the CSA acceptance criteria with an adequate margin up to the end of commercial operation.

In response to CNSC staff requests, OPG has also developed a detailed fuel channel readiness plan. This plan documents licensee's activities to control and monitor the degradation mechanisms that could affect the operation of the Pickering fuel channels. The life cycle management activities for Pickering fuel channels are well established and will continue to provide the required evidence of the fitness for service of this crucial component.

Detailed technical information on fuel channel fitness for service requirements and evaluation methodologies is provided in CMD 18-M4. This CMD was presented to the Commission in January 2018 and is attached in Addendum A.

Feeders

OPG has implemented and continued to update the feeder life cycle management plan (LCMP) to ensure that the feeders maintain required safety margins up to the end of commercial operation. The most significant life limiting degradation mechanism for feeders is pipe wall thinning due to the flow accelerated corrosion (FAC). The FAC wall thinning has been managed through scheduled wall thickness measurements at susceptible locations and a confirmation that the predicted thickness at the end of operating cycle meets the wall thickness requirement. To determine the minimum required thickness satisfying design intended safety margins, OPG, jointly with CANDU industry, had developed the Feeder Fitness for Service Guideline (FFSG). The FFSG had been reviewed by third party experts and validated by testing; CNSC staff accepted the FFSG after in-depth technical reviews. For a small number of feeders that are predicted not to meet the required thickness before the end of commercial operation, OPG has established a replacement plan. OPG has the experience and capacity to replace degraded sections during a maintenance outage.

CNSC staff concludes that OPG has appropriate strategies to manage the expected aging of the Pickering feeders over the proposed operation period to 2024. CNSC staff regularly review feeder performance through compliance monitoring activities.

2.2 SCA Radiation Protection

In recent years, several intervenors have raised concerns to the Commission regarding the potential health risks for workers and public associated with exposure to tritium as well as exposure to low doses of radiation in general. Some intervenors allege that risks associated with exposure to low doses of radiation are being underestimated while others allege they are being overestimated.

CNSC staff position:

With respect to the potential health risks associated with exposure to tritium, in 2007, CNSC staff initiated the Tritium Studies Project, a Commission-directed initiative to enhance the information available to guide regulatory oversight of tritium processing facilities and tritium releases in Canada.

In 2010, as part of the Tritium Studies Project, the CNSC published the results of a study on the health effects of tritium in INFO-0799 *Health effects, dosimetry and radiological protection of tritium* [11]. The main objectives of the study were to:

1. conduct an independent review of the scientific literature to assess the health risk to workers and the public from exposures to tritium;
2. assess Canadian and international dosimetry practices for tritium intakes; and
3. review the current approaches for limiting exposure to tritium.

The study concluded that based on both epidemiological and radiobiological studies, the evidence showed that adverse health effects due to tritium exposure are highly unlikely at current exposure levels in Canada.

Follow up activities to this study were presented to the Commission in November 2017, in CMD 17-M48 [12]. As reported in CMD 17-M48, CNSC staff have concluded that adequate provisions have been made through existing regulatory mechanisms for the protection of Canadians from exposure to tritium releases. The results support the conclusion that the dose to a member of the public due to exposure from tritium releases is at least 100 times lower than the public dose limit of 1 mSv.

In November 2017, CNSC staff also presented to the Commission CMD 17-M46 [13] on the topic of biological mechanisms acting at low doses of radiation (below 100 mSv).

CNSC staff concluded that there is no epidemiological or medical evidence of a measureable effect from exposure to low doses of radiation. The scientific community's view is that if there was any increased risk of cancer at low doses of radiation, the risks would be small and not observable.

CNSC staff also concluded that the current Canadian radiation protection regulatory requirements framework is robust and protects workers and the public. The framework is based on the principle of ALARA (as low as reasonably achievable), which is derived from the radiation dose-response model known as the linear-non-threshold (LNT) model. The International Commission on Radiological Protection (ICRP) presents the LNT model as the best practical approach to managing risk from radiation exposure. However, it should be noted that the LNT model should not be used for individual or population-based cancer risk assessment as it does not consider individualized information. Other models that consider the type of cancer, the absorbed dose, as well as the gender and age of an individual, are more appropriate for cancer risk assessments [14].

The Commission agreed with CNSC staff's assessment as presented in CMD 17-M46.

2.3 SCA Environmental Protection

Within the Environment Protection SCA, a number of interventions raised the following points:

1. The comprehensiveness of an Environmental Assessment (EA) under the *Nuclear Safety and Control Act* (NSCA) compared to an EA under the *Canadian Environmental Assessment Act* 2012 (CEAA 2012)
2. Tritium in drinking water
3. Tritium in groundwater at and around the Pickering site

CNSC staff position.

1. Comprehensiveness of an Environmental Assessment (EA) under the NSCA compared to an EA under CEAA 2012

The CNSC has a strong environmental protection framework in place. Under the NSCA, the CNSC has a legislated mandate to ensure the protection of the environment and the health and safety of persons. As part of its mandate, the CNSC regulates all environmental stressors including radionuclides, non-radiological contaminant, and physical stressors. If a project falls outside the definitions under CEAA, such as this licence renewal, the CNSC undertakes a robust EA under the NSCA. The core scientific basis of an EA under the NSCA is as rigorous as that of a CEAA 2012 EA.

An EA under the NSCA is conducted for projects or activities that have either previously been assessed under CEAA, or for existing facilities. For this reason, the cumulative effects assessments and alternative means assessments found in EAs under CEAA are not part of the EA under the NSCA. However, an assessment of existing regional data is used to support the EA under the NSCA and, where more thorough regional assessments are conducted, these are included in the analysis. The analysis and assessment taken together satisfy the need to consider the impact of cumulative effects.

An added benefit of EAs under the NSCA is that they are part of the ongoing regulatory and environmental oversight of all nuclear facilities, and in this way, can incorporate new knowledge and allow for adaptive management.

In all cases, whether under CEAA 2012 or under the NSCA, the environmental protection measures are commensurate with the scale and complexity of the environmental risks associated with the nuclear facility or activity.

2. Tritium in drinking water

The CNSC Tritium Studies Project, discussed in section 2.2 above, also included a study on INFO-0766 *Standard and Guidelines for Tritium in Drinking Water* [15]. The result of this study were reported to the Commission in CMD 10-M38 [16]. The study concluded that the Canadian guideline of 7000 Bq/L of tritium in drinking water is consistent with the criteria adopted by the majority of the international community. The guideline is based on the radiation protection and health recommendations of the International Commission on Radiological Protection (ICRP) and the World Health Organization (WHO).

Results from OPG's 2017 Environmental Monitoring Program report show that tritium averages at all water supply plants were well below the 7000 Bq/L provincial standard and below the Ontario Drinking Water Advisory Council recommendation of 20 Bq/L.

CNSC staff will continue to ensure that the latest developments in tritium science are integrated, as appropriate, in regulating tritium-emitting nuclear facilities.

3. Tritium in groundwater

OPG has an established groundwater monitoring program to monitor the physical, chemical, and radiological characteristics of the groundwater beneath the site. Specifically, the objectives of the groundwater monitoring program are to:

- Confirm the predominant on-site groundwater flow characteristics;
- Monitor changes to on-site groundwater quality to ensure timely detection of inadvertent releases of nuclear and hazardous substances to groundwater; and
- Ensure that there are no adverse off-site impacts from contaminants in groundwater.

OPG submits an annual Pickering Nuclear Groundwater Monitoring Results report for CNSC staff review. The 2017 groundwater monitoring results show that tritium concentration trends over time at monitored locations, with the exception of the Units 5 and 6 Reactor Building areas, have remained nearly constant or have decreased in many cases, indicating stable or improved environmental performance.

Elevated tritium concentrations in groundwater were identified in the Unit 5 and 6 Reactor Building Area, in 2016. An investigation was initiated by OPG at that time to determine the source(s) of the tritium and continued into 2017. The elevated tritium concentration was attributed to leakage from the Unit 5 moderator room through construction joints in the foundation slab. The construction joints were subsequently sealed and tritium concentrations in the Unit 5 reactor building foundation drainage ground tubes were observed to decline. A similar investigation and repairs have recently been completed at Unit 6. Upon discovery of the elevated tritium concentrations in groundwater around Units 5 and 6, CNSC staff have undertaken several regulatory actions, including instructing OPG to inspect and, if necessary, repair construction joints at all Units, identify the root cause, assess the impact on public safety and to confirm efficiency of the issue resolution process. CNSC staff receive frequent updates on the progress of corrective actions. CNSC staff have confirmed that there are multiple provisions in place to prevent, reduce and monitor releases of tritiated water into the environment. CNSC is satisfied with OPG's actions to date in addressing issues related to control of tritium in groundwater.

With regards to the tritium concentrations around site perimeter, the 2017 groundwater monitoring program results confirmed that tritium concentrations remain below the drinking water standard of 7000 Bq/L, indicating no off-site impacts. According to OPG's 2017 annual report, groundwater samples from site perimeter monitoring wells had tritium concentrations ranging from less than 70.3 Bq/L to 5.55×10^3 Bq/L. The maximum concentration of 5.55×10^3 Bq/L was observed at a monitoring well located on the southwestern perimeter of the site. The source of tritium at this location has been attributed to legacy spills. Monitoring at this location shows that the tritium concentration at this location peaked in 2014 and has been decreasing since then, which confirms that there is no ongoing source of tritium. Monitoring will continue at this location.

2.3.1 Update on developments with the Environmental Protection SCA

Pickering site-wide Environmental Risk Assessment

As stated in CMD 18-H6 and CMD 18-H6.A, OPG submitted a site-wide Environmental Risk Assessment (ERA) report (revision R000) for the Pickering site in April 2017 [17].

In March, 2018, OPG submitted its revised ERA report (revision R001) for the Pickering site [18] and posted the revised report on its website.

CNSC staff conducted a detailed review and commented on the assessment. In April 2018, OPG provided CNSC and Environment and Climate Change Canada (ECCC) with clarifications regarding the revised Pickering site-wide ERA. OPG clarifications addressed physical stressors; maximum hazard quotients; thermal effect on smallmouth bass and emerald shiner; and stormwater. Following review of OPG clarifications, there were no outstanding regulatory issues or concerns.

CNSC staff conclusions for ERA R001 remain unchanged from R000; namely CNSC staff found:

- The site-wide ERA report for the Pickering site is consistent with the requirements of CSA standard N288.6-12, *Environmental risk assessments at class I nuclear facilities and uranium mines and mills*; and
- Meaningful adverse ecological and human health effects due to releases to air and water from Pickering NGS are unlikely.

Derived Release Limits

As reported in CMD 18-H6, in 2017 OPG submitted revised Derived Release Limits (DRL) and Environmental Action Levels (EALs) [19] based on CSA guidelines N288.1-14 *Guidelines for Calculating Derived Release Limits for* *radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*. DRLs are calculated to ensure that the licensee controls and minimizes releases to levels which ensure that that public exposure is below the dose limit of 1 mSv per year as set out in the *Radiation Protection Regulations*. On April 25, 2018, CNSC staff accepted that changes to the DRLs and EALs are within the licensing basis. OPG is expected to implement these changes by January 1, 2019. CNSC staff will update the Licence Conditions Handbook with the revised EALs, DRLs (which are therefore the release limits) and their effective date prior to their expected implementation.

2.4 SCA Emergency Preparedness

Concerns with the state of emergency preparedness, specifically off-site, was a significant issue with the many intervenors who are opposed to the Pickering NGS licence renewal. In general, the concerns are related to:

1. The need to demonstrate meeting current national and international standards for emergency preparedness as part of the licensing decision;
2. The adequacy of the emergency planning zones established under the revised Provincial Nuclear Emergency Response Plan (PNERP) and the distribution zone for potassium iodide (KI) pills; and
3. The level of the public awareness of emergency procedures and provisions for public alerting.

CNSC staff position:

1. *The need to demonstrate meeting current national and international standards for emergency preparedness as part of the licensing decision.*

CNSC staff verified that Pickering NGS meets the regulatory requirements of REGDOC-2.10.1 version 1, for emergency preparedness plans, procedures and equipment. The requirements and guidance in REGDOC-2.10.1 are consistent with modern national and international[1] practices addressing issues and elements that control and enhance nuclear safety. In particular, they establish a modern, risk-informed approach to the categorization of accidents – one that considers a full spectrum of possible events, including events of greatest consequence to the public.

With regards to off-site planning, the PNERP was updated in 2017 to better align with national and international standards. CNSC staff confirmed the updated PNERP master plan conforms to both CSA N1600 *General Requirements for Nuclear Emergency Management Programs*, and IAEA GSR-7 *Preparedness and Response for a Nuclear or Radiological Emergency*. In addition, CNSC staff

[1] REGDOC-2.10.1 used the following key IAEA documents in its development:
IAEA Safety Standards Series GS-R-2, *Preparedness and Response for a Nuclear or Radiological Emergency*Vienna, 2002 ; IAEA Safety Standards Series GS-G-2.1 *Arrangements for Preparedness for a Nuclear or Radiological Emergency*, Vienna, 2007; EPR-Exercise *Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency*, Vienna, 2005

determined that Pickering NGS is currently meeting the requirements of the 2017 PNERP master plan.

2. *The adequacy of the emergency planning zones established under the revised PNERP and the distribution zone for potassium iodide (KI) pills.*

Following the Fukushima accident, the CNSC Fukushima Task Force recommendations further strengthened each layer of defence built into the Canadian nuclear power plant design and licensing philosophy. Application of the defence in depth principle ensures that the likelihood of accidents with serious radiological consequences is extremely low, with an emphasis on prevention and mitigation of severe accidents. Improvements were implemented at all the nuclear power plants, including Pickering NGS, including modifications to enhance emergency plans and capabilities to respond effectively in a severe event or multi-unit accident.

For emergency planning, the planning zones established by the Province in the PNERP are adequate to address the protective actions to minimize the health risks to the public. The Province released a discussion paper to the public in May 2017 and the comments were considered by a special advisory group in August 2017. The planning zones remain unchanged with the addition of the Contingency Planning Zone out to 20 km, which is consistent with CSA N1600.

The revised PNERP includes alignment of the thyroid blocking Protective Action Level (PAL) with provincial, federal and international guidance, and the review of measures in place around KI pill stocking and distribution strategies.

As stated in CMD 18-H6 Pickering NGS meets the 2017 PNERP master plan requirements regarding distribution of KI tablets, public alerting and communications, and the designation of emergency response centers.

3. *The level of the public awareness of emergency procedures and provisions for public alerting.*

There are extensive public information programs by Pickering NGS, Durham Region, Office of the Fire Marshal and Emergency Management (OFMEM), and the CNSC in order to ensure the public has numerous methods of receiving emergency information or being able to obtain emergency information.

Information about emergency preparedness is provided to the residents surrounding Pickering NGS annually and in multiple media types. OPG provides information through newspapers, TV advertisements and newsletter mail outs. OPG, Durham Region, OFMEM and the CNSC maintain web sites with details regarding emergency preparedness and guidance. All of these groups use various types of media to provide emergency preparedness information in a form that can be easily understood.

The public information programs include details regarding public alerting systems in the Pickering area. The public have the ability to subscribe to email alerts from the Region of Durham and the Province of Ontario. A new wireless system is currently being tested nationally and will be in service soon. This system will provide emergency alerts to cell phones and wireless devices. Alerts will also be provided through TV and radio broadcasts. This new system has been advertised to the public in multiple media systems including cell phone test messages to all Canadians.

On May 9 and 10, 2018, the annual public alerting testing took place in the 3 km zone for sirens and in the 10 km zone for the auto-dialing phone system.

2.4.1 Update on developments within the Emergency Preparedness SCA

Provincial Nuclear Emergency Response Plan (PNERP)

On April 4, 2018, the OFMEM provided to the Commission an update in CMD 18-M21on emergency management in Ontario and the 2017 PNERP. CMD 18-M21 is attached in Addendum B for information.

CMD 18-M21 provides highlights on the 2017 PNERP master plan and implementing plans, which included:

- A new Contingency Planning Zone, clarifying how local protective actions could be implemented if needed;
- Descriptions of accident scenarios, including severe accidents;
- Descriptions of key emergency response activities for various accident scenarios;
- Requirements to regularly review the plan, and complete public consultation;
- Guidelines for protective actions, roles and responsibilities for stakeholder organizations, and updated training and exercise requirements consistent with national and international standards; and
- A more detailed rationale behind key features of the plan, including planning zone sizes.

The Pickering NGS Implementing Plan was updated following the 2017 revision to the PNERP and has been available on the OFMEM website since April 30, 2018. The implementing plans apply the principles, concepts and policies contained in the master plan, in order to provide detailed guidance and direction for dealing with emergencies at the Pickering site. The plan will be implemented over the next year as is the normal practice for a revised plan. Meanwhile, there is a fully functioning implementation plan in place today and all stakeholders are prepared should an emergency happen today.

OPG has performed a gap analysis to identify any need for potential changes to its emergency plans and programs to fully meet the 2017 PNERP master plan. Changes to the Pickering NGS emergency plans are mostly administrative. OPG will perform updates to the large number of plans and program documents to reference the new 2017 PNERP. OPG continues to provide support to offsite authorities.

Exercise Unified Control

As detailed in CMD 18-H6, in December 2017, OPG conducted "Exercise Unified Control" at Pickering NGS. Exercise Unified Control was a large full-scale nuclear exercise that simulated a severe accident and tested OPG's ability to respond to extreme events, including the use of the portable emergency mitigation equipment and connections points added to the station post-Fukushima. More than 30 organizations, including the CNSC participated in the exercise.

During and following Exercise Unified Control, several evaluations have taken place. Recently, the evaluation reports have been completed and made available.

1. OPG documented results of their exercise assessment in an After Action Report [20] in which several recommendations were identified for further improvements in areas of communications, data transfer and decision making. A number of good practices were also identified such as conservative initiation of protective actions, availability of real time radiation data, and the use of effective methods of communication to the public.
2. CNSC Pickering site inspectors performed a Type II inspection at the OPG Site Management Center during the exercise [21]. This inspection resulted in one action notice and two recommendations to OPG. The action notice directs OPG to ensure that their staff adhere better to procedures during an exercise while the recommendations deal with the opportunities to improve situation awareness at the Site Management Center.
3. An evaluation of the CNSC response to the simulated emergency was conducted by an independent expert [22]. While a number of recommendations were identified to refine the CNSC nuclear emergency response program, this evaluation concluded that CNSC has the fundamental capabilities in place to fulfill its mandate during a nuclear emergency.

Overall, the evaluations completed after Exercise Unified Control confirm that the existing capabilities to respond to an emergency at Pickering NGS are adequate to protect the health and safety of the public. OPG, CNSC, OFMEM and other off-site authorities are prepared to respond to a severe accident at a nuclear facility.

2.5 SCA Waste Management

Several interventions raised the subject of waste management and decommissioning plans as a matter of concern. Broadly, such concerns were related to:

1. The comprehensiveness of the Canadian regulatory framework for nuclear waste and decommissioning;
2. The strategy and location for long-term and permanent disposal of OPG's radioactive waste;

3. The robustness of current on-site waste storage facilities against terrorist attack or extreme natural hazards; and
4. The financial and social impacts of delayed decommissioning on current and future generations.

CNSC staff position:

1. Canada's regulatory framework for waste and decommissioning

The CNSC licenses, monitors and inspects nuclear facilities, including radioactive waste management facilities in order to assure the protection of the health, safety and security of persons and the environment. Since all nuclear substances associated with licensed activities will eventually become radioactive waste, the safe long-term management of that radioactive waste is an important consideration during the review process for any licensed activity or facility.

The Government of Canada's Radioactive Waste Policy Framework sets the stage for institutional and financial arrangements to manage radioactive waste in a safe, comprehensive, environmentally sound, integrated and cost-effective manner. The Framework recognizes that long-term management arrangements may be different for various categories of radioactive wastes, such as used nuclear fuel, low- and intermediate-level radioactive waste, and uranium mining and milling waste. The framework specifies that:

- The Government of Canada is responsible for developing policy and for regulating and overseeing radioactive waste producers and owners to ensure that they comply with legal requirements and they meet their funding and operational responsibilities.
- In accordance with the "polluter pays" principle, waste owners are responsible for the funding, organization, management and operation of the facilities required to safely manage their wastes over the short and long terms

In 2002, Parliament passed the *Nuclear Fuel Waste Act* (NFWA), making the owners of used fuel responsible for the development of long-term waste management approaches. The legislation required nuclear energy corporations, including OPG, to establish a waste management organization as a separate legal entity to manage the full range of long-term used fuel management activities. It also required the organization to prepare and submit a study to the Government of Canada on proposed approaches for the long-term management of the waste. The Nuclear Waste Management Organization (NWMO) is the organization responsible for designing and implementing Canada's plan for the safe, long-term management of used nuclear fuel. Under the NFWA, the Government of Canada is responsible for reviewing the study prepared by the NWMO, selecting a long-term management option from those proposed and ensuring oversight during its implementation.

The nuclear industry, including the organizations managing the radioactive waste, is also subject to the *Nuclear Safety and Control Act* (NSCA), *Canadian*

Environmental Assessment Act, 2012, the *Canadian Environmental Protection Act*, and the *Fisheries Act*.

The CNSC's regulatory approach for radioactive waste stems from the NSCA and is articulated in CNSC documents P-299 *Regulatory Fundamentals*, REGDOC-2.11.1 *Waste Management Volume II: Assessing the Long Term Safety of Radioactive Waste Management*, and RD/GD-370 *Management of Uranium Mine Waste Rock and Mill Tailings*. In developing these documents, the CNSC draws upon recommendations of the IAEA and best practices from the international and national community.

REGDOC-2.11.1, published in May 2018, outlines the philosophy and six principles, as described below, that govern the CNSC's regulation of radioactive waste. It is fully consistent with the federal Radioactive Waste Policy Framework.

The policy indicates that, when making regulatory decisions about the management of radioactive waste, the CNSC will seek to achieve its objectives by considering the following key principles in the context of the facts and circumstances of each case, as follows:

- The generation of radioactive waste is minimized to the extent practicable by the implementation of design measures, operating procedures and decommissioning practices.
- The management of radioactive waste is commensurate with its radiological, chemical and biological hazard to the health and safety of persons, the environment and to national security.
- The assessment of future impacts of radioactive waste on the health and safety of persons and the environment encompasses the period of time in which the maximum impact is predicted to occur.
- The predicted impacts on the health and safety of persons and the environment from the management of radioactive waste are no greater than the impacts that are permissible in Canada at the time of the regulatory decision.
- The measures needed to prevent unreasonable risk to present and future generations from the hazards of radioactive waste are developed, funded and implemented as soon as reasonably practicable.
- The transborder effects on the health and safety of persons and the environment, which could result from the management of radioactive waste in Canada, are not greater than the effects experienced in Canada.

The principles contained in REGDOC-2.11.1 *Waste Management Volume II: Assessing the Long Term Safety of Radioactive Waste Management* are consistent with those recommended by the IAEA.

With regards to decommissioning, requirements are set out in the CNSC regulations and further specified in the CNSC regulatory document G-219 *Decommissioning Planning for Licensed Activities.* CNSC staff also participate in the development of waste-related and decommissioning CSA standards, such as N294-09 *Decommissioning of facilities containing nuclear substances,* and these standards complement the CNSC's regulatory framework.

Licensees of Class I nuclear facilities, such as Nuclear Power Plants, are required to keep decommissioning plans up to date throughout the lifecycle of a licensed activity. In addition, the CNSC requires that all licensees implement financial guarantees to cover the cost of decommissioning work resulting from the licensed activities. Decommissioning plans that assume the need for post-closure licensing, monitoring, surveillance and maintenance of the decommissioned activities must include financial provisions for these actions.

The CNSC requires licensees to prepare a preliminary decommissioning plan (PDP) and a detailed decommissioning plan (DDP) for approval by CNSC. The PDP must be filed with the CNSC as early as possible in the lifecycle of the activity or facility and must be reviewed and updated:

- Every five years;
- When operational experience is gained or technological advancements are made; or
- When requested by the Commission or a person authorized by the Commission

The PDP documents the preferred decommissioning strategy – whether it is prompt decommissioning, deferred decommissioning or in situ confinement – along with objectives at the end of decommissioning and sets the basis for the decommissioning cost estimate. The licensee's financial guarantee must cover the projected cost of the decommissioning, including the cost of the waste management option proposed. The PDP does not authorize the licensee to conduct decommissioning activities. The DDP is filed with the CNSC prior to decommissioning and is required for appropriate licensing action (i.e., to authorize decommissioning).

Decommissioning strategies are not prescribed by the CNSC. Proponents must propose their preferred strategy as part of their decommissioning plan and must support it with a safety case. Any proposed decommissioning strategy will be assessed by the CNSC against regulatory requirements to ensure the protection of health and safety of the public and the environment.

2. *Strategy and location for long-term and permanent disposal of radioactive waste*

In accordance with the NFWA, the Nuclear Waste Management Organization (NWMO) was established in 2002 by Canada's nuclear electricity producers, including OPG. The NWMO assumed responsibility for designing and implementing Canada's plan for the safe, long-term management of used nuclear fuel. In 2007, after a comprehensive three-year study and public engagement, the Government of Canada selected the NWMO's Adaptive Phased Management approach for the safe and secure long-term management of used nuclear fuel. The initiative is presently in the site-selection process for siting a deep geological repository, with five of the original 22 interested communities remaining in the process.

With regards to low- and intermediate-level radioactive waste (L&ILW), OPG has safely managed L&ILW from the Pickering NGS, Darlington NGS and the Bruce NGSs for more than 40 years. OPG recognizes that a permanent solution will be required to safely dispose of such waste. The concept for the deep geological repository at the Bruce NGS site was developed following a request by the Municipality of Kincardine to explore he options for long-term management of L&ILW in that region.

The current project proposed by OPG is to prepare the site and construct a deep geological disposal facility on the secure Bruce site within the Municipality of Kincardine. The purpose of the proposed repository is to ensure the protection of the environment by safely isolating and containing L&ILW deep underground in stable rock formations that are more than 450 million years old.

OPG's Deep Geologic Repository project is designed for 200,000 cubic meters of emplaced L&ILW from operations and refurbishment activities and is planned to be constructed at a depth of 680 meters. The proposed site is adjacent to OPG's existing Western Waste Management Facility (WWMF), which provides centralized storage for L&ILW from the operation and refurbishment of OPG-owned reactors in Ontario (excluding the ILW generated from the refurbishment of Pickering A and the Darlington NGS).

The Canadian Environmental Assessment Agency (CEA Agency) and the CNSC established a joint review panel (JRP) in January 2012 to review OPG's environmental impact statement in support of its application for a licence to prepare the site and construct a deep geological repository for its L&ILW. The JRP held public hearings in 2013 and 2014. On May 6, 2015, the JRP issued its environmental assessment report, which included 97 recommendations, to the Minister of Environment and Climate Change for review and decision under the *Canadian Environmental Assessment Act, 2012*. In this report, the JRP concluded that OPG's Deep Geologic Repository project is not likely to cause significant adverse environmental effects, provided the mitigation measures proposed, the commitments made by OPG during the review and the mitigation measures recommended by the JRP are implemented.

The Minister of Environment and Climate Change requested additional information from OPG in 2016 and 2017. The CEA Agency will review the additional information, which considers input from the federal review team, Indigenous groups and the public. Subject to the minister's decision, the JRP under the *Nuclear Safety and Control Act*, would decide whether to issue a licence to OPG to prepare a site and construct the Deep Geologic Repository facility for L&ILW.

3. *Robustness of on-site waste storage facilities against terrorist attack or extreme natural hazards*

All waste generated from the Pickering NGS is safely managed by OPG at the Pickering Waste Management Facility (PWMF) and the WWMF, which are operated under CNSC waste facility operating licences. The licences for the WWMF and PWMF were reissued in 2017 (CMD 17-H3) and 2018 (CMD 17-H5), respectively, both following public hearings in April 2017. The safety analysis for these facilities takes into account potential malevolent acts and natural hazards.

Spent fuel is categorized as Category II Nuclear Material in accordance with the *Nuclear Security Regulations* (NSR) and the international Convention on Physical Protection of Nuclear Material (CPPNM). Licensees that store Category II nuclear material within their nuclear facility must have security measures in place to protect the nuclear material. The spent fuel generated at Pickering NGS is stored at the PWMF Phase I or Phase II sites which are contained within Protected Areas, in accordance with the NSR. OPG has in place a robust nuclear security program that meets the NSR and all its associated regulatory documents.

The Safety Analysis Reports (SARs) for the PWMF and WWMF provide assessments of the potential impacts of postulated events both inside and external to the facility. The external events considered include natural hazards such as earthquakes, tornados, thunderstorms, and floods. The SARs are submitted to CNSC staff for review and acceptance on a minimum 5-year basis.

4. *Financial and social impacts of delayed decommissioning on current and future generations*

The CNSC requires that planning for decommissioning take place throughout a facility's life-cycle. A preliminary decommissioning plan (PDP) is in place for the Pickering NGS with the latest revision submitted to CNSC staff in January 2017. CNSC staff reviewed OPG's PDP and concluded that it complies with the licensing requirements, in particular those of CSA standard N294-09 *Decommissioning of facilities containing nuclear substances*. In accordance with the current Canadian regulations, it is up to the licensee to propose the decommissioning strategy considering factors such as potential doses to workers, the availability of waste management and disposal capacity, costs, as well as social factors.

In the PDP OPG selected a deferred decommissioning strategy, which means that following shutdown of the reactor units and stabilization activities, there will be a storage with surveillance period of 28-31 years to allow for radiation levels to decay prior to station dismantling and demolition. The dismantling and demolition stage is expected to begin in 2050. Decommissioning is expected to be completed in 2065. The facility will continue to require a CNSC licence and be subject to regulatory oversight until that date.

The PDP also serves as the basis for the decommissioning cost estimate, which in turn is used to determine the amount of the financial guarantee that OPG must have in order to ensure that sufficient funds are available to decommission the facility. OPG maintains a consolidated financial guarantee for all of the nuclear facilities it owns. As of December 31, 2017, this financial guarantee was valued at $21,171 M, which exceeds the minimum required amount of $16,468 M for 2018. Regardless of the selected decommissioning option, the licensee must ensure safety of the workers and public and the protection of the environment. The CNSC will maintain adequate regulatory oversight of the Pickering NGS throughout the entire decommissioning to ensure that requirements will be met.

2.6 Other Matters

2.6.1 End of Commercial Operation and a 10-year Licence

Generally, issues raised by intervenors with regards to the end of commercial operation focused on OPG's plans to operate Pickering NGS beyond the original shutdown date of 2020 out to December 2024, and the lack of certainty around the final shutdown date. Other concerns involve opportunities for public involvement during a 10-year licence period.

CNSC staff position:

CNSC requested OPG to conduct a Periodic Safety Review (PSR) to ensure that Pickering NGS operation, condition and programs conform, to the extent practicable, to modern codes and standards, and that arrangements exist to enhance the continued safe operation of the plant. A PSR takes into account evolving national requirements and international safety practices; considers worldwide operating experience; and, in particular, undertakes an assessment of the impact of plant aging on safety. The PSR findings are addressed by safety enhancement actions which are scheduled in an Integrated Implementation Plan (IIP).

The PSR covers a 10-year period and is the basis for CNSC staff's recommendation for a 10-year licence. As the proposed licence period will cover operational and stabilization phases as well as the beginning of the safe storage phase, the PSR identified the safety significant systems required for each phase; especially at the point of hand over from permanent shutdown to the stabilization phase and from the stabilization phase to the safe storage with surveillance phase. Continued fitness for service of those systems has been demonstrated for the recommended 10-year licence period.

As described in CMD 18-H6, licence condition (LC) 15.4 in the proposed PROL requires OPG to implement and maintain plans for the end of commercial operation of all Pickering units. Should OPG be asked by the Province to investigate operating any unit beyond December 31, 2024, the compliance verification criteria specified under LC 15.4, require that OPG shall notify the CNSC in writing and no later than December 31, 2022, of its consideration to operate any unit of the Pickering NGS beyond December 31, 2024 and provide as a minimum the following:

- Changes to OPG P-PLAN-09314-00003, *Pickering Site Strategic Plan*;
- Revised dates for the end of commercial operation of each Pickering operating reactor unit;
- Timeline for the reassessment of the impact of operations beyond 2024, based on the assessment included in the PSR Global Assessment Report, and the consequential new IIP actions; and
- Request for CNSC acceptance, by a specific date, of potential new or revised actions in the IIP.

As operation of any unit beyond December 31, 2024 would constitute a change to the licensing basis, OPG will be required to seek Commission approval.

Additionally, under LC 15.4, OPG is required to provide a sustainable operations plan (SOP) for the safe operation until the final permanent shutdown of each reactor and a stabilization activity plan (SAP) for transitioning every shutdown reactor unit to the safe storage state. The SOP is to be developed and implemented at least 5 years prior to the permanent shutdown of any reactor unit and updated annually. The SAP is to be developed at least 3 years prior to the permanent shut down of any reactor unit and implemented immediately after the unit is shut down.

CNSC staff report annually to the Commission on performance of nuclear generating stations through the NPP Regulatory Oversight Report at a public Commission Meeting. This will provide an annual opportunity for the public to submit written comments during the 10-year licence period about matters such as the end of commercial operation as well as the progress of the SOP and SAP activities.

2.6.2 Fukushima Action Items

Many intervenors made reference to the 2011 Fukushima accident in their submissions and expressed concerns with Pickering NGS's ability to cope with a severe accident due to its age and design. Specific concerns were raised with respect to the preservation of containment integrity.

<u>CNSC staff position:</u>

Despite being designed in the 1960's and first operated in the 1970's, Pickering NGS has implemented many design modifications and safety upgrades that are currently available to prevent a beyond design basis accident from happening in the first place and, should it happen, from progressing to a severe accident of the scale of Fukushima accident.

Following the Fukushima accident, CNSC established an Action Plan to ensure that the essential lessons were applied in Canada to enhance the safety of nuclear facilities. For Pickering NGS, all Fukushima action items are closed and specific safety enhancements have been implemented. The design modifications and safety upgrades include provisions to increase reliability of the safety significant equipment, multiple means of assuring supply of power and cooling water to specific components, strengthening of heat sinks, measures to prevent or mitigate hydrogen combustion in containment, options for controlled filtered containment venting, portable equipment stored on- and off-site, and robust accident management guidance. The IIP actions for protecting containment integrity will bring further improvements in the plant defence in depth. Analyses and regular accident drills confirm the plant robustness.

Given the multiple engineered provisions to protect the physical barriers (such as fuel bundles, pressure tubes, primary circuit, calandria vessel and containment) in Pickering NGS, a severe accident will be prevented or stopped within the calandria. In the unlikely case where a severe accident progresses further, any venting will be controlled and filtered. In the PSR IIP, an additional modification dealing with assuring an alternative venting pathway is scheduled for implementation by June 2019, which will further enhance safety and assure maintaining of the integrity of containment. The results of the Probabilistic Safety Analyses demonstrate that the likelihood of large radioactive releases is very low, meets the applicable requirements and will further be reduced with the completion of the PSR IIP actions.

2.6.3 Nuclear Liability

In addition to issues around public safety in the event of a severe accident, some interventions also identified liability and compensation limits as a concern. Although the administration of the *Nuclear Liability and Compensation Act* resides with Natural Resources Canada (NRCan), additional clarification on the Act is provided below.

CNSC staff position:

The new *Nuclear Liability and Compensation Act* (NLCA) came into force on January 1, 2017 and replaced the old *Nuclear Liability Act* in order to provide a stronger legislative framework to better address the question of liability and compensation after a nuclear incident. It sets the absolute liability limit of an operator of a nuclear installation to an amount that will gradually increase to $1 billion over four years after the act’s coming into force. In setting the limit the following points were considered:

1. The amount is sufficient to deal with the consequences of a nuclear incident at a Canadian nuclear power plant involving controlled releases of radiation;
2. It is within the capacity of insurers to provide insurance at this level for reasonable costs; and
3. It is more in line with liability limits in other countries.

The Minister of Natural Resources is responsible for all issues related to financial responsibility pursuant to the NLCA including the level of insurance a nuclear installation is required to carry. The Minister must review the limit of liability, referred to in subsection 24(1) of the NLCA, on a regular basis and at least once every five years.

3. UPDATES TO PROPOSED LICENCE AND LCH

3.1 Updates to the Power Reactor Operating Licence

As detailed in CNSC staff CMD 18-H6 [10], OPG is seeking Commission approval to operate Pickering Unit 5-8 fuel channels up to 295,000 EFPH. This is the maximum operating time expected for the lead unit before the end of commercial operation on December 31, 2024. One of the principle factors influencing the pressure tube material properties is the hydrogen equivalent concentration or [Heq]. Based on current [Heq] predictions, the lead Pickering channels are not expected to reach 120 ppm before the end of the target service life at any unit. This concentration represents the upper validity limit for the approved pressure tube fracture toughness models.

Regardless, CNSC staff recommended a specific licence condition (LC 15.3) to assure the presence of adequate compliance verification criteria should the projected [Heq] predictions exceed 120 ppm before the end of Pickering pressure tube target service life.

For consistency with the request made by the Commission to CNSC staff during the Bruce Power licence renewal Part 1 Hearing [23], CNSC staff have strengthened LC 15.3 as follows:

Old proposed LC 15.3	**New proposed LC 15.3**
The licensee shall maintain pressure tube fracture toughness sufficient for safe operation.	Before hydrogen equivalent concentrations exceed 120 ppm, the licensee shall demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm

Additional clarification has also been incorporated into the Licence Conditions Handbook, as summarized in the following section.

This modification does not change CNSC staff's recommendation that the Commission approve the operating of Pickering NGS Unit 5-8 fuel channels up to a maximum of 295,000 EFPH.

3.1.1 Updates to the Licence Conditions Handbook

The following are the proposed changes to the LCH. These modifications are meant to correct typographical errors, update the versions of documents to the most current ones, and otherwise reflect the developments since the Part 1 Hearing.

Section of LCH	Proposed improvements to the proposed LCH since the Part 1 CMD
All	Administrative updates for typos, to licensee document titles and numbers to reflect typos or improvements to the management system. Addition of licensee documents that were only included by reference and removal non-programmatic documents or correspondence from the Licensee Documents table.
2.1 Human Performance Program	Addition of the implementation strategy for REGDOC-2.2.4, Volume II: *Managing Alcohol and Drug Use*, Version 2.
3.1 Operating Performance	Revision to the Compliance Verification Criteria (CVC) for regulatory undertakings to better reflect the requirements of REGDOC-3.1.1. Revision to the CVC for heat sinks as the focus of the CVC is on heat sink management irrespective of outage duration. The CVC for Instrument Uncertainty Calculations (IUCs) was removed as changes that negatively impact the licensing basis require approval by the Commission in accordance with LC G.1. The CVC for enhanced neutron overpower (NOP) protection were updated to reflect current status. The date was removed for the update of the safety analysis for Common Mode Events (CME) as the updates are required in accordance with REGDOC-3.1.1.
5.3 Equipment and Structure Qualification Program	The CVC for the seismic program was moved back to Guidance as they are not explicitly required by the current version of CSA N289.1.
6.1 Fitness for Service Program	The CVC for structures, systems and components (SSC) specific aging management programs was revised back to the CVC in the current LCH as it provided more clarity and also to better reflect the notification requirements in LC G.2. The bullet referring to submitting a research and development test plan and schedule for the validation of the cohesive zone-based fracture toughness model was removed as OPG has provided the plan. The text on dispositioning of pressure tubes with high Heq concentrations was removed from the CVC and Guidance as these requirements are specified in CSA N285.8-15 and the purpose of the LCH is not to reiterate these requirements.
9.1 Environmental Protection	A note was added for CSA N288.1-14. The revised Derived Release Limits (DRLs) including Environmental Release Limits (EALs) will be updated in the LCH for 2019-01-01.

13.1 Safeguards Program	Addition as a guidance publication CNSC regulatory document REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*, with a submission date for the implementation plan and gap analysis of July 31, 2018.
15.3 Pressure Tube Fracture Toughness	Revision of the licence condition and CVC for demonstration of sufficient pressure tube fracture toughness.

The LCH will continue to be updated and improved throughout the life of the PROL and revisions to the LCH, once issued, will be approved by the Director General of the Directorate of Power Reactor Regulation. This is the standard process that is followed by all LCHs for NPPs regulated by the CNSC. An update on the revisions to the LCH will be given annually to the Commission via the NPP Regulatory Oversight Report.

4. OVERALL CONCLUSIONS AND RECOMMENDATIONS

The information provided in this supplemental CMD does not change the overall CNSC staff conclusions and recommendations provided in CMD 18-H6.

CNSC staff conclude with respect to paragraphs 24(4)(*a*) and (*b*) of the NSCA, that OPG:

1. Is qualified to carry on the activity authorized by the licence.
2. Will, in carrying out that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

CNSC staff recommend to the Commission the following:

1. Renew the Pickering NGS PROL, and associated Licence Conditions Handbook (LCH), authorizing OPG to carry out the activities listed in Part IV of the licence from September 1, 2018 to August 31, 2028.
2. Accept the station-specific conditions included in the proposed licence requiring OPG to:
    - implement the Integrated Implementation Plan;
    - maintain Units 2 and 3 in the safe storage phase;
    - before hydrogen equivalent concentrations exceed 120 ppm, demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm[2];
    - implement and maintain plans for the end of commercial operations of all Pickering units;
    - implement and maintain a Cobalt-60 program for activities described under Part IV of the licence;
    - limit the activities of import and export to the nuclear substances occurring as contaminants in laundry, packaging, shielding or equipment.
3. Authorize OPG to operate the Pickering NGS Units 5-8 fuel channels up to a maximum of 295,000 EFPH.
4. Authorize the delegation of authority as set out in section 6.11 of CMD 18-H6.

[2] The condition was strengthened based on feedback from the Commission during the Part 1 licence renewal hearing for Bruce Nuclear Generating Stations A and B.

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19. OPG Report P-REP-03482-00006 R000, "Derived Release Limits and Environmental Action Levels for Pickering Nuclear", May 29, 2017, e-Doc 5299362
20. Exercise Unified Control 2017 After Action Report, 8 May 2018, e-Doc 5558575
21. CNSC Type II Inspection Report PRPD-2018-005, “Planned Emergency Response Exercise”, Marcy 6, 2018, e-Doc 5472979
22. Independent Evaluation Report, Exercise Unified Control December 6-7, 2018, April 24, 2018, e-Doc 5514434
23. Canadian Nuclear Safety Commission, Transcript of March 14, 2018 Public Hearing, available at http://www.nuclearsafety.gc.ca/eng/the-commission/hearings/documents_browse/

A. CMD 18-M4 TECHNICAL UPDATE ON FUEL CHANNEL FITNESS-FOR-SERVICE IN CANADIAN NUCLEAR POWER PLANTS

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

Canada

Technical Update on Fuel Channel Fitness-For-Service in Canadian Nuclear Power Plants

Commission Meeting, January 23 2018

CMD 18-M4

CNSC Staff Presentation

e-Docs #5422679 (PPTX)
e-Docs #5436079 PDF

Purpose

In relation to aging management of existing operating facilities, CNSC staff presents the science behind fuel channel fitness-for-service assessments in support of technical information for Regulatory recommendations.

Previous CMDs

Pressure tubes have been mentioned during several NPP Re-Licensing Hearings; the following is a list of CMDs that provided detailed technical information:

- CMD 13-H2.A: Supplemental CNSC staff submission recommending Hold Point for OPG-Pickering (in connection with request to operate beyond 210,000 EFPH)
- CMD 14-H2: CNSC staff submission regarding OPG-Pickering request to remove 210,000 EFPH Hold Point
- CMD 14-M15: OPG/BP technical briefing regarding PT fitness-for-service
- CMD 14-M15.1: CNSC staff submission regarding PT fitness-for-service
- CMD 17-M12: CNSC staff submission (follow-up) regarding Commission Meeting Item: CANDU Safety Issues

Outline

- Overview of the CANDU fuel channel
- Some useful concepts
- Degradation of pressure tubes (“PT”)
- Regulatory oversight of PT degradation
  - Example 1 - PT flaws
  - Example 2 - reduced PT fracture toughness
- CNSC evaluation of requests for extended PT operation
  - Timeline of licencee requests for extended operation
  - Operation beyond 247,000 EFPH: area of regulatory focus
- Summary

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OVERVIEW OF THE CANDU FUEL CHANNEL

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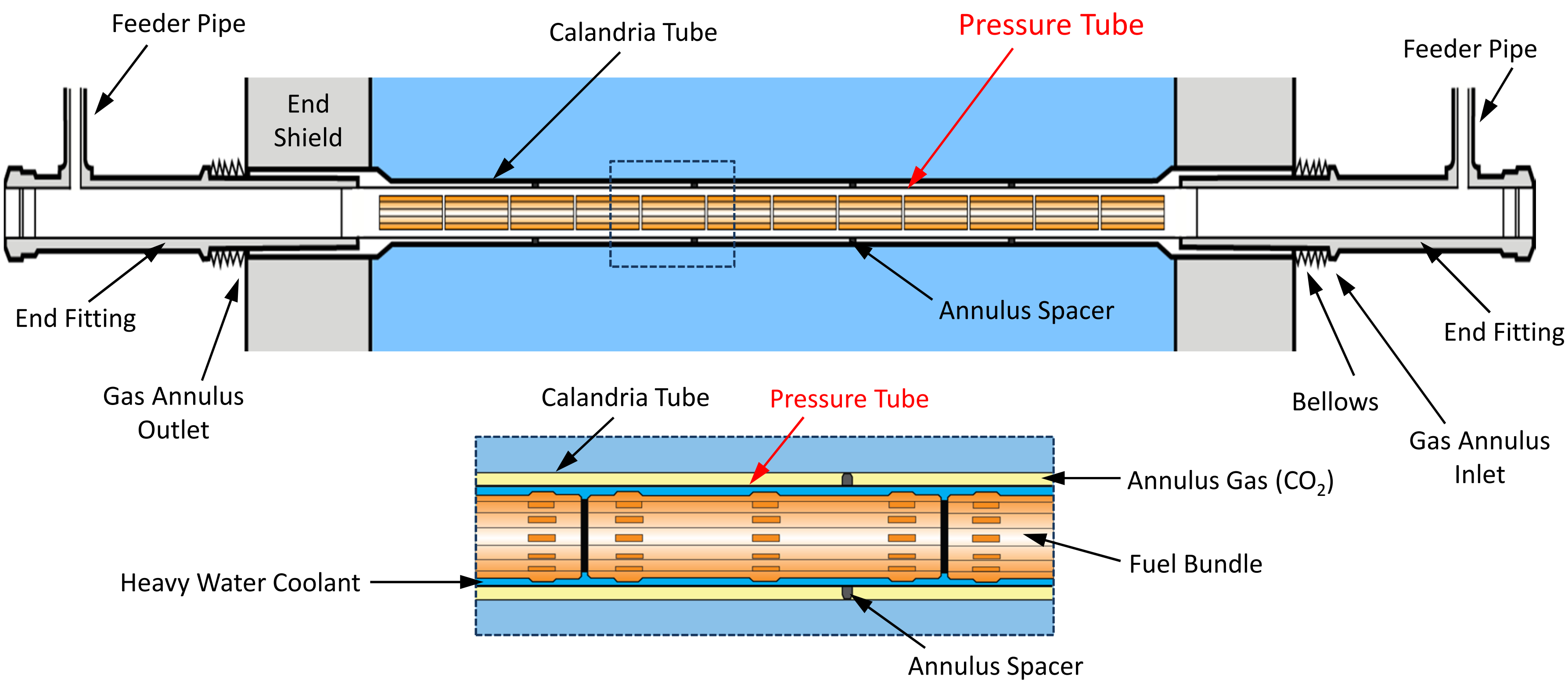
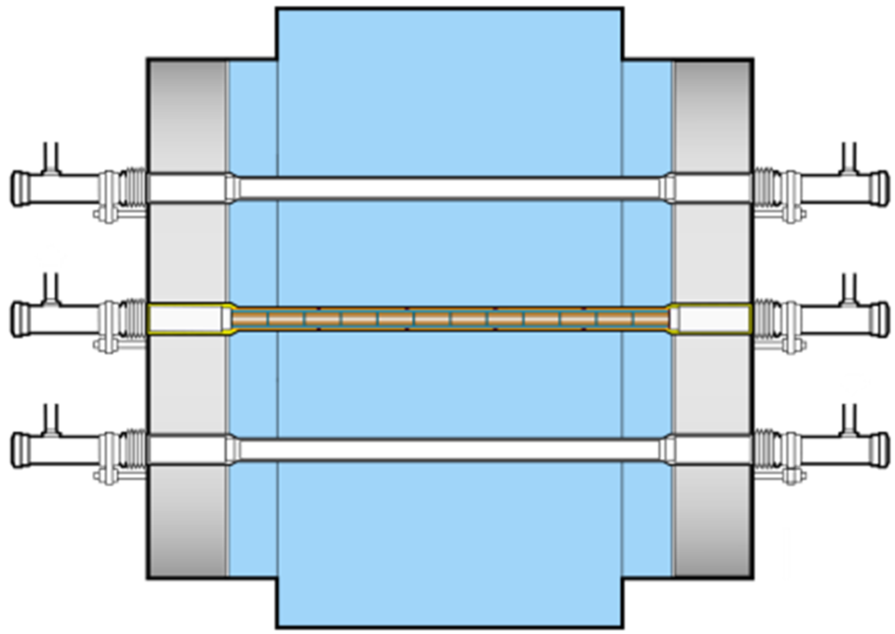
CANDU Fuel Channel (FC)



CANDU Fuel Channels (2 of 2)

Pressure Tubes

- 380 to 480 per core
- Horizontal orientation
- Zirconium-2.5 wt.% Niobium
- Dimensions
  - 5.94 m in length
  - Inside diameter 103.4 mm
  - 4.2 mm wall thickness



Normal Operating Conditions

- ≈250^{o}C (inlet) to ≈310^{o}C (outlet)
- ≈11 MPa (inlet) to ≈10 MPa (outlet)

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CMD 18-M4

THECHNICAL CONCEPTS

Some Technical Concepts

Before describing the basis for pressure tube (PT) assessments, it is useful to review a few concepts:

1. Fitness-for-Service of pressure tubes
2. Hydrogen/deuterium in pressure tubes
3. Units for reactor operating time

Concept #1
Fitness-for-Service of PTs (1 of 2)

- Pressure tubes form part of the pressure boundary of the Primary Heat Transport System
- Structural integrity of the Heat Transport System is an important element of CANDU safety case
  - Under Normal Operating Conditions, PTs contain the high-pressure, high-temperature primary coolant
  - During (postulated) Design Basis Accidents, PTs keep the fuel cool

Concept #1
Fitness-for-Service of PTs (2 of 2)

- For these reasons, PT design must support an extremely low probability of failure under all reactor operating conditions:
  - Pressure tubes are designed not to leak
  - Pressure tubes are designed to resist propagation of a through-wall crack to the point of PT rupture

Goal of fitness-for-service: ensure PTs continue to meet the design intent

Concept #1

Pressure Tube Evaluations

CNSC requirement:

licencee must demonstrate acceptable performance of 100% of pressure tubes over future period

Fitness-for-Service assessments based on results from periodic inspections	**30%** of pressure tubes
	+
Risk assessments* based on CNSC-accepted Models	**70%** of pressure tubes

✓ **100% of PTs assessed against defined acceptance criteria**

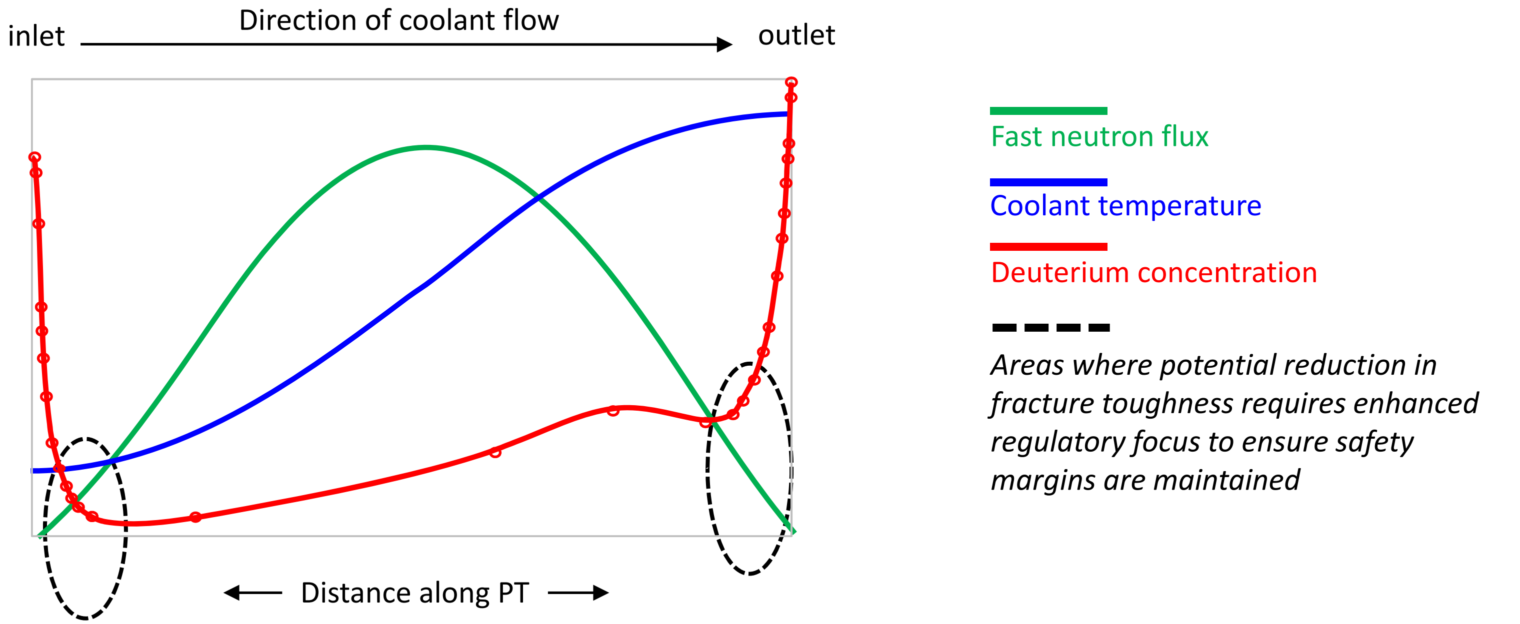
* Examples: Leak-Before-Break (Slide 22) and fracture protection (Slide 28)

Concept #2
Hydrogen/Deuterium

- While three hydrogen isotopes are important to CANDU operation, only two affect PTs
- Every PT contains some **hydrogen (H)**, originating from its manufacture
- In the presence of hot heavy water coolant, PTs corrode to form zirconium oxide. This releases **deuterium (D),** a fraction of which is absorbed by the tube
- By convention, H and D concentrations are reported as milligrams per kilogram of PT material (or parts-per-million, PPM)
- Every PT contains both H and D. The two are often combined and reported as a single value: hydrogen-equivalent (Heq) concentration
  - For convenience, the term “Heq” will be used throughout this CMD

Concept #2

Factors Influencing Heq Level Along a PT



Concept #3
Units for Reactor Operating Time

- Reactor operating time is described in two ways:
  - ***Hot Hours*** (HH) – includes all periods when the Heat Transport System exceeds ≈200°C
    - Since PTs corrode at these temperatures, Hot Hours is a useful metric for comparing Heq levels
  - ***Effective Full Power Hours*** (EFPH) – captures only those periods when fuel is undergoing fission
    - Since PTs irradiated by fast neutrons during such periods, EFPH useful for tracking degradation arising from neutron damage e.g. PT elongation
- Example: 1 calendar year = 8760 Hot Hours ≈ 7890 EFPH*

* Varies by station, and operating circumstances

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DEGRADATION OF PRESSURE TUBES

e-Docs #5422679 (PPTX)
e-Docs #5436079 PDF

Degradation of Pressure Tubes due to aging

- PTs located in reactor core are exposed to high temperatures, high pressure and intense radiation fields
- Leads to in-service degradation

1. PT deformation
- Elongation
- Reduction in wall thickness
- Increase in diameter
- PT sag

2. Calandria tube-to-LISS contact

3. PT corrosion

4. PT flaws

5. Degradation of annulus spacers

6. Changes in PT material properties
(fracture toughness of particular interest)

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CMD 18-M4

REGULATORY OVERSIGHT

e-Docs #5422679 (PPTX)
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CMD 18-M4

Regulatory Oversight of PT Degradation

Understand Degradation

- Research and Development
- Operating ecperience (OPEX)

Plan to assess risk

- Research and Development
- Periodic inspections (non-destructive)
- Destructive examinations

Monitor extent and severity of degradation

Perform

- Periodic inspections
- Destructive examinations

Demonstrate PTs meet acceptance criteria

- Assess inspection results
- Identify trends in degradaton

CNSC Requirement
licencee must have Fitness-for-Service Program evaluated and accepted by CNSC staff

e-Docs #5422679 (PPTX)
e-Docs #5436079 PDF

CNSC Staff's Management of Risk – Two Examples

Two examples of staff's regulatory oversight of PT degradation:

- Flaws in PTs
- Declining PT fracture toughness

Example 1
PT Flaws (1 of 3)

Progression of flaw degradation:

- Flaw initiated in pressure tube
- Flaw develops into crack (e.g. Delayed Hydride Cracking)
- Crack propagates through the PT wall -> primary coolant leakage
- Crack extends axially along PT ***(predictable rate, by design)***
  - **Leak-Before-Break:** reactor cooled and shut-down before PT crack reaches “Critical Length” (point of instability)
  - **Break-Before-Leak:** crack reaches Critical Length before reactor can be shut-down

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CMD 18-M4

Example 1

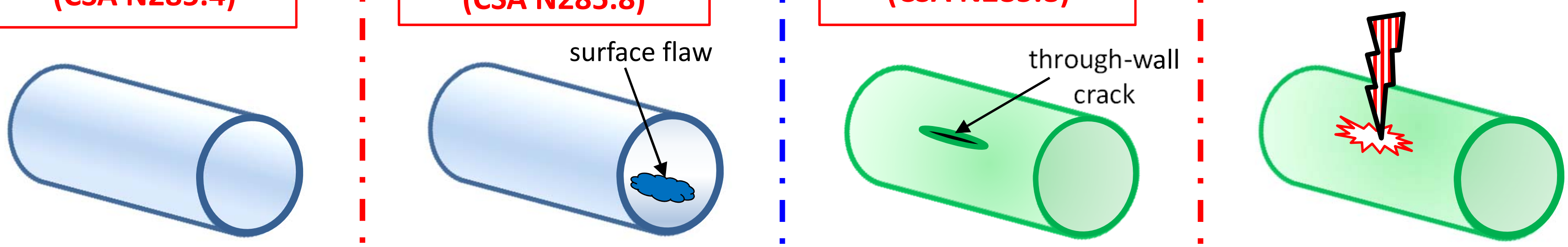
Safety Case for PTs (2 of 3)

Barrier #1 – must pass inaugural inspection (CSA N285.4)

Barrier #2 – detected flaw must not initiate crack (CSA N285.8)

Barrier #3 – must demonstrate Leak-Before-Break (CSA N285.8)

pressure tube rupture (Break-Before-Leak)



As-installed pressure tube

Inspected pressure tube

Uninspected pressure tube

Uninspected pressure tube

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CMD 18-M4

Recalling Slide 20

Understand Degradation
- Research and Development
- Operating ecperience (OPEX)

Plan to assess risk
- Research and Development
- Periodic inspections (non-destructive)
- Destructive examinations

Monitor extent and severity of degradation

Perform
- Periodic inspections
- Destructive examinations

Demonstrate PTs meet acceptance criteria
- Assess inspection results
- Identify trends in degradaton

CNSC Requirement
licencee must have Fitness-for-Service Program evaluated and accepted by CNSC staff

Example 1
PT Flaws (3 of 3)

Requirement	Regulations	licencee actions to address requirements
Understand	REGDOC-2.6.3	Industry research and development; fuel channel Condition Assessments
Plan	CSA N285.4 (per licence Condition Handbook)	Periodic Inspection Program (PIP); fuel channel Life-Cycle Management Plan
Perform	CSA N285.4, CSA N285.8 (per licence Condition Handbook)	Periodic inspections; PT material surveillance; research and development
Demonstrate acceptance criteria met	CSA N285.4, CSA N285.8, REGDOC-2.6.3 (per licence Condition Handbook)	Fitness-for-service assessments; follow-up inspections; research and development

Example 2
Fracture Toughness (1 of 5)

Definition* - resistance a material will offer to a growing crack

- Fracture toughness vital for quantifying risk posed by postulated PT cracks (uninspected PTs)
- Unique situation
  - Unlike PT flaws (which can be identified and monitored in-situ), fracture toughness cannot be measured in in-service pressure tubes
  - Can only confirm toughness of a tube once it has been removed
  - **To predict behavior of operating pressure tubes, licencees must rely on models**
- Industry relies on two forward-looking toughness Models
  - Statistical upper-shelf model: predicts PT toughness at $\geq 250^oC$
  - **Cohesive Zone-based Model**: predicts toughness for lower-shelf and transition regimes

* Carter & Paul, ***Materials Science & Engineering*** ASM International, © 1991

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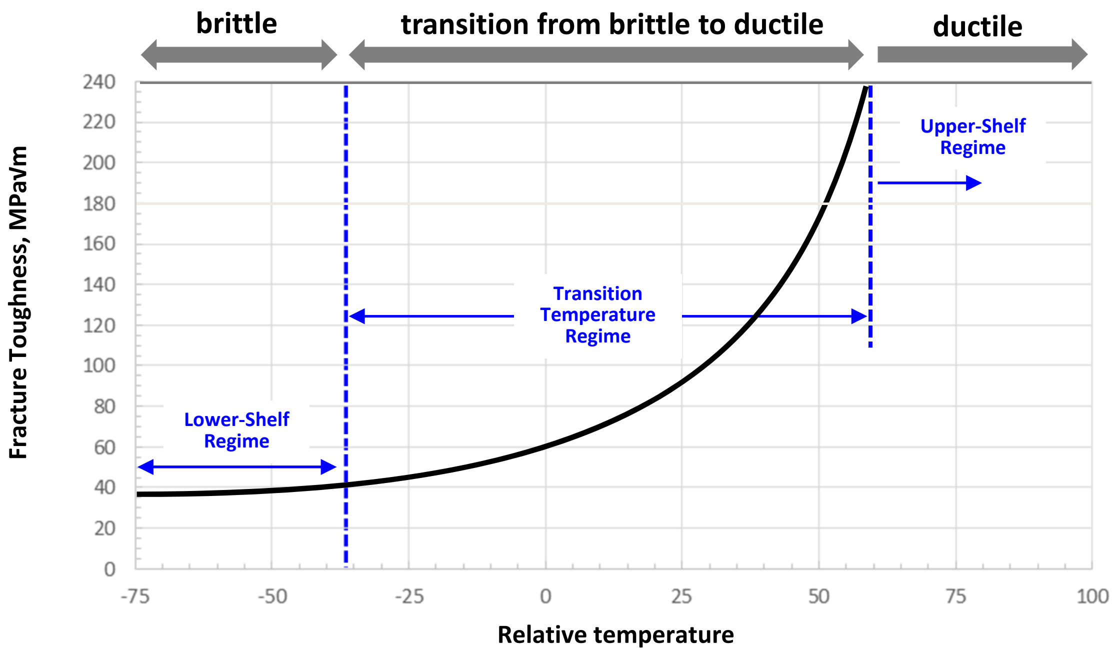
Example 2
Fracture Toughness (2 of 5)



- Relationship between lower-bound toughness and temperature
- Based on destructive tests of irradiated samples of LWR pressure vessel steel
- Three regimes of fracture behavior

Example 2

Fracture Toughness (3 of 5)

- Periodic (destructive) examination of PTs has confirmed adequate fracture toughness over the near-term i.e. successful demonstration of Leak-Before-Break
- However, research and development has demonstrated that PT toughness has, and will continue to decline as Heq levels increase
- To ensure PTs can perform their design function
  - Under Normal Operating Conditions ($\geq 250^{o}C$) PTs must be ***fully ductile*** to respond to anticipated loads under (postulated) Design Basis Accidents. That is, 100% of the pressure tubes in a core must exhibit upper-shelf behavior
  - During reactor heat-up/ cool-down ($35^{o}C$ to $250^{o}C$), transition behavior of PTs must be known, and fracture toughness must be adequate

See Slide 26

- Impact of decreased toughness during heat-up/cool-down is addressed in the following Slide

Example 2

Fracture Toughness (4 of 5)

Heat Transport System heat-up/cool-down envelope*

- ***Regulatory requirement*** – licencee must operate the Heat Transport System (HTS) so as to maintain integrity of pressure-boundary components
  - To address this for pressure tubes, licencees establish a “envelope” within which operators must maneuver pressure and temperature during reactor start-ups and shut-downs
- The upper-bound of the envelope is defined using a ***PT fracture protection assessment***. Assuming a through-wall crack in an uninspected PT, the assessment calculates the maximum operating pressure beyond which the crack would be unstable
- Fracture toughness is a key input
  - Until recently, Heq levels were low enough that PT toughness remained high. This ensured a reasonable safety margin between the heat-up/ cool-down envelope and the maximum allowable Heat Transport System pressure
  - However, PT toughness has decreased as Heq levels increased. licencees can adjust their heat-up/cool-down envelopes to stay below revised maximum pressure values, but safety margins must be demonstrated as adequate
- Since PT toughness is affected by Heq levels only when temperatures fall within the heat-up/cool-down range, ample safety margins are expected to exist under Normal Operating Conditions (i.e. PT temperature >250°C)

* see Appendix

Example 2
Fracture Toughness (5 of 5)

- Regulatory requirements similar to Slide 24

✓ licencee activities involve similar level of effort and focus compared to those devoted to fitness-for-service assessments (e.g. PT flaws)

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CMD 18-M4

CNSC EVALUATION OF EXTENDED PT OPERATION

e-Docs #5422679 (PPTX)
e-Docs #5436079 PDF

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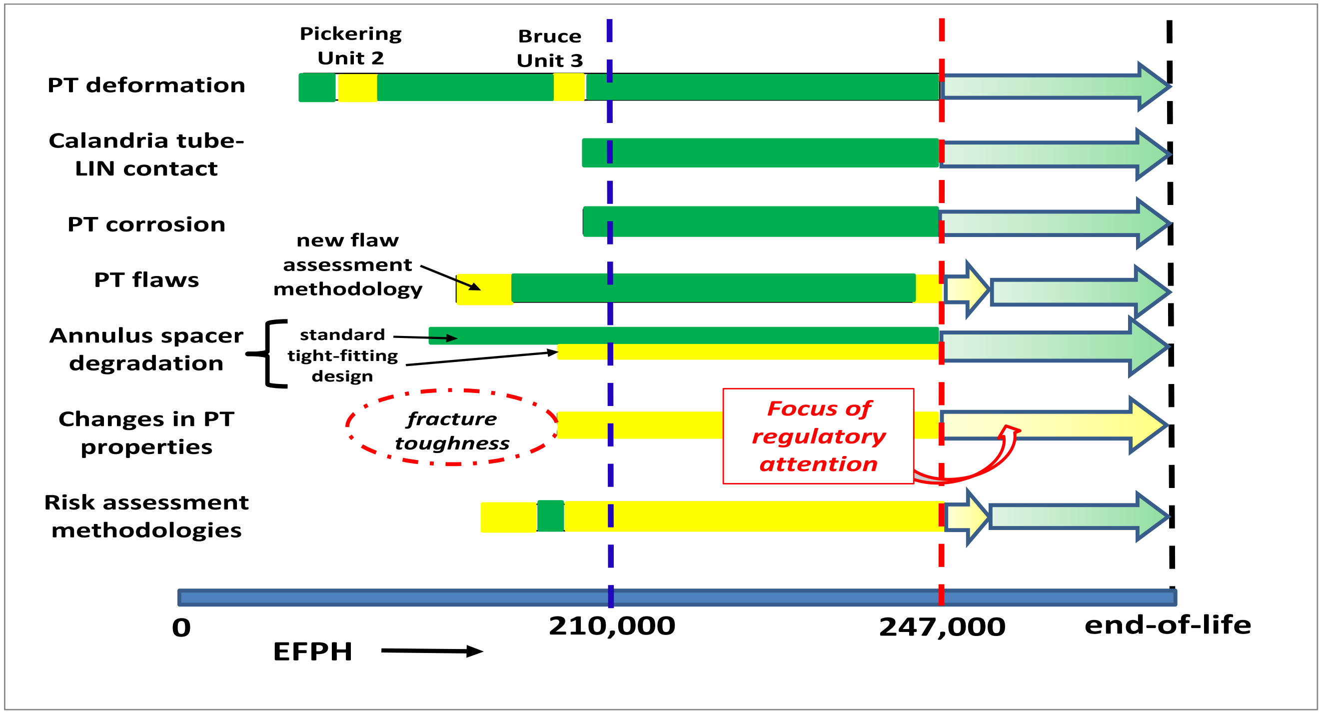
CNSC Evaluation of Proposals for Extended PT Operation (1 of 2)

Existing PROL
licencee provisions satisfactory
Enhanced regulatory scrutiny required

Requested PROL
Staff anticipates satisfactory licencee performance
Staff anticipates continued need for enhanced scrutiny



e-Docs #5422679 (PPTX)
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CNSC Evaluation of Proposals for Extended PT Operation (2 of 2)

Operation beyond 247,000 EFPH ?

- CNSC staff evaluating licencee progress on outstanding issues from Slide 31

Issue	Status in 2014 (prior to 210,000 EFPH)	Current status
Degradation of tight-fitting annulus spacers	Limited data; modest understanding of degradation phenomena	***Additional data collected; improved understanding of phenomena; FFS guidelines have been drafted***
Methodologies for PT risk assessments	New methodologies proposed; limited practical experience	***Two methodologies accepted for use; regulatory decision on third is pending***
Fracture toughness	Limited validation of, and limited experience using two new Models	***Development and validation of new Model? handling of uncertainties?***

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CMD 18-M4

SUMMARY

e-Docs #5422679 (PPTX)
e-Docs #5436079 PDF

Summary (1of 2)

PT degradation mechanisms

- ***CNSC expectation -*** licencees must have an in-depth understanding of PT degradation phenomena, based on extensive research and development and an effective OPEX program
- ***CNSC requirement*** – licencees must routinely inspect PTs to monitor the incidence and severity of known (and emerging) degradation mechanisms
- ***Comprehensive and effective regulatory oversight***
  - Reviews of licencee fitness-for-service assessments, risk assessments, Type II inspections, periodic reviews of the state of industry technical knowledge
  - Clear, well-documented expectations (REGDOC-2.6.3, N285.8 Compliance Plans)
  - Effective Compliance Verification Criteria (CVC) in the Licence Conditions Handbook
  - Regular updates to the Commission (Annual Regulatory Oversight Report)

Summary (2 of 2)

Reduction in fracture toughness

- On-going, dedicated industry research and development program
- ***Regulatory expectations have not changed***: licencees must demonstrate PTs are, and will remain capable of meeting the design intent (*extremely low probability of failure*)
- For acceptance by CNSC staff, models must conservatively predict PT toughness over range of EFPH and Heq concentration shown in the Appendix

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APPENDIX

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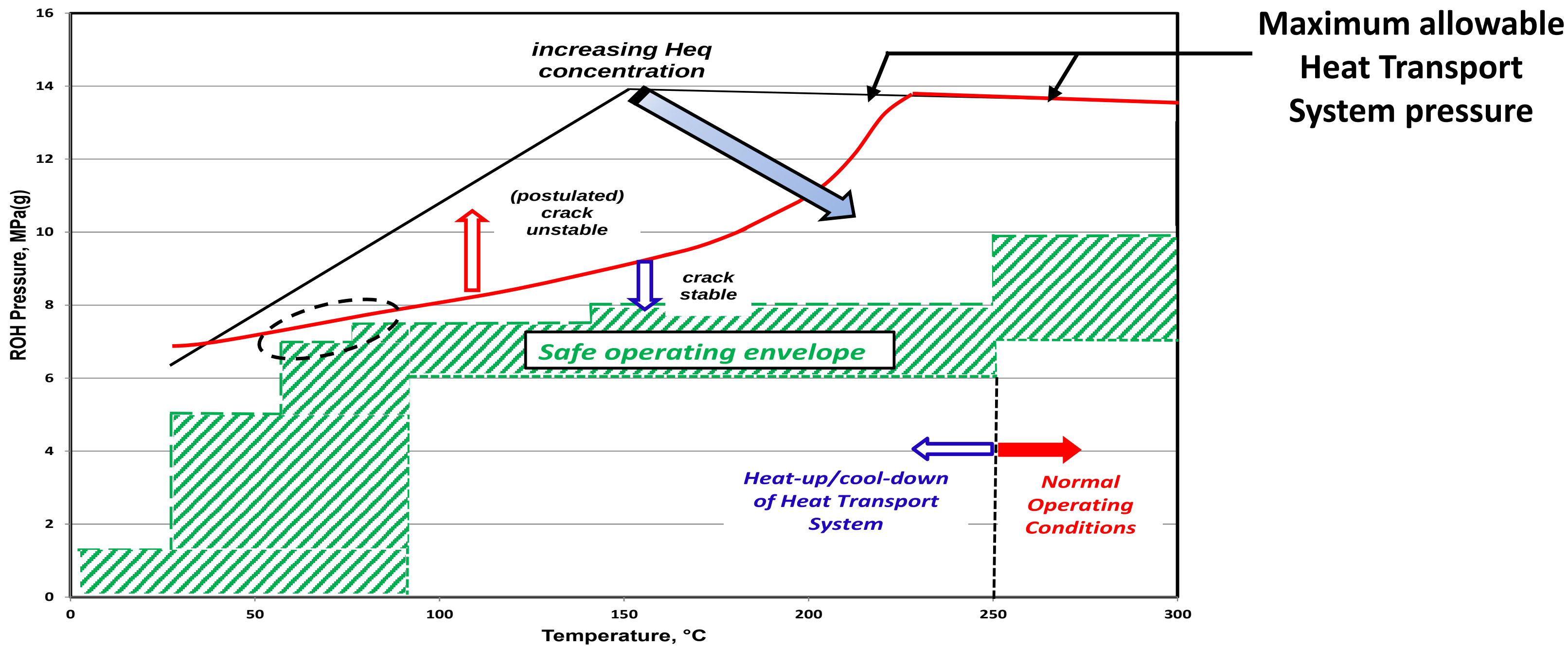
APPENDIX
Typical Heat Transport System Heat-Up/Cool-Down Envelope



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APPENDIX
Canada's Pressure Tube Population

Station	Number of fuel channels	Existing cores		Refurbished cores	
		Original PTs began service	EFPH (as of Dec. 2017)	New PTs began service	EFPH (as of Dec. 2017)
Pickering Units 1 & 4	390	(1983), (1993)	134,000		
Pickering Units 5 - 8	380	1982 – 1985	237,000		
Darlington Units 1, 3, 4	480	1990 – 1993	196,000		
Bruce Units 1 & 2	480			Fall 2012	35,000
Bruce Units 3 & 4	480	1977 – 1978	211,000		
Bruce Units 5 - 8	480	1984 - 1987	233,000		
Point Lepreau	380			Fall 2012	35,000

APPENDIX
In-Service Degradation of Fuel Channels (1 of 2)

Type of degradation	Potential risk	How do licencees manage the risk
PT deformation		
• Elongation	Potential for inadequate fuel channel support (*e.g. postulated earthquake)*	Periodic inspections. Fuel channel maintenance
• Reduction in wall thickness	Potential reduction in margin-to-rupture (*postulated design basis accident)*	Periodic inspections
• Increase in diameter	Potential reduction in margin to fuel dry-out (*postulated design basis accident*)	Periodic inspections. Ensure adequate provisions for avoidance of fuel dry-out
• PT sag	Potential contact between pressure tube and calandria tube (CT)	Periodic inspections. Shift annulus spacers (as required)

APPENDIX
In-Service Degradation of Fuel Channels (2 of 2)

Type of degradation	Potential risk	How do licencees manage the risk
Fuel channel sag	Potential contact between CT and liquid (poison) injection nozzles	Periodic inspections. Re-positioning nozzles
PT corrosion	Reduction in PT wall thickness	Periodic inspections
PT flaws	Delayed Hydride Cracking (DHC) can initiate at flaws	Periodic inspections. Assess risk of DHC initiation
Degradation of annulus spacers	Potential contact between PT and calandria tube	Periodic inspections (gap). Periodic material surveillance
Changes in PT material properties	Key mechanical properties (e.g. fracture toughness) diverge from values assumed in PT safety case	Periodic removal of PTs for destructive examination

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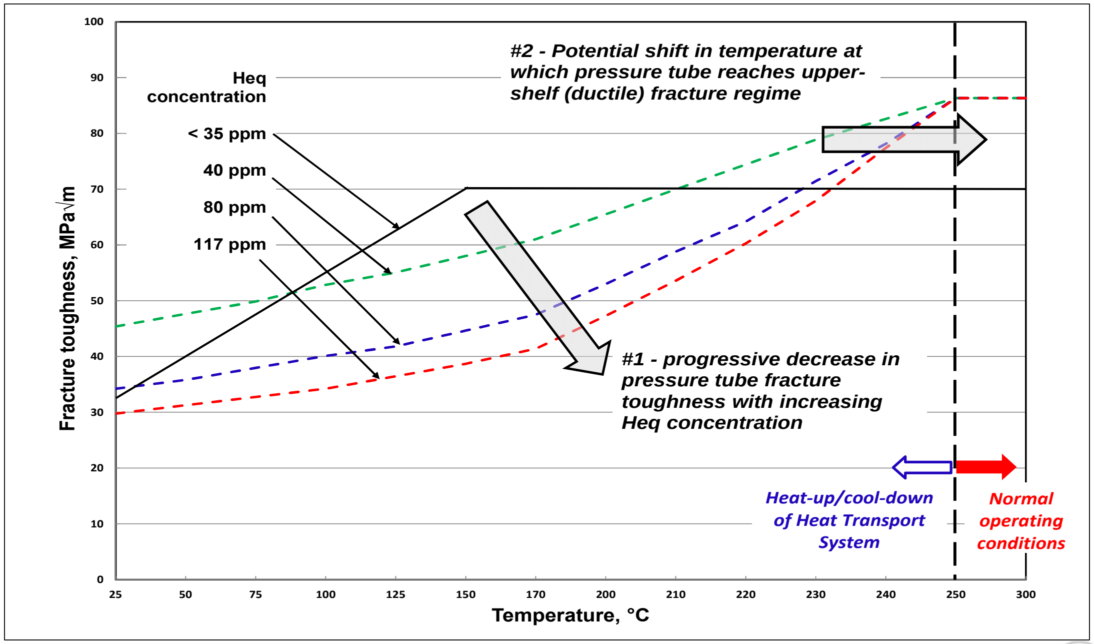
APPENDIX
Impact of Increasing Heq Concentration on PT Fracture Toughness
(Lower-Shelf & Transition Temperature Regimes)



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APPENDIX
Projected Heq Concentrations for Ontario PTs: Near-Inlet

Station	Projections		
		June 2018	Target Service-life
Pickering-B	EFPH	234,680	289,000
	Heq, ppm	**38**	**55-60**
Darlington Units 1, 3, 4	EFPH	192,790	234,000
	Heq, ppm	**45**	**66**
Bruce-A (Units 3, 4)	EFPH	215,035	255,000
	Heq, ppm	**50**	(unknown)
Bruce-B	EFPH	229,260	298,000
	Heq, ppm	**40**	**70**

APPENDIX
Projected Heq Concentrations for Ontario PTs: Near-Outlet

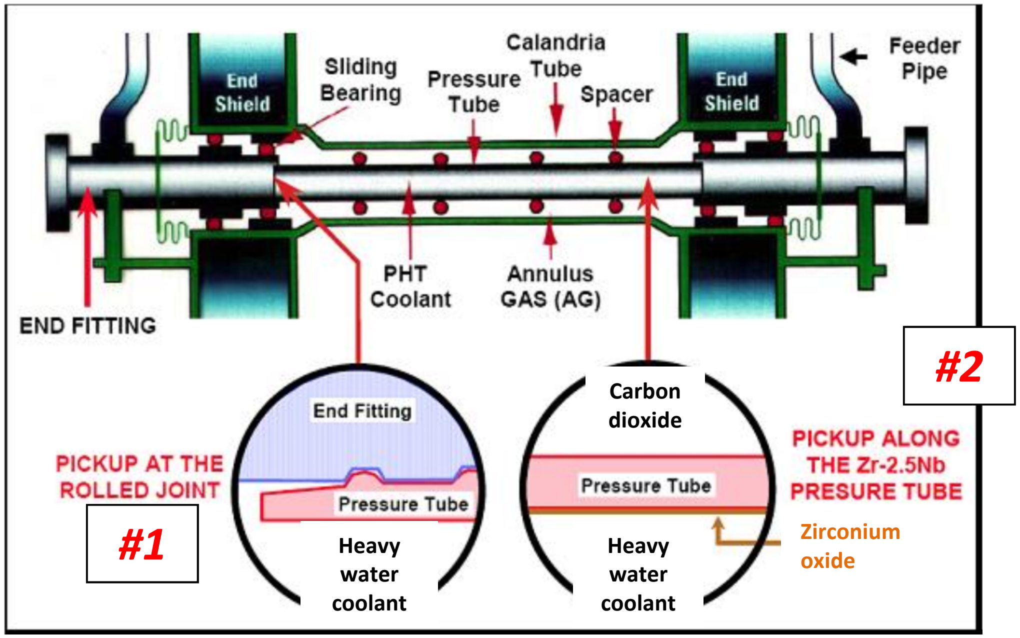
Station	Projections		
		June 2018	Target Service-life
Pickering-B	EFPH	234,680	289,000
	Heq, ppm	55	82
Darlington Units 1, 3, 4	EFPH	192,790	234,000
	Heq, ppm	52	127
Bruce-A (Units 3, 4)	EFPH	215,035	255,000
	Heq, ppm	71	105
Bruce-B	EFPH	229,260	298,000
	Heq, ppm	90	160

APPENDIX
Attributes of an Acceptable Model

1. The model should (preferably) be founded on a mechanistic understanding of the phenomenon, and/or based on experimental evidence
2. The model must be verified and its predictions validated prior to use
3. Model inputs and assumptions must be identified and justified
4. Model uncertainties must be quantified
5. To focus improvements to the model, a sensitivity analysis is invaluable
6. Forward-looking models must be periodically re-validated

APPENDIX

Sources of Deuterium Uptake



APPENDIX
Sources of PT data

Periodic (CSA-mandated) / In-Service Inspection programs (licencee-initiated, part of Licensing Basis)

- Frequency: typically 2 to 3-year intervals (planned outages)
- Scope: 10 PTs (CSA minimum); mix of uninspected and previously inspected tubes
- Non-destructive examinations include PT dimensions, PT-CT gap, flaws etc.
- Heq concentration

Material surveillance (CSA requirement)

- Frequency: typically 2 to 4-year intervals
- Remove one PT (plus annulus spacers if possible)
- Destructive examinations: Heq, PT material properties (e.g. fracture toughness)

Research and Development

- 35+ years of dedicated effort that continues within Canadian industry

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B. CMD 18-M21 EMERGENCY MANAGEMENT IN ONTARIO

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 18-M21

Date: 2018-03-26
File / dossier : 6.02.04
Edocs: 5491292

Presentation from the Office of the Fire Marshal and Emergency Management

Présentation du Bureau du commissaire des incendies et de la gestion des situations d’urgence

Emergency Management in Ontario

Gestion des urgences en Ontario

Update on Emergency Management in Ontario and the Provincial Nuclear Emergency Response Plan (PNERP)

Mise à jour sur la gestion des urgences en Ontario et le Plan provincial d'intervention en cas d'urgence nucléaire (PPIUN)

Commission Meeting

Réunion de la Commission

April 4, 2018

Le 4 avril 2018

Canada

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Ministry of Community Safety and Correctional Services

Emergency Management in Ontario

PRESENTED TO: CANADIAN NUCLEAR SAFETY COMMISSION

DATE: APRIL 4, 2018

Purpose

- Provide an overview of emergency management in Ontario
- Review the Ministry of Community Safety and Correctional Services (MCSCS) Emergency Management Action Plan
- Provide context to offsite nuclear emergency response in Ontario
- Review the development of the approved 2017 Provincial Nuclear Emergency Response Plan (PNERP) Master Plan
- Highlight some of the more significant improvements
- Review next steps for nuclear emergency planning in Ontario

Emergency Management in Ontario

Emergency Management (EM) Overview

- *The Emergency Management and Civil Protection Act* (EMCPA) establishes the province's framework for managing emergencies – defining the authority and responsibilities of provincial ministries, municipalities and specific individuals (e.g., Commissioner of Emergency Management)
- The Office of the Fire Marshal and Emergency Management (OFMEM) is responsible for monitoring, coordinating and assisting in the development and implementation of emergency management programs
- All municipalities and provincial ministries must meet a legislated standard of emergency management (e.g., conducting hazard and risk assessments for their areas of responsibility, developing programs and plans to address those risks, and conducting annual training exercises)
- All provincial ministries are required to develop continuity of operations plans that ensure critical government services are available during emergencies
- In addition, 13 provincial ministries are also responsible for the formulation of emergency plans for specific types of emergencies assigned by Order in Council (OIC) 1157/2009 (see Appendix A)

Drivers of change in EM

- Climate change is causing severe weather events to occur more frequently
- New technologies are creating opportunities to increase efficiency/effectiveness of EM programs
- Increasing focus on vulnerable populations and resiliency
  - Best practices are moving towards more humanitarian, client-centred EM and risk communication approaches
  - Need for greater collaboration with First Nations on EM to develop policies and programs that reduce/eliminate gaps
- Increasing focus on relief and early recovery
  - Major disasters require major responses, including complex systems and partnerships to expedite processes that return communities back to pre-emergency activities
  - Greater integration and inclusion of non-traditional responders and functions needed in the relief and recovery process (e.g., social services, not-for-profit and faith-based organizations, etc.)
- Increasing emphasis on accountability and demonstrating "value for money"

EM Reviews and Reports

- Auditor General Value for Money Audit on Emergency Management (Dec 2017)
  - 13 recommendations directed at MCSCS focused on gaps in leadership, governance, program, resources and infrastructure
- Emergency Management Review (Ministry commissioned review Aug 2017)
  - 52 recommendations aimed at decision making, service delivery, collaboration and coordination, communications and sustainability
- 2013 Southern Ontario Ice Storm After Action Report
  - 24 ‘opportunities for improvement’ focused on strengthening communications and information, enhancing coordination between Ontario’s emergency management community and the province’s critical infrastructure sector, updating the Provincial Emergency Response Plan and improving planning for vulnerable populations
- Report of the Elliot Lake Inquiry (2014)
  - 29 recommendations focused on rationalization, organization and integration of emergency response systems
- Report on the Supply Chain Management During Emergency Events (2014)
  - 2 recommendations focused on capacity issues in the province’s ability to provide material and financial resources to Ontarians during large scale emergencies

Emergency Management Action Plan (EMAP)

MCSCS has proposed a comprehensive strategy to respond to various recent EM reviews and audits; it consists of actions in five key areas:

Strengthen EM Oversight and Governance	• Recruit dedicated Chief of EM position • Enhance inter-ministerial and multi-level governance frameworks to support decision-making, collaboration and information sharing • Implement robust performance measurement and evaluation framework
Modernize EMCPA	• Undertake a comprehensive review of the EMCPA and make changes necessary to modernize Ontario's legislative framework for EM
Update All Risk Assessments and Response Plans	• Review existing provincial risk assessments and emergency response plans (e.g., Provincial Emergency Response Plan) • Re-establish province-wide Continuity of Operations Program (COOP) and directly support development of municipal continuity programs
Enhance EM Program Capacity	• Enhance readiness for large scale emergencies • Adopt and meet international/national best practices • Mandate a standardized emergency response approach • Enter into mutual assistance agreements with neighbouring jurisdictions
Increase Support to Municipalities and EM Partners	• Enable Provincial Emergency Operations Centre (PEOC) to more quickly deploy resources to supplement local capacity • Implement EM software to support provincial-municipal information and resource sharing • Enhance capacity to deploy humanitarian aid • Implement EM supply chain/logistics program

Ongoing Initiatives & EM Business Plan

- Many actions that support the implementation of the EMAP and address other recommendations related to EM are already underway as part of OFMEM's 2017 EM Branch business plan and other initiatives:
  - PNERP Implementing plans and technical study
  - Establishing a Provincial Exercise Strategy and Program aligned to provincial risk assessment
  - Re-establishment of the Incident Management System Steering Committee
  - Development of an on-line HIRA tool and municipal compliance tool
  - Co-chairing multiple FPT/Senior Officials Responsible for Emergency Management (SOREM) working groups
  - Working with the federal government to establish a new improved EM programs for First Nations in Ontario
  - Strengthening relationships with contiguous jurisdictions and the federal government to leverage existing capacity and facilitate effective information sharing during emergencies
  - Strengthening stakeholder relationships through an enhanced communications and engagement strategy, including monthly stakeholder meetings, ONReady Newsletter, and continuing education sessions
  - Collaboration with the NGO Alliance of Ontario to explore opportunities to leverage capacity of NGOs and volunteer organizations to address humanitarian needs during disasters

Offsite Nuclear Emergency Response in Ontario

Offsite Emergency Response in Context

- The *Emergency Management and Civil Protection Act (EMCPA):*
  - The responsibility to plan for nuclear and radiological emergencies, as well as any emergency that requires the coordination of provincial Emergency Management is assigned to the Ministry of Community Safety and Correctional Services (OFMEM).
- In the event of a nuclear or radiological emergency, the Province of Ontario is responsible for managing the offsite consequences of the emergency by supporting and coordinating the offsite response, and for directing any offsite protective actions required.
- Provincial responsibilities are executed in concert with the efforts of organizations with nuclear emergency responsibilities as set out in PNERP.
- The PNERP was developed pursuant to Section 8 of the *EMCPA* and is approved by the Ontario Cabinet.

Offsite Emergency Response in Context

- The PNERP Master Plan describes the general roles and responsibilities for the response to a radiological or nuclear emergency in Ontario. It is applied through detailed implementing plans for each major nuclear facility and for all other types of radiological emergencies.
- All other major organizations (e.g., municipalities, NPPs) involved developed their own plans consistent with the requirements of the PNERP, its implementing plans, and their individual mandates.
- In accordance with the PNERP, a provincial nuclear committee comprised of local, provincial, federal and industry representatives meets twice a year to discuss current issues and ensure coordination in planning and response.
- The provincial response to nuclear and radiological emergencies is coordinated through the PEOC.
- The province, through OFMEM, regularly participates in nuclear drills and exercises.

PNERP Master Plan Development

- The PNERP-Master Plan was updated and approved in December 2017 after a public consultation and input from nuclear emergency response organizations
- The Province conducted a public consultation and created an advisory group, comprised of national and international experts to assess comments received and provide recommendations to the Minister
- Feedback and recommendations were incorporated into the new plan; these updates make the plan more transparent and accountable, increase alignment with national and international standards, and enhance emergency planning

Overview of PNERP Public Consultation and Results

- PNERP consultation documents were posted to the Regulatory and Environmental Registries from May 15, 2017 to July 28, 2017
- A total of 1568 submissions were received during the consultation period (May 15 – July 28, 2017)
  - 9 municipal and federal government stakeholders
  - 33 organizations
  - 1526 individuals (440 unique comments; 1086 submissions from two separate letter-writing campaigns)
- The PNERP Advisory Group was appointed by the Minister to review all comments and provide recommendations on the incorporation of public feedback in the updated Master Plan
- The PNERP Advisory Group met in Toronto during the week of August 21 – 25 to conduct in-person consultations and deliberations

Overview of PNERP Advisory Group Report

- The report contains 15 recommendations, the general themes of which are:
  - Providing more robust justification/clarification of the rationale, principles and assumptions used to create or modify emergency plans
  - Conducting more detailed and definitive technical assessments on which to base future iterations of the PNERP
  - Implementing more formal procedures governing the regular review of the PNERP, including guiding principles for transparency, and public and stakeholder engagement
  - Clearly communicating linkages between the PNERP and other emergency preparedness plans the province has in place (including those that are not under the purview of MCSCS)

Overview of Disposition of PNERP Advisory Group Report Recommendations

- Other examples of the result of the Advisory Group report:
  - The Advisory Group found that the assessments used in the Planning Basis Discussion Paper were highly sensitive to radiological source term selection and of limited scope; in some cases, analysis was confined to only a few weather patterns or used modelling methods that may not be appropriate for farther distances from the nuclear generating station
  - Despite these limitations, the Advisory Group found that the existing planning zone sizes are likely appropriate for a) single-unit unmitigated accidents and, b) multi-unit coincident events where some post-Fukushima improvements are credited in the source term calculation
  - They also found that planning zone sizes may require revision if the planning basis includes a multi-unit failure event where none of the post-Fukushima improvements or mitigating actions are credited in the source term calculation

PNERP Technical Study

- To assess the potential impacts of weather and topographical features on dose projection modelling to strengthen the Planning Basis
- Will identify any requirement to expand protective measures, planning zone distances and preparedness measures (e.g., KI pre-distribution)
- The Technical Study will be completed by the end of 2018 and OFMEM will at that time propose any options for revisions to the PNERP or Implementing Plans to the Minister

2017 PNERP Master Plan Updates

Commitment to Future Public Consultations

- OFMEM revised the PNERP Master Plan to include new Administration requirements in Section 1.3
  - 1.3.3 sets out New 5 year plan review cycle
  - 1.3.4 states the purpose of the PNERP review process is to uphold the Province's commitment to transparency and accountability
  - 1.3.5 requires the PNERP review process to include consultations with stakeholders and the public
- Any review of PNERP protective action strategies or modifications to hazard descriptions must involve consultation with Designated Municipalities and impacted Municipalities as they are among the stakeholders referenced in clause 1.3.5

2017 PNERP Master Plan Highlights

- Alignment throughout with Health Canada, CSA-N1600-16 and international standards (IAEA GSR-7)
- Updated descriptions of planning basis accident scenarios, including severe accidents (Chapter 2)
- New Generic Criteria and Operational Intervention Levels to support protective action decision-making (Section 2.2.4)
- New Contingency Planning Zone 10-20 km from reactor facility (Section 2.2.5)
- New concept of operations section describing key emergency response activities for various accident scenarios (Section 3.3)
- Improved ease of use and terminology

2017 PNERP Master Plan Highlights

- New Program Management requirements (Section 3.2.1)
- New requirement to define and document training requirements (Section 3.2.8)
- New requirement to develop and document exercise program requirements (Section 3.2.9)
- New detailed descriptions of emergency phases (Section 5.9) and the transition to recovery phase (Section 6.3.4)
- New section on Management of Radioactive waste in line with national and international guidance (Section 7.14)
- New annex with detailed rationale behind the planning basis including planning zone sizes. (Annex L)

New Emergency Planning Zones

- *Automatic Action Zone:* The zone immediately surrounding installation reactor facility in which an increased level of planning and preparedness is undertaken and priority protective actions would be implemented, if necessary. (3km)
- *Detailed Planning Zone:* The zone around installation reactor facility within which detailed planning and preparedness shall be carried out for measures against exposure to a radioactive plume. (10km)
- *Contingency Planning Zone:* The zone around a reactor facility, beyond the Detailed Planning Zone, where contingency planning and arrangements are made in advance, so that during a nuclear emergency, protective actions can be extended beyond the Detailed Planning Zone as required to reduce potential for exposure. (20km)
- *Ingestion Planning Zone:* A larger zone within which it is necessary to plan and prepare measures to prevent ingestion of radioactive material. (50km)

New Contingency Planning Zone (CPZ)

- The CPZ is intended to be used as necessary in the event of very low probability, severe accident situations where the area affected could extend beyond the Detailed Planning Zone
- The CPZ does not require the same level or type of detailed arrangements as the Automatic Action Zone or Detailed Planning Zone, in so far as there are no default or pre-planned protective measures associated with the CPZ
- Response activities within the CPZ may occur in the event of a limited and localized radiological release and based on the results received from environmental radiation monitoring activities
- Greater clarity has been set out in Annex C of the PNERP Implementing Plans for Pickering NGS and Bruce NGS

New Contingency Planning Zone Requirements

- Requires identification of existing *response* centres that fall within the CPZ and development of a list of possible alternates located outside the CPZ
- Requires Iodine Thyroid Blocking (ITB) requirements consistent with those stipulated for the *Ingestion Planning Zone*
- Requires public awareness and education requirements consistent with *Ingestion Planning Zone* requirements
- **No** requirement for designation of additional emergency *response* centres (e.g., EOCs, EIC, Reception and Evacuation Centres, personal monitoring and decontamination facilities, etc.) beyond those designated for *Detailed Planning Zone*
- **No** additional public alerting and communications requirements beyond those already established for the *Detailed Planning Zone*

Funding for Additional Planning Costs

- OFMEM identified funding as an item under Program Management.
  - Section 3.2.1 b) states that Senior Management of stakeholder organizations *should* ensure funding is in place to maintain their emergency preparedness program
- OFMEM revised Master Plan Section 3.2.4 b) to highlight program funding as an example of an inter-organizational issue to be resolved by the NEMCC
- As per Master Plan Annex I, Appendix 13, reactor facilities are required to "assist the Province and the Designated Municipalities in their planning and preparedness for a nuclear emergency."
- The Province has not allocated any additional funds for Designated Municipalities.

Protection of Emergency Workers

- PNERP Master Plan, Annex H has been revised to reflect the adoption of Health Canada, *Canadian Guidelines for Protective Actions during a Nuclear Emergency* (Draft 2016).

Transportation Management and Evacuation Planning

- PNERP Master Plan Sections 4.9.1 Unified Transportation Coordination Centre (UTCC) and 7.5 Transportation Management provide focused requirements and responsibilities for evacuation planning and response (e.g., development of site-specific Unified Transportation Management Plans (UTMPs)).
- OFMEM is committed to work with municipal stakeholders in 2018/19 to identify additional host municipalities for developing evacuee housing strategies for incorporation into the next PNERP revision.
- Additional significant progress is now being made. More information in the ‘Next Steps’.

Coordination of Emergency Information and Public Direction

- Public direction shall be provided through the co-ordinated release of emergency bulletins issued from the PEOC and broadcast through the media and all other mechanisms normally available to provincial authorities.”
- All roles and responsibilities sections (Annex I) for each ministry or agency were revised to include all Ministries shall:
  - “Coordinate the release and content of emergency information for public release with the Provincial Emergency Information Section.”
- A *Joint Information Centre* may be established by the Provincial Chief Information Officer to support media briefings to ensure the public are provided with timely and accurate information on the emergency. The JIC location has not yet been defined

Potassium Iodide (KI) Pills

- The new PNERP uses Health Canada and IAEA 50 mSv intervention level and CSA N288.2-14 to support its planning basis
- Maintained pre-distribution within the 10 km Detailed Planning Zone and added availability for anyone who wants it out to 50 km
- The current processes also meets CNSC REGDOC 2.10.1

Protection and Care of Animals

- The PNERP has been updated to include the provision of the protection and care of animals (Section 7.13):
  - Is pursuant to Section 7.0.2. (4) of the *EMCPA*, provincial evacuation orders which can include animals under a declared provincial emergency.
  - Is broadly worded to provide for those nuclear communities which are more agricultural in nature
  - Highlights the other stakeholders that can be consulted for assistance (e.g., Ministry of Food and Rural Affairs (OMAFRA)
  - During an emergency the PEOC will provide assistance

Training and Exercises

- There is a new requirement for municipalities to document their Emergency Response Organization training plan and exercise program introduced in PNERP Sections 3.2.8 and 3.2.9 to align with CSA N1600 and international standards. The goal is to ensure appropriate training of municipal staff to develop and maintain competency
- Additional requirements for Designated Municipalities in Annex I include:
  - Ensure that all municipal personnel assigned any functions under emergency plans for nuclear emergencies are suitably trained for their tasks
  - Implement and participate in nuclear emergency training and exercises
  - Municipal staff working in the EOC should have an overall knowledge of their emergency plans and PNERP

Protective Actions

- Protective actions are measures taken to prevent or reduce both the exposure and ingestion of ionizing radiation to the public and first responders
- Protective actions are decided on and directed by the PEOC Commander for all areas and zones where the doses are expected to meet the protective action levels for sheltering, evacuation, or ingestion controls
- The Provincial Chief Medical Officer of Health (CMOH) makes the decision regarding KI ingestion
- The 2017 PNERP Master Plan introduces 3 phases: early, intermediate and recovery

Next Steps

Next Steps – Evacuation Planning

- In 2018-2019, the Ministry of Transportation (MTO) is updating all traffic control plans and revising them into a Unified Transportation Management Plan which will incorporate all modes of transportation
- Includes consultation with the Nuclear Emergency Management Coordinating Committee (NEMCC) Sub-Committee on Transportation
- In the interim- existing Joint Traffic Control Plans will be utilized

Next Steps - Recovery Phase Planning

- A new Provincial Emergency Recovery Plan is planned for development with NEMCC participation and alignment with a new Health Canada and CNSC Framework Document on Recovery.
- The 2017 PNERP Master Plan states “Recovery actions may be described in a separate plan”

Next Steps – Environmental Radiation and Assurance Monitoring Group (ERAMG)

- Revision of the ERAMG Plan is in the approval process and will contain a concept of operations for PEOC-based roles and field teams
- The ERMAG Plan aligns with the 2017 PNERP, CSA N1600, and IAEA standards (GSR-7, GSR-2 etc)
- Planning is underway for a workshop and tabletop exercise for 2018 that will test and validate the new concept of operations

Next Steps- Supporting Plans

- Supporting plans to the PNERP that are ministry authored, such as the *Radiation Health Response Plan* and *Unified Transportation Management Plans*, are currently being updated to align with the 2017 PNERP.
- Municipal plans will be updated in accordance with the Implementing Plans (IP) once published. Although there is no defined deadline for this, the goal is to have an updated plan one year from IP published date.
- In the interim- existing supporting plans will be utilized and where there is conflict with the 2017 PNERP, the latter will take precedent as much as possible.

Other Related Initiatives

- OFMEM is conducting PNERP information sessions for municipal stakeholders
  - Sessions have been held or scheduled in all designated municipalities
- Canada is hosting an Emergency Preparedness Review (EPREV)
  - EPREV is a peer review program of the International Atomic Energy Agency (IAEA).
  - This public review will assess nuclear emergency management in Canada compared to international standards and best practices. The focus will be nuclear generating stations in Ontario and New Brunswick.
- Nuclear Drills and Exercises are ongoing
  - The next full-scale exercise is scheduled for October 2019 (Bruce Power)
- Ongoing updates to the PNERP Implementing Plans.
- Ongoing review and alignment with the 2017 PNERP to all PEOC nuclear procedures, including emergency bulletins

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PART TWO

Part Two provides:

1. The revised proposed licence (PROL 48.00/2028) to replace the proposed licence provided in CMD 18-H6.
2. The revised draft Licence Conditions Handbook

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PROPOSED LICENCE

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DRAFT R01
PDF Ref.: e-Doc 5558765
Word Ref.: e-Doc 5189303
File / Dossier: 2.01

NUCLEAR POWER REACTOR OPERATING LICENCE

PICKERING NUCLEAR GENERATING STATION

I) LICENCE NUMBER: **PROL 48.00/2028**

II) LICENSEE: Pursuant to section 24 of the *Nuclear Safety and Control Act* this licence is issued to:

Ontario Power Generation Inc.
700 University Avenue
Toronto, Ontario
M5G 1X6

III) LICENCE PERIOD: This licence is valid from September 1, 2018 to Month Day, 2028, unless suspended, amended, revoked or replaced.

IV) LICENSED ACTIVITIES:

This licence authorizes the licensee to:

(i) operate the Pickering Nuclear Generating Station (hereinafter “the nuclear facility”) at a site located in the City of Pickering, in the Regional Municipality of Durham, in the Province of Ontario;

(ii) possess, transfer, use, package, manage and store the nuclear substances that are required for, associated with, or arise from the activities described in (i);

(iii) import and export the nuclear substances, except controlled nuclear substances, that are required for, associated with, or arise from the activities described in (i);

(iv) possess, transfer, produce, package, manage, and store produce Cobalt-60;

(v) possess, transfer, manage and store heavy water from other nuclear facilities;

(vi) transport Category II nuclear material by road vehicle from the nuclear facility spent fuel bay to the onsite waste storage facility;

(vii) possess, transfer, export, package, manage and store nuclear substances, except controlled nuclear substances, from the Western Waste Management Facility.

(viii) possess and use prescribed equipment and prescribed information that are required for, associated with, or arise from the activities described in (i); and

(ix) possess, use, manage and store enriched uranium as required for fission chambers for the Pickering Nuclear Generating Station units 1 and 4 Shutdown System Enhancement, including spares.

V) EXPLANATORY NOTES:

(i) Nothing in this licence shall be construed to authorize non-compliance with any other applicable legal obligation or restriction.

(ii) Unless otherwise provided for in this licence, words and expressions used in this licence have the same meaning as in the *Nuclear Safety and Control Act* and associated Regulations.

(iii) The Pickering NGS Licence Conditions Handbook (LCH) provides compliance verification criteria used to verify compliance with the conditions in the licence. The LCH also provides information regarding delegation of authority, applicable versions of documents and non-mandatory guidance on how to achieve compliance.

VI) CONDITIONS:

G. **General**

G.1 The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) the regulatory requirements set out in the applicable laws and regulations;
(ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence;
(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (CNSC, hereinafter “the Commission”).

G.2 The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

G.3 The licensee shall control the use and occupation of any land within the exclusion zone.

G.4 The licensee shall provide, at the nuclear facility and at no expense to the Commission, suitable office space for employees of the Commission who customarily carry out their functions on the premises of that nuclear facility (onsite Commission staff).

G.5 The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

G.6 The licensee shall implement and maintain a public information and disclosure program.

1. Management System

1.1 The licensee shall implement and maintain a management system.

2. Human Performance Management

2.1 The licensee shall implement and maintain a human performance program.

2.2 The licensee shall implement and maintain the minimum shift complement and control room staffing for the nuclear facility.

2.3 The licensee shall implement and maintain training programs.

2.4 The licensee shall implement and maintain certification programs in accordance with CNSC regulatory document RD-204, *Certification of Persons Working at Nuclear Power Plants*.

Persons appointed to the following positions require certification:

(i) Responsible Health Physicist;
(ii) Shift Manager;
(iii) Control Room Shift Supervisor; and
(iv) Authorized Nuclear Operator.

3. Operating Performance

3.1 The licensee shall implement and maintain an operations program, which includes a set of operating limits.

3.2 The licensee shall not restart a reactor after a serious process failure without the prior written approval of the Commission, or prior written consent of a person authorized by the Commission.

3.3 The licensee shall notify and report in accordance with CNSC regulatory document REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants*.

4. Safety Analysis

4.1 The licensee shall implement and maintain a safety analysis program.

5. Physical Design

5.1 The licensee shall implement and maintain a design program.

5.2 The licensee shall implement and maintain a pressure boundary program and have in place a formal agreement with an Authorized Inspection Agency.

5.3 The licensee shall implement and maintain an equipment and structure qualification program.

6. Fitness for Service

6.1 The licensee shall implement and maintain a fitness for service program.

7. Radiation Protection

7.1 The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

8. Conventional Health and Safety

8.1 The licensee shall implement and maintain a conventional health and safety program.

9. Environmental Protection

9.1 The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

10. Emergency Management and Fire Protection

10.1 The licensee shall implement and maintain an emergency preparedness program.

10.2 The licensee shall implement and maintain a fire protection program.

11. Waste Management

11.1 The licensee shall implement and maintain a waste management program.

11.2 The licensee shall maintain a decommissioning plan.

12. Security

12.1 The licensee shall implement and maintain a security program.

13. Safeguards and Non-Proliferation

13.1 The licensee shall implement and maintain a safeguards program.

14. Packaging and Transport

14.1 The licensee shall implement and maintain a packaging and transport program.

15. Nuclear Facility-Specific

15.1 The licensee shall implement the Integrated Implementation Plan.

15.2 The licensee shall maintain Units 2 and 3 in the safe storage phase.

15.3 Before Hydrogen equivalent concentration exceeds 120 ppm, the licensee shall demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm.

15.4 The licensee shall implement and maintain plans for the end of commercial operations of all Pickering units.

15.5 The licensee shall implement and maintain a Cobalt-60 program for activities described under Part IV) of this licence.

15.6 The licensee shall limit the import and export of nuclear substances to those occurring as contaminants in laundry, packaging, shielding or equipment.

SIGNED at OTTAWA ________________________

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Michael Binder
President
CANADIAN NUCLEAR SAFETY COMMISSION

PROPOSED LICENCE CONDITIONS HANDBOOK

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Canada's Nuclear Regulator

e-DOC 5503899 (Word)

e-DOC 5556935 (PDF)

LICENCE CONDITIONS HANDBOOK

LCH-PR-48.00/2028-R000

PICKERING NUCLEAR GENERATING STATION NUCLEAR POWER REACTOR OPERATING LICENCE

LICENCE # PROL 48.00/2028

DRAFT 001

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Canada

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Licence Conditions Handbook **Effective: Month day, 2018**

LCH-PR-48.00/2028-R000

Pickering Nuclear Generating Station

Nuclear Power Reactor Operating Licence

PROL-48.00/2028

SIGNED at OTTAWA this Xth day of month 20XX

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Gerry Frappier, Director General

Directorate of Power Reactor Regulation

CANADIAN NUCLEAR SAFETY COMMISSION

Revision History

Effective Date	Revision	Word e-Doc and Version	Description of the Changes	DCR e-Doc
N/A	DRAFT 000	5189658 v6	Original Document for Day 1 Hearing	N/A

N/A	DRAFT 001	5503899 v2	Administrative Changes
			• Typos were corrected on pages 14, 57, 65, 69, 79, 87, 106, 113, 122, 140 and 150.
			• The word "recently" was removed for LC G.1 in the discussion for the amendment for contaminants in laundry as the timing of the amendment is captured in the references.
			• N-STD-MP-0020, Margin Management was deleted from the Licensee Documents table under LC 3.1 as it no longer exists. Margin Management is addressed by N-PROG-MP-0009, Design Management for LC 5.1.
			• The OSRs were added to the Licensee Documents table for LC 3.1.
			• The Regulatory Undertakings CVC was updated for LC 3.1 to better reflect requirements from REGDOC-3.1.1.
			• Code-over-code reviews were removed from the Licensee Documents table for LC 5.1 as they are captured in the "List of Significant Technical Changes from Code-over-Code reviews".
			• Updates to Appendices C, D and E to reflect administrative and technical changes.
			
			Technical Changes
			• OPG's letters of April 18 and May 31, 2018 were added the Licensing Documents table for LC G.1. Both provided additional information on implementation of CSA standards and Regulatory Documents, as follows:
			  ◦ REGDOC-2.2.4 Volume II was removed from Guidance and added to the CVC for LC 2.1 along with applicable effective dates and CVC.
			  ◦ An effective date was added for REGDOC-2.3.2, Version 1 in the Licensing Basis Publications table for LC 3.1.
			  ◦ An effective date was added for CSA N291-08 in the Licensing Basis Publications tables for LC 5.1 and 6.1 along with CVC under the Structure Design section.
			  ◦ An effective date was added for CSA N289.1 in the Licensing Basis Publications table for LC 5.3.
				N/A

			- CSA N285.4-14 was removed from the Licensing Basis Publications table and placed in the Guidance Publications table for LC 6.1 to align with the CVC, which expects OPG to submit dispositions for all the gaps. - CSA N285.5-13 was removed from the Licensing Basis Publications table and placed in the Guidance Publications table for LC 6.1 with applicable guidance. - The compliance date for CSA N288.1-14 was added to the Licensing Basis Publications table for LC 9.1 to reflect that CNSC has accepted the revised DRLs. It was consequently removed from the Guidance section. - CSA N293-07 was removed and the compliance date for CSA N293-12 was added to the Licensing Basis Publications table for LC 10.2. - The last line in the section on Heat Sinks was deleted for LC 3.1 as the focus of the compliance criteria is on heat sink management irrespective of outage duration. - The paragraph for instrument uncertainty calculations (IUCs) was removed under the section for SOE for LC 3.1 as any changes that negatively impact the licensing basis require approval by the Commission in accordance with LC G.1. - The section on Other Limits for LC 3.1 was updated to reflect current status for enhanced neutron overpower (NOP) protection. This included revisions to the currently installed trip setpoint validity. - The date was removed for the update of the safety analysis for common mode events (CME) for LC 4.1 as the updates are required in accordance with REGDOC-3.1.1 and will occur for Pickering B in 2019 and Pickering A in 2023. - The bullets related to the seismic qualification program for LC 5.3 were moved back to the Guidance section as they are not required explicitly by CSA N289.1. - The CVC for structures, systems and components (SSC) specific aging management programs for LC 6.1 was revised back to the version in the current LCH (e-Doc 5237801) as it provided more clarity and also to better reflect the notification requirements in LC G.2. - The bullet referring to submitting a R&D test plan and schedule for the validation of the cohesive zone-based fracture toughness model for LC 6.1 was removed as OPG has provided	

			the plan. • The text on dispositioning of pressure tubes with high Heq concentrations was removed from the CVC and Guidance sections for LC 6.1 as these requirements are specified in CSA N285.8-15 and the purpose of the LCH is not to reiterate these requirements. • Assessments required by CSA N293 were removed from the Licensee Documents for LC 10.2 as they are not programmatic. • Revisions to the Guidance section for LC 13.1 to reflect that OPG is expected to submit an implementation plan and gap analysis for REGDOC-2.13.1. • Revisions to LC and CVC for LC 15.3 to align with a similar condition and CVC for Bruce Power.	

TABLE OF CONTENT

INTRODUCTION

The general purpose of the Licence Conditions Handbook (LCH) is to identify and clarify the relevant parts of the licensing basis, CNSC document INFO-0795, *Licensing Basis Objectives and Definitions* (2010), for each licence condition (LC). This will help ensure that the licensee conducts the activities described in the licence in accordance with the licensing basis for the facility. The LCH should be read in conjunction with the regulatory requirements, the licence and licence application and supporting documents.

The LCH is organized in accordance with the CNSC's Safety and Control Area (SCA) Framework (e-Doc 3410839). The SCA Framework includes fourteen SCA areas, their definitions and specific areas. The licensee may request a copy of this document at any time.

The licensing basis described in this LCH applies to the facility known as the Pickering Nuclear Generating Station or Pickering NGS. The licensing basis is a key input to establish compliance verification activities for the Pickering NGS in accordance with the CNSC Power Reactor Regulatory Program Compliance Verification Strategy, e-Doc 5115523.

Pickering NGS consists of eight units; Units 1 to 4 are at times referred to as Pickering NGS-A, and Units 5 to 8 may be called Pickering NGS-B. This distinction is due to the different times of construction and differences in design. The LCH sometimes refers to Pickering NGS-A (or Units 1 to 4) and/or Pickering NGS-B (or Units 5 to 8) as the licensing conditions and requirements may be specific to a Unit or to a combination of Units.

The LCH typically has three parts under each LC: the Preamble, Compliance Verification Criteria (CVC), and Guidance. The Preamble explains, as needed, the regulatory context, background, and/or history related to the LC. CVC are criteria used by CNSC staff to verify and oversee compliance with the LC. Guidance is non-mandatory information, including direction, on how to comply with the LC.

Throughout the licence, the statement "consent of a person authorized by the Commission" reflects the fact that the Commission may delegate certain authority (hence "consent") to CNSC staff. Unless otherwise indicated in the CVC of specific LCs in this LCH, the delegation of authority by the Commission to act as a "person authorized by the Commission" is only applied to the incumbents of the following positions (source: Record of Decision for licence renewal issued Month 20XX, e-Doc XXXXXXX):

- Director, Pickering Regulatory Program Division
- Director General, Directorate of Power Reactor Regulation
- Executive Vice-President and Chief Regulatory Operations Officer, Regulatory Operations Branch

Current versions of the licensee documents listed in this LCH are tracked in the document "OPG Pickering NGS PROL Written Notification Documents in LCH" (e-Doc 4027172), which is controlled by the Pickering Regulatory Program Division (PRPD) and is available to the licensee upon request.

This LCH includes appendices A to E which contain acronyms, a glossary of terms and lists of LCH-related documents.

More information on the LCH is available in e-Doc 4967591.

GENERAL

G. GENERAL

G.1 Licensing Basis for the Licensed Activities

Licence Condition G.1:

The licensee shall conduct the activities described in Part IV of this licence in accordance with the licensing basis, defined as:

(i) the regulatory requirements set out in the applicable laws and regulations;

(ii) the conditions and safety and control measures described in the facility's or activity's licence and the documents directly referenced in that licence;

(iii) the safety and control measures described in the licence application and the documents needed to support that licence application;

unless otherwise approved in writing by the Canadian Nuclear Safety Commission (CNSC, hereinafter "the Commission").

Preamble:

Paragraph 24 (1) of the *Nuclear Safety and Control Act* (*NSCA*) states "The Commission may establish classes of licences authorizing the licensee to carry on any activity described in any of paragraphs 26 (a) to (f) that is specified in the licence for the period that is specified in the licence."

Paragraph 26 (a) of the *NSCA* states "Subject to the regulations, no person shall, except in accordance with a licence,

(a) possess, transfer, import, export, use or abandon a nuclear substance, prescribed equipment or prescribed information;

(b) mine, produce, refine, convert, enrich, process, reprocess, package, transport, manage, store or dispose of a nuclear substance;

(c) produce or service prescribed equipment;

(d) operate a dosimetry service for the purposes of this Act;

(e) prepare a site for, construct, operate, modify, decommission or abandon a nuclear facility; or

(f) construct, operate, decommission or abandon a nuclear-powered vehicle or bring a nuclear-powered vehicle into Canada."

The standardized licence conditions, organized by Safety and Control Areas (SCAs), apply to all the licensed activities. Specific licence conditions were added for nuclear facility-specific activities, if required. The licensed activities are explained in more detail below:

Nuclear Facility

Activity (i) in the licence authorizes the licensee to operate the Pickering NGS. There is a number of specific licence conditions, with applicable sections of the LCH, that provide additional context to what is meant by "operate" for Pickering NGS, namely:

- LC 15.1 describes that the results of the Periodic Safety Review (PSR) shall be implemented;
- LC 15.2 describes which units shall be maintained in the safe storage phase;
- LC 15.3 describes the requirement to maintain pressure tube fracture toughness sufficient for safe operation; and
- LC 15.4 describes the requirement for plans for the end of commercial operations (ECO).

Nuclear Substances

Activity (ii) in the licence authorizes the licensee to possess, transfer, use, package, manage and store nuclear substances and activity (iii) in the licence authorizes the licensee to import, export nuclear substances, except controlled nuclear substances.

The licence was amended to include the activities for import and export for contaminants in laundry, packaging, shielding or equipment, which are not controlled nuclear substances. In addition, a new activity (vii) was included in an amendment to authorize additional activities to possess, transfer, export, package, manage and store nuclear substances from the Western Waste Management Facility for laundry from the Western Waste Management Facility. See CMD 17-H109 (e-Doc 5251787), CMD 17-H109.A (e-Doc 5338229) and the Record of Decision (e-Doc 5373857) for more information related to these amendments.

Licence conditions that relate to activities (ii), (iii) and (vii) include:

- LC 11.1 describes the waste management program;
- LC 14.1 describes the packaging and transport program;
- LC 15.6 describes the importing and exporting of contaminants in laundry, packaging, shielding or equipment.

Activity (iv) in the licence authorizes the licensee to possess, transfer, produce, package, manage and store Cobalt-60. Activity (v) in the licence authorizes the licensee to possess, transfer, manage and store heavy water, which was added as an amendment in 2016. See CMD 16-H111 (e-Doc 5035292) and the Record of Decision (e-Doc 5089672) for more information related to this amendment. Licence conditions that relate to activities (iv) and (v) include:

- LC 3.1 describes the heavy water management program at Pickering NGS, which includes the management of heavy water from other facilities; and
- LC 15.5 describes the Cobalt-60 production program at Pickering NGS.

Transport of Nuclear Material

Activity (vi) in the licence authorizes the licensee to transport Category II nuclear material i.e. fuel by road from Pickering NGS spent fuel bay to the onsite waste storage facility, The Pickering waste storage facility is licenced separately from the Pickering NGS licence (WFOL-W4-350.02/2018 – e-Doc 4002929). This activity is addressed as part of LC 14.1, which describes the packaging and transport program.

Prescribed Equipment and Prescribed Information

Activities (viii) in the licence authorizes the licensee to possess and use prescribed equipment and prescribed information related to the operating Pickering NGS i.e. activity (i). Activity (ix) authorized the licensee to possess, use, manage and store enriched uranium as required for the fission chambers for Pickering NGS Units 1 and 4 Shutdown System Enhancement, including spares. Licence conditions that relate to these activities include:

- LC 12.1 describes the security program, which includes site access control and measures to prevent loss or illegal use, possession or removal of nuclear substances, prescribed equipment or prescribed information; and
- LC 13.1 describes the safeguards program, which specifies for the import and export of controlled nuclear substances, equipment and information a separate authorization is required from the CNSC. Additionally, it describes reporting requirements for all fissionable and fertile substances.

Compliance Verification Criteria:

Licensee Documents		
Document #	**Title**	**Prior Notification**
P-CORR-00531-05055	Letter, Randy Lockwood to M. A. Leblanc, “Application for Renewal of Pickering Nuclear Generating Station Power Reactor Operating Licence”, August 28, 2017, e-Doc 5328792.	N/A
P-CORR-00531-05087	Letter, Randy Lockwood to A. Viktorov, “Pickering NGS: Application Requirements for Power Reactor Operating Licence Renewal – Preliminary List of CNSC Regulatory Documents and CSA Standards”, August 11, 2017, e-Doc 5320044.	N/A
P-CORR-00531-05140	Email, Susan Ebata to A. Viktorov, “Documents referred to in P-CORR-0531-05055”, September 1, 2017, e-Doc 5333436.	N/A
P-CORR-00531-05223	Letter, Randy Lockwood to M. A. Leblanc, “Supplementary Information to the Application for Renewal of the Pickering Nuclear Generating Station Power Reactor Operating Licence”, December 11, 2017, e-Doc 5414520.	N/A

P-CORR-00531-05228	Letter, Randy Lockwood to A. Viktorov, "Application Requirements for Power Reactor Operating Licence Renewal – CNSC Regulatory Documents and CSA Standards", December 14, 2017, e-Doc 5417613.	N/A
N-CORR-00531-18933	Letter, Heather Ferguson to A. Viktorov, N. Riendeau, K. Glenn, "Gap Analysis and Implementation Plan for Compliance with CSA Standard N288.7-15", December 14, 2017, e-Doc 5421310.	N/A
N-CORR-00531-18966	Letter, Heather Ferguson to A. Viktorov, N. Riendeau, K. Glenn, "Gap Analysis and Implementation Plan for Compliance with CSA Standard N288..3.4-13", December 14, 2017, e-Doc 5421300.	N/A
P-CORR-00531-05193	Letter, Randy Lockwood to A. Viktorov, "Pickering NGS: Application Requirements for Power Reactor Operating Licence Renewal – Compliance with Standard CSA N285.4-14", December 15, 2017, e-Doc 5419126.	N/A
P-CORR-00531-05213	Letter, Randy Lockwood to A. Viktorov, "Pickering NGS: Application Requirements for Power Reactor Operating Licence Renewal – Update to CNSC Regarding Use of CSA N285.8-15 Fitness for Service Assessment of Pressure Tubes", December 15, 2017, e-Doc 5419124.	N/A
P-CORR-00531-05188	Letter, Randy Lockwood to A. Viktorov, "Pickering NGS: Application Requirements for Power Reactor Operating Licence Renewal – Update on the CSA N293-12 Implementation Plan", December 15, 2017, e-Doc 5419135.	N/A
P-CORR-00531-05360	Letter, Randy Lockwood to A. Viktorov, "Pickering NGS: CNSC REGDOCs and CSA Standards for Pickering Licence Renewal", April 18, 2018, e-Doc 5514173.	N/A
P-CORR-00531-05419	Letter, Randy Lockwood to A. Viktorov, "CNSC REGDOCs and CSA Standards for Pickering NGS Licence Renewal – Implementation of REGDOC-2.3.2 Version 1 (2013)", May 31, 2018, e-Doc 5552629.	N/A

INFO-0795, section 2, defines the licensing basis in three parts. Part i) of the licensing basis consists of the regulatory requirements set out in the applicable laws and regulations.

Besides the *NSCA* and its associated Regulations, licensees are subject to other applicable laws and regulations including, but not limited to, the following:

- Canadian Environmental Assessment Act
- Canadian Environmental Protection Act
- Nuclear Liability and Compensation Act
- Transportation of Dangerous Goods Act
- Radiation Emitting Devices Act
- Access to Information Act
- Canada/IAEA Safeguards Agreement
- National Building Code of Canada

The safety and control measures mentioned in the LC under Parts (ii) and (iii) of the licensing basis include important aspects of analysis, design, operation, etc. They may be found in high-level, programmatic licensee documents but might also be found in lower-level, supporting documentation. They also include safety and control measures in licensing basis publications (e.g., CNSC regulatory documents or CSA standards) that are cited in the licence, the application, or in the licensee's supporting documentation. CNSC regulatory documents are abbreviated as REGDOC(s) and CSA standards are abbreviated as CSA followed by the applicable document number and title.

Licensing basis publications are listed in tables in this LCH under the most relevant LC. All "shall" or normative statements in licensing basis publications are considered compliance verification criteria (CVC) unless stated otherwise. If any "should" or informative statements in licensing basis publications are also considered CVC, this is explained under the most relevant LC.

The licensee documents and licensing basis publications may cite other documents that also contain safety and control measures (i.e., there may be safety and control measures in "nested" references). There is no predetermined limit to the degree of nesting at which relevant safety and control measures may be found.

Not all details in referenced documents are necessarily considered to be safety and control measures.

- Details that are not directly relevant to safety and control measures for facilities or activities authorized by the licence are excluded from the licensing basis.
- Details that are relevant to a different safety and control area (i.e., not the one associated with the main document) are only part of the licensing basis to the extent they are consistent with the main requirements for both safety and control areas.

In the event of any perceived or real conflict or inconsistency between two elements of the licensing basis, the licensee shall consult CNSC staff to determine the approach to resolve the issue.

In case of a conflict between CSA standards, CNSC will consult with CSA Group before reaching a conclusion on the resolution.

This LC is not intended to unduly inhibit the ongoing management and operation of the facility or the licensee's ability to adapt to changing circumstances and continuously improve, in accordance with its management system. Where the licensing basis refers to specific configurations, methods, solutions, designs, etc., the licensee may propose alternate approaches as long as they remain, overall, in accordance with the licensing basis and have a neutral or positive impact on health, safety, the environment, security, and safeguards. However, the licensee shall assess changes to confirm that operations remain in accordance with the licensing basis.

Changes to certain licensee documents require written notification to the CNSC, even if they are in accordance with the licensing basis. Further information on this topic is provided under LC G.2.

For unapproved operation that is not in accordance with the licensing basis, the licensee shall take action as soon as practicable to return to a state consistent with the licensing basis, taking into account the risk significance of the situation.

In the event that the Commission grants approval to operate in a manner that is not in accordance with existing licensing basis, this would effectively revise the licensing basis for the facility. The appropriate changes would be reflected in the CVC of the relevant LC.

Guidance:

When the licensee becomes aware that a proposed change or activity might not be in accordance with the licensing basis, it should first seek direction from CNSC staff regarding the potential acceptability of this change or activity. The licensee should take into account that certain types of proposed changes might require significant lead times before CNSC staff can make recommendations and/or the Commission can properly consider them. Examples of these types of changes are discussed under various LCs in this LCH. Guidance for notifications to the CNSC related to licensee changes are discussed under LC G.2.

G.2 Notification of Changes

Licence Condition G.2:

The licensee shall give written notification of changes to the facility or its operation, including deviation from design, operating conditions, policies, programs and methods referred to in the licensing basis.

Preamble:

CNSC staff track, in e-Doc 4027172, the version history of licensee documents that require notification of change (with the exception of security-related documents).

Compliance Verification Criteria:

Written notification (WN) is a written letter or electronic communication from a person authorized to act on behalf of the licensee to a CNSC delegated authority.

The licensee shall notify the CNSC of changes to identified licensee documents. The LCH identifies them under the most relevant LC. However, the licensee documents identified in the LCH only represent the minimum subset of documents that require notification of change. For any change that is not captured as a change to a document listed in the LCH, the licensee shall notify CNSC of the change in licensing basis documents if the change may negatively impact designs, operating conditions, policies, programs, methods, or other elements that are integral to the licensing basis. For example, if a licensee document identified in the CVC refers to another document, including a third-party document, without citing the revision number of that document, if that document changes and the licensee uses the revised version, the licensee shall determine if it is necessary to notify the CNSC of the change.

The documents needed to support the licence application may include documents produced by third parties (e.g., reports prepared by third party contractors). Changes to these documents require written notification to the CNSC only if the new version continues to form part of the licensing basis. That is, if the licensee implements a new version of a document prepared by a third party, it shall inform the CNSC of the change(s), per LC G.2. On the other hand, if a third party has updated a certain document, but the licensee has not adopted the new version as part of its safety and control measures, the licensee is not required to inform the CNSC that the third party has changed the document.

Licensee documents tabulated in the CVC of the LCH are subdivided into two groups having different requirements for notification of change – ones that require prior written notification of changes and those that require written notification at the time of implementation. For the former type, the licensee shall submit the document to the CNSC prior to implementing the change. Typically, the requirement is to submit the proposed changes 30 days prior to planned implementation; however, the licensee shall allow sufficient time for the CNSC staff to review the change proportionate to its complexity and the importance of the change. If change modified a document which requires formal CNSC staff acceptance, additional time should be allowed. For the latter type, the licensee need only submit the document at the time of implementing the change.

Written notifications shall include a summary description of the change, the rationale for the change, expected duration (if not a permanent change), and an explanation of how the licensee has concluded that the change remains in accordance with the licensing basis (e.g., an evaluation of the impact on health, safety, security, the environment and Canada's international obligations). A copy of the revised WN document shall accompany the notification.

Changes that are not clearly in the safe direction may require Commission approval in accordance with LC G.1.

The licensee shall notify the CNSC in writing when it plans to implement a new licensing basis publication, including the date by which implementation of the publication will be complete. The notice shall indicate the corresponding changes to licensee documents listed in CVC of the LCH.

Guidance:

A list of criteria that could help determine if a change would be in accordance with the licensing basis is provided in Appendix A of CNSC internal document "*Overview of assessing licensee changes to documents or operations*", e-Doc 4055483. Such criteria would also be used if the change requires CNSC staff acceptance, due to other requirement in the licensing basis.

For proposed changes that would not be in accordance with the licensing basis, the Guidance for LC G.1 applies.

G.3 Land Use and Occupation

Licence Condition G.3:

The licensee shall control the use and occupation of any land within the exclusion zone.

Preamble:

The exclusion zone is an area, immediately surrounding a nuclear facility where no permanent habitation is allowed. The siting guide used at the time of design of Pickering NGS (AECB-1059, e-Doc 3000249) stipulated an exclusion zone that extended at least 914 metres (3000 feet) from the reactor core.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
NK30-D0A-10200-0001	Building Development Site Plan	No
NA44-SR-01320-00001	Pickering A Safety Report (Part 1)	No*
NK30-SR-01320-00001	Pickering B Safety Report (Part 1)	No*

**Updates to facility descriptions are required every 5 years or when requested by the CNSC in accordance with REGDOC-3.1.1 (LC 3.3).*

The licensee shall ensure that the use and occupancy of land within the exclusion zone does not compromise the safety and control measures in the licensing basis. Specifically, the licensee shall consider emergency preparedness and ALARA when controlling land use within the exclusion zone. This applies to land the licensee occupies as well as to land occupied by others.

The licensee shall not permit a permanent dwelling to be built within the exclusion zone. "Permanent dwelling" refers to housing that is meant to be fixed. The licensee may erect, for a short time without prior notification, a temporary dwelling (e.g., a trailer).

OPG's document NK30-D0A-10200-0001, *Building Development Site Plan*, describes the exclusion zone and identifies the parcels of land within the exclusion zone that are controlled but not owned by OPG. The licensee shall notify the CNSC of changes to the use and occupation of any land within the exclusion zone.

OPG has an agreement with the City of Pickering for fire protection and community emergency management, which describes mutual aid arrangements for on-site and off-site emergencies (P-CORR-00531-04586, e-Doc 4891727). The agreement describes how resources are combined to help safeguard the community in the event of a major incident.

The response agreement and assurance of fire response shall be maintained as per the agreement, as amended from time to time. OPG shall notify the CNSC of any changes to the agreement with the City of Pickering.

See LC 10.1 and 10.2 for more information on emergency management and fire protection.

Guidance:

There is none provided.

G.4 Office for CNSC On-Site Inspectors

Licence Condition G.4:

The licensee shall provide, at the nuclear facility and at no expense to the Commission, suitable office space for employees of the Commission who customarily carry out their functions on the premises of that nuclear facility (onsite Commission staff).

Preamble:

CNSC staff require suitable office space at the nuclear facility in order to satisfactorily carry out its regulatory activities.

Compliance Verification Criteria:

Any changes of accommodation shall be made based on discussion and subsequent agreement between the CNSC and the licensee.

Suitable office space is office space that is separated from the remainder of the building in which it is located by walls or other suitable structures.

Guidance:

There is none provided.

G.5 Financial Guarantees

Licence Condition G.5:

The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.

Preamble:

The *General Nuclear Safety and Control Regulations* requires under paragraph 3(1)(l) that a licence application contain a description of any proposed financial guarantee relating to the activity to be licensed.

The licensee is responsible for all costs of implementing the proposed decommissioning plans (see LC 11.2) and providing an appropriate financial guarantee that is acceptable to the Commission.

Ontario Power Generation Inc. (OPG) maintains a consolidated financial guarantee to cover the future decommissioning of all of its Class I and waste nuclear substance licence facilities, and the long-term management of used fuel and low- and intermediate-level radioactive waste. The current financial guarantee for OPG was accepted by the Commission on November 27, 2017. OPG conducted a complete decommissioning cost estimate review as part of the 5-year Ontario Nuclear Funds Agreement reference plan update cycle. Gaps identified between the preliminary decommissioning plan and CSA N294-09, *Decommissioning of facilities containing nuclear substances*, that could impact on the decommissioning costs were addressed by OPG in the cost estimate review (LC 11.2).

The acceptance of proposed financial guarantee is a subject of a separate Commission proceeding not related to the licence renewal process. The OPG consolidated financial guarantee includes:

- Segregated funds established pursuant to the Ontario Nuclear Funds Agreement between OPG, the Province of Ontario and the CNSC effective January 1, 2018 to December 31, 2022; and
- A trust fund for the management of used fuel established pursuant to the *Nuclear Fuel Waste Act*.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Document Title**	**Prior Notification**
N/A	CNSC Financial Security and ONFA Access Agreement between OPG, the Province of Ontario and the CNSC effective January 1, 2018*	Yes
W-STD-WM-0003	Nuclear Liability Management – Update of Cost Estimates for the Ontario Nuclear Funds Agreement and Financial Guarantee Processes	No

**Commission Decision e-Doc 5400969 and CMD 17-H11 e-Doc 5306917*

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CSA	N294	Decommissioning of facilities containing nuclear substances	2009	2013-09-01

The financial guarantee for decommissioning the nuclear facility shall be reviewed and revised by the licensee every five years or when the Commission requires or following a revision of the preliminary decommissioning plan that significantly impacts the financial guarantee.

The next full update to the 5 year reference plan for financial guarantee purposes is expected in 2022.

The licensee shall submit annually to the Commission a written report confirming that the financial guarantees for decommissioning costs remain valid and in effect and sufficient to meet the decommissioning needs. The licensee shall submit this report by the end of Februaprog-001ry of each year, or at any time as the Commission may request.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	G-206	Financial Guarantees for the Decommissioning of Licensed Activities	2000
CNSC	G-219	Decommissioning Planning for Licensed Activities	2000

G.6 Public Information and Disclosure

Licence Condition G.6:

The licensee shall implement and maintain a public information and disclosure program.

Preamble:

A public information and disclosure program (PIDP) is a regulatory requirement for licence applicants and licensees under the *Class I Nuclear Facilities Regulations*, paragraph 3(j), which requires that a licence application contain a description of a program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment, health and safety of persons.

The primary goal of the PIDP, as it relates to the licensed activities, is to ensure that information related to the health, safety and security of persons and the environment, and other issues associated with the lifecycle of nuclear facilities are effectively communicated to the public.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
N-STD-AS-0013	Nuclear Public Information Disclosure	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	RD/GD-99.3	Public Information and Disclosure	2012	2013-09-01

Where the public has indicated an interest to know, the PIDP shall include a commitment to and disclosure protocol for ongoing, timely communication of information related to the licensed facility during the course of the licensing period.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	REGDOC-3.2.2	Aboriginal Engagement	2016

OPG should submit annually a report summarizing the public outreach events and developments involving Pickering NGS.

1 SCA – MANAGEMENT SYSTEM

1.1 Management System

Licence Condition 1.1:

The licensee shall implement and maintain a management system.

Preamble:

Safe and reliable operation requires a commitment and adherence to a set of management system principles and, consistent with those principles, the establishment and implementation of processes that achieve the expected results. CSA N286, *Management system requirements for nuclear facilities*, contains the requirements for a management system throughout the life cycle of a nuclear power plant and extends to all safety and control areas.

A management system brings together in a planned and integrated manner the processes necessary to satisfy requirements and to carry out licensed activity in a safe manner. Management system requirements provide direction to management to develop and implement management practices and controls. The elements of a management system include areas such as organization structure and culture, resources, equipment, and information. The management system must satisfy the requirements set out in the regulations made pursuant to the *Nuclear Safety and Control Act*, the licence and the measures necessary to ensure that safety is paramount.

An adequately established and implemented management system provides CNSC staff with confidence and evidence that the licensing basis under which the Commission made its decision and had issued a licence, remains valid.

The management system SCA includes the following specific areas (SpAs):

- Management system;
- Organization;
- Performance assessment, improvement and management review;
- Operating experience (OPEX);
- Change management;
- Safety Culture;
- Configuration management;
- Records management;
- Management of contractors; and
- Business continuity.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Management System		
N-POL-0001	Nuclear Safety Policy	No
N-CHAR-AS-0002	Nuclear Management System	Yes
N-PROG-AS-0001	Managed Systems	No
Organization		
N-STD-AS-0020	Nuclear Management Systems Organizations	No
OPG-PROC-0166	Organization Design Change	No
Performance Assessment, Improvement and Management Review		
N-PROG-RA-0010	Independent Assessment	No
N-PROC-RA-0097	Self-Assessment and Benchmarking	No
N-PROC-RA-0023	Fleetview Program Health and Performance Rating	No
Operating Experience (OPEX)		
N-PROG-RA-0003	Corrective Action	No
N-PROC-RA-0035	Operating Experience Process	No
N-PROC-RA-0022	Processing Station Conditions Records	No
Change Management		
N-PROG-MP-0001	Engineering Change Control	No
OPG-PROC-0166	Organization Design Change	No
OPG-PROC-0178	Controlled Document Management	No
Safety Culture		
N-STD-AS-0023	Nuclear Safety Oversight	No
OPG-PROG-0010	Health and Safety Management System Program	No
N-PROC-AS-0077	Nuclear Safety Culture Assessment	No
Configuration Management		
N-STD-MP-0027	Configuration Management	No

N-STD-OP-0024	Nuclear Safety Configuration Management	No
Records Management		
OPG-PROG-0001	Information Management	No
Management of Contractors		
OPG-PROG-0009	Items and Services Management	No
N-PROC-MM-0021	Supply Inspection	No
Business Continuity		
N-PROG-AS-0005	Business Planning	No
N-PROC-AS-0080	Nuclear Business Planning	No
OPG-PROG-0033	Business Continuity Program	No
OPG-PROG-0039	Project Management	No
OPG-PROG-0010	Safety Management System Program	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CSA	N286	Management system requirements for nuclear facilities	2012	2016-11-07

Management System

OPG's management system is defined in N-CHAR-AS-0002, *Nuclear Management System*, which takes its authority from N-POL-0001, *Nuclear Safety Policy*.

The management system SpA includes the following review topics and requirements from CSA N286:

- Management system – Defined and implemented (Clauses 4.1, 4.1.1);
- Management system – Based on a set of principles (Clauses 4.1.2 (a) to (l)); and
- Graded approach (Clause 4.1.3).

The management system documentation shall contain sufficient detail to demonstrate that the described processes stated directly or by reference provide the needed direction to comply with the conditions stated in the Power Reactor Operating Licence (PROL) or licence and the criteria herein.

Organization

The organization SpA includes the following review topics and requirements from CSA N286:

- Organizational structure (Clause 4.4 (a));
- Authorities, accountabilities and responsibilities (Clause 4.4 (b));
- Internal and external interfaces (Clause 4.4 (c)); and
- Decisions (Clause 4.4 (d)).

The licensee shall document the organizational structure for safe and reliable conduct of licensed activities and shall include all positions with responsibilities for the management and control of the licensed activity.

The licensee's organization, including names of persons assigned to positions, is also subject to the requirements of Paragraph 15(c) of the *General Nuclear Safety and Control Regulations*, which requires the licensee to inform the CNSC of organizational changes within 15 days. In addition, there are annual reporting requirements in accordance with REGDOC 3.1.1 *Reporting Requirements for Nuclear Power Plants.* See LC 3.3 for more information on REGDOC 3.1.1.

Performance Assessment, Improvement and Management Review

The performance assessment, improvement and management review SpA includes the following review topics and requirements from CSA N286:

- Assessment and self-assessment (Clauses 4.11 and 4.11.1);
- Independent assessment (Clauses 4.11, 4.11.2 (a) and (b)); and
- Continual improvement (Clauses 4.13 (a) – (e)).

Operating Experience (OPEX)

The operating experience (OPEX) SpA includes the following review topics and requirements from CSA N286:

- Problem identification and resolution (Clauses 4.9, 4.9 (a) to (d));
- Actions employed to control and resolve problems (Clause 4.9);
- Experience is identified and collected (Clause 4.12 (a));
- Experience is reviewed for relevance and significance (Clause 4.12 (b));
- Actions to prevent recurrence (Clause 4.12 (c));
- Initiate improvements (Clause 4.12 (d)); and
- Experience is made available (Clause 4.12).

Change Management

The change management SpA includes the following review topics and requirements from CSA N286:

- Change (Clauses 4.10 and 4.10 (a) – (g));
- Completion Assurance (Clause 7.11 and 7.11.1); and
- Turnover (Clause 7.11.2 and 7.11.2 (a) – (e)).

Safety Culture

Clause 4.2 of CSA N286 contains requirements related to the understanding and promotion of safety culture.

Licensees shall ensure that the management of the organization supports the safe conduct of nuclear activities. The licensee shall ensure that sound nuclear safety is the overriding priority in all activities performed in support of the nuclear facilities and has clear priority over schedule, cost and production. The framework, guiding principles and accountabilities for nuclear safety oversight is governed by N-STD-AS-0023, *Nuclear Safety Oversight*, which summarizes the licensee's internal and external processes used for oversight and assessment. The requirements for such oversight are described in CSA N286.

Configuration Management

Configuration management shall be incorporated into all aspects of purchasing, construction, commissioning, operating, and maintenance documentation so that the as-built configuration of the facility is aligned with the design and safety analysis in accordance with CSA N286 Clause 7.5. This includes the establishment of processes for making the identification and labelling of structures, systems and components and identification and marking of items to control their use and establish traceability where required.

With regard to modifications, the design basis for the plant should be documented and maintained to reflect design changes to ensure adequate configuration management. See LC 5.1, 5.2 and 5.3 for more information regarding the plant design. The design basis should be maintained to reflect new information, operating experience, safety analyses, and resolution of safety issues or correction of deficiencies. The impacts of the design changes should be fully assessed, addressed and accurately reflected in the safety analyses prior to implementation.

Records Management

The records management SpA includes the following review topics and requirements from CSA N286:

- Documentation of the management system (Clause 4.7.1);
- Information (Clause 4.7.2 (a - d));
- Documents (Clause 4.7.3 (a-f)); and
- Records (Clause 4.7.4 (a-g)).

Management of Contractors

The management of contractors SpA includes the following review topics and requirements from CSA N286:

- The Supply Chain Process (Clause 7.6 and 7.6.1);
- Purchasing Requirements (Clause 7.6.2 (a - l));
- Supplier Acceptability (Clauses 7.6.3.1 to 7.6.3.5);
- Provision of the purchasing requirements to suppliers (Clause 7.6.4);
- Supplier selection and award (Clause 7.6.5);
- Supplier-customer relationship (Clause 7.6.6 (a-e);
- Verification Services (Clause 7.6.7);
- Receipt and Inspection of Items (Clauses 7.6.8 and 7.6.8.1 to 7.6.8.2)
- Segregation and disposition of problem items (Clause 7.6.9);
- Storage and Handling (Clause 7.6.10 (a-e); and
- Planning for replacement parts (Clause 7.6.11 (a-g).

Business Continuity

The business continuity SpA includes the following review topics and requirements from CSA N286:

- Business Planning (Clause 4.3 and 4.3 (a) to (f));
- Pandemic;
- Resources (Clauses 4.5 and 4.5.1); and
- Financial Resources (Clause 4.5.3).

The licensee implements and maintains a "Nuclear Pandemic Plan", to support minimum shift complement staffing and makes provisions should a labour dispute arise by implementing and maintaining strike contingency documentation, "Guideline for Maintaining Staff in Key Positions When Normal Station Access is Impeded" (refer to LC 2.2).

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
Management System			
CSA	N286.0.1	Commentary on N286-12 Management System	2014

Configuration Management			
CSA	N286.10	Configuration Management for High Energy Reactor Facilities	2016

Safety Culture

The management system should be used to promote and support a healthy safety culture. The CNSC recognizes the following characteristics that form the framework for a healthy safety culture:

- Safety is a clearly recognized value;
- Accountability for safety is clear;
- Safety is integrated into all activities;
- A safety leadership process exists, and
- Safety culture is learning-driven.

The licensee should conduct self-assessments of safety culture periodically. The assessment method should be documented and the framework should include links to the safety culture characteristics listed above.

CNSC staff encourage OPG management to continue to foster a healthy safety culture to ensure that OPG staff understand the influence that safety culture has over all other organizational processes and its role in maintaining and improving safety performance.

2 SCA – HUMAN PERFORMANCE MANAGEMENT

The human performance management SCA includes the following SpAs:

- Human performance program (LC 2.1);
- Personnel training (LC 2.3);
- Personnel certification (LC 2.4);
- Initial certification and requalification tests (LC 2.4);
- Work organization and job design (LC 2.2); and
- Fitness for Duty (LC 2.1).

2.1 Human Performance Program

Licence Condition 2.1:

The licensee shall implement and maintain a human performance program.

Preamble:

Paragraph 3(d.1) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed human performance program for the activity to be licensed, including measures to ensure workers' fitness for duty.

The human performance program addresses and integrates the range of human factors that influence human performance, including but not limited to:

- The provision of qualified workers;
- The reduction of human error;
- Organizational support for safe work activities;
- The continuous improvement of human performance; and
- Monitoring hours of work.

It is important that the licensee continuously monitors human performance, takes steps to identify human performance weaknesses and mechanisms that will improve human performance and reduce the likelihood of nuclear safety events that are attributable to human performance.

Human factors are factors that influence human performance as it relates to the safety of a nuclear facility or activity over all design and operations phases. These factors may include the characteristics of the person, task, equipment, organization, environment, and training. The consideration of human factors in issues such as interface design, training, procedures, and organization and job design may affect the reliability of humans performing tasks under various conditions.

CNSC Regulatory Policy P-119, *Policy on Human Factors*, describes how the CNSC will take human factors into account during its licensing, compliance and standards-development activities.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Human Performance Program		
N-PROG-AS-0002	Human Performance	No
P-PLAN-01900-00005	Pickering Human Performance Strategic Plan	No
N-STD-OP-0002	Communications	No
N-STD-OP-0012	Conservative Decision Making	No
Fitness for Duty		
N-PROC-OP-0047	Limits of Hours of Work	Yes

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	REGDOC-2.2.4	Fitness for Duty: Managing Worker Fatigue	2017	2019-01-01
CNSC	REGDOC-2.2.4	Fitness for Duty, Volume II: Managing Alcohol and Drug Use, version 2	2017	2019-07-01* 2019-12-01**
CNSC	RD-363	Nuclear Security Officer Medical, Physical, Psychological Fitness	2008	2013-09-01

* Full compliance with the exception of random testing.
** Full compliance including random testing.

Human Performance Program

The human performance program is an integrated approach of strategies, policies, processes and practices that considers a broad range of human and organizational factors. The human performance program interfaces with other programs with regard to human factors aspects. These interfaces are captured below as review topics and requirements.

Fitness for Duty

REGDOC-2.2.4 *Fitness for Duty: Managing Worker Fatigue*, was published March 21, 2017. As detailed in OPG letter N-CORR-00531-18759 (e-Doc 5355839), OPG has developed a plan to fully implement REGDOC-2.2.4 by January 1, 2019.

REGDOC-2.2.4 *Fitness for Duty, Volume II: Managing Alcohol and Drug Use*, version 2 was published January 2018. As detailed in OPG letter N-CORR-00531-19123 (e-Doc 5500805), OPG has developed a plan to fully implement REGDOC-2.2.4, Fitness for Duty, Volume II by July 1, 2019, with the exception of random testing. Full implementation, including random testing, is expected by December 1, 2019.

The licensee shall also monitor and control the fitness for duty of its workers at all times by implementing and maintaining N-CMT-62808-00001, *Continuous Behaviour Observation Program*, which covers aspects related to fitness for duty.

Fitness for duty requirements for certified staff are described in Section 11 of RD-204, which is a published document under LC 2.4.

Nuclear Security Officer Medical, Physical and Psychological Fitness

The licensee shall, in accordance with RD-363, ensure that the required documentation and necessary medical, physical, and psychological certification of a person is obtained before authorizing that person to act as a nuclear security officer.

Hours of Work

In order to establish, maintain and improve human performance, the licensee shall monitor and control the work hours and shift schedules of nuclear workers. All workers (including casual construction trades) in safety sensitive positions performing safety-related tasks or working on safety-related systems (defined in REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants*) are subject to these hours of work and scheduling limits.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	G-323	Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement	2007

The Human performance program should address and integrate the range of human and organizational factors that influence human performance, which include, but may not be limited to the following:

- the provision of qualified staff
    - certification and training
    - staffing
    - minimum shift complement
    - fitness for duty
        - hours of work
        - fatigue management

- the reduction of human error
  - human factors in design
  - procedures development
  - procedural compliance
  - work protection and work permit systems
  - shift turnover
  - pre- and post-job briefings
  - human actions in safety analysis
  - safe work strategies/practices

- organizational factors that influence safety performance through support of safe work activities
  - organization and management processes and safety culture

- the continuous improvement of human performance

In addition to certified personnel, the licensee should implement and maintain fitness for duty requirements for all workers, including security personnel. Oversight requirements should also be identified for supervisors of certified and security personnel. Licensees should have in place a documented fitness-for-duty program that provides confirmation that any person filling a minimum shift complement position does not have a physical or mental limitation that would make the person incapable of performing the duties of the applicable position, as stated in G-323, Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities: Minimum Staff Complement.

2.2 Minimum Shift Complement

Licence Condition 2.2:

The licensee shall implement and maintain the minimum shift complement and control room staffing for the nuclear facility.

Preamble:

The minimum shift complement specifies the numbers of qualified staff that are required to operate and maintain unit(s) safely under all operating states including normal operations, anticipated operational occurrences, design basis accidents and emergencies.

This licence condition ensures the presence at all times of a sufficient number of qualified workers to ensure safe operation of the nuclear facility, and to ensure adequate emergency response capability.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Work Organization and Job Design		
P-INS-09100-00003	Pickering Minimum Shift Complement	Yes
P-INS-09260-00008	Duty Crew Minimum Complement Assurance	Yes
N-INS-03490-10003	Minimum Shift Complement Resources, Qualifications and Procedures Required for Responding to Resource Limiting Events	No

Work Organization and Job Design

Minimum Shift Complement (MSC)

The licensee's minimum shift complement (MSC) documentation, P-INS-09100-00003, *Pickering Minimum Shift Complement*, and P-INS-09260-00008, *Duty Crew Minimum Complement Assurance*, describes the minimum number of workers with specific qualifications required for the most resource-intensive conditions under operating states, design basis accidents and emergencies and the measures in place to mitigate the impact of any MSC violations until minimum complement requirements are restored.

The licensee shall operate the nuclear facility in accordance with these documents and shall monitor and keep records of each shift's complement.
The MSC is considered part of the licensing basis. The following table summarize the facility's MSC. This table is taken from P-INS-09100-00003. In the event of a discrepancy between this table, below, and

the licensee documentation upon which they are based, the licensee documentation shall be considered the authoritative source (assuming that the licensee has followed its own change control process).

Work Group/Position	Position Certified by the CNSC	Number Required
PNGS-A Shift Manager	Yes	1
PNGS-A Control Room Shift Supervisor	Yes	1
PNGS-A Field Shift Operating Supervisor	No	1
PNGS-A Shift Advisor Technical Support	No	1
PNGS-A Authorized Nuclear Operator	Yes	4
PNGS-A Supervising Nuclear Operator	No	4
PNGS-A Nuclear Operators (2 Critical Safety Parameter qualified, 1 Self-Contained Breathing Apparatus qualified)	No	8
PNGS-B Shift Manager	Yes	1
PNGS-B Control Room Shift Supervisor	Yes	1
PNGS-B Field Shift Operating Supervisor	No	1
PNGS-B Shift Advisor Technical Support	No	1
PNGS-B Authorized Nuclear Operator	Yes	6
PNGS-B Supervising Nuclear Operator	No	4
PNGS-B Nuclear Operators (3 Critical Safety Parameter qualified, 1 Self-Contained Breathing Apparatus qualified)	No	8
PNGS-B Fuel Handling Major Panel Operator*	No	1
PNGS-B Fuel Handling Nuclear Operator*	No	1
Control Maintenance Shift Control Technician (1 Self-Contained Breathing Apparatus qualified)	No	2
Shift Mechanical Maintainer (1 Self-Contained Breathing Apparatus qualified)	No	2
Out of Plant Coordinator (Days only, 12hr/day, 7 days/wk)	No	1
Off Site Survey Team Captain (Days only, 12/hr/day, 7 days/wk)	No	1
Off Site Survey Team (Days only, 12/hr/day, 7 days/wk)	No	2
In Plant Coordinator	No	1

Work Group/Position	Position Certified by the CNSC	Number Required
Shift Resource Coordinator	No	1
In-Plant Survey Team	No	2
Chemical Laboratory Technician	No	2
Shift Emergency Response Manager	No	1
Emergency Response Maintainer	No	6
TOTAL		**65**

**One of either the Fuel Handling Major Panel Operator or the Fuel Handling Nuclear Operator must be Critical Safety Parameter qualified.*

Control Room Staffing

In conjunction with the minimum shift complement for the facility, the licensee shall maintain adequate control room staffing. The licensee shall have the following certified personnel at all times:

- In the Pickering NGS-A main control room, an authorized nuclear operator in direct attendance at each of the control panels of units 1 and 4.
- In the Pickering NGS-B main control room, an authorized nuclear operator in direct attendance at each of the control panels of units 5 to 8.

"In direct attendance" means the certified person must physically be in the direct line of sight and in close proximity to the control room panels to continuously monitor, recognize and differentiate panel displays, alarms and indications.

A certified person shall be in a position to rapidly respond, in accordance with his/her role, to changing unit conditions, at all times, as described in OPG document, P-INS-09100-00003.

The minimum certified personnel requirements for the main control room that this condition imposes do not apply where this minimum cannot be met due to emergency conditions that could cause an unwarranted hazard to personnel in the main control room, in which case the licensee shall place the reactor(s) in a safe shutdown state and the nuclear facility in a safe condition.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
Work Organization and Job Design			
CNSC	G-278	Human Factors Verification and Validation Plans	2003

CNSC	G-323	Ensuring the Presence of Sufficiently Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement	2007

G-278, *Human Factors Verification and Validation Plans*, describes the elements of effective human factors verification and validation planning, including a suggested format for documenting these elements. A verification and validation plan documents the set of activities within a specific project that will be carried out to demonstrate that the human factors considerations of the project conform to accepted human factors principles. This will ensure that the licensee enables personnel to perform their tasks safely and to meet operational goals.

G-323, *Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement*, describes the CNSC recommended approach for defining the minimum shift complement and sets out the key factors that CNSC staff will take into account when assessing whether the licensee has made, or the applicant will make, adequate provision for ensuring the presence of a sufficient number of qualified staff.

The adequacy of the minimum shift complement should be determined through a systematic analysis of the most resource-intensive conditions under all operating states, design basis accidents, and emergencies. The results of the analysis should then be validated to determine the degree to which the minimum shift complement facilitates the achievement of the overall safety goals.

OPG has implemented the Minimum Complement Coordination Program (MCCP) to monitor the minimum shift complement at Pickering NGS at all times, which helps to ensure that even short-term violations are prevented.

The licensee should provide a rolling five year profile of certified operators on an annual basis.

2.3 Training Programs

Licence Condition 2.3:

The licensee shall implement and maintain training programs.

Preamble:

There is none provided.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Personnel Training		
N-PROG-TR-0005	Training	No
N-PROC-TR-0008	Systematic Approach to Training	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	REGDOC-2.2.2	Personnel Training	2014	2016-11-07

Personnel Training

As defined by the *General Nuclear Safety and Control Regulations*, a worker is a person who performs work that is referred to in a licence. Workers include contractors and temporary employees; therefore, training requirements apply equally to these types of workers as to the licensee's own employees.

This licence condition provides the regulatory requirements for the development and implementation of training programs for workers. It also provides the requirements for training programs and processes necessary to support responsibilities, qualifications and requalification training of persons at the nuclear facility.

REGDOC-2.2.2 also provides the requirements necessary to support initial certification training and renewal of certification training of persons for the positions listed in LC 2.4, and as required by RD-204.

The licensee shall ensure that all workers are qualified to perform the duties and tasks required of their position.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	REGDOC-2.2.2	Human Performance Management Personnel Training, Version 2	2016

2.4 Certification Programs

Licence Condition 2.4:

The licensee shall implement and maintain certification programs in accordance with CNSC regulatory document RD-204, *Certification of Persons Working at Nuclear Power Plants*.

Persons appointed to the following positions require certification:

(i) Responsible Health Physicist;

(ii) Shift Manager;

(iii) Control Room Shift Supervisor; and

(iv) Authorized Nuclear Operator.

Preamble:

The licensee's documentation describes the authority and responsibilities of certified positions.

This licence condition provides the regulatory requirements for the initial certification, the renewal of certification and training of persons for the positions listed in the licence condition.

It also provides the requirements regarding the program and processes necessary to support the certification and training of persons at the nuclear facility.

As defined by the *General Nuclear Safety and Control Regulations*, workers include contractors and temporary employees who perform work that is referred to in the licence. Training and certification requirements apply equally to these types of workers as to the licensee's own employees.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Personnel Certification (includes Certified Positions)		
N-PROG-TR-0005	Training	No
N-PROC-TR-0008	Systematic Approach to Training	No
N-MAN-08131-10000-CNSC-031	Responsible Health Physicist	Yes
N-MAN-08131-10000-CNSC-007	Shift Manager, Pickering Nuclear	Yes
N-MAN-08131-10000-CNSC-010	Authorized Nuclear Operators	Yes

N-MAN-08131-10000-CNSC-028	Control Room Shift Supervisor, Pickering Nuclear	Yes
Initial Certification Examinations and Requalification Tests		
N-INS-08920-10004	Written and Oral Initial Certification Examination for Shift Personnel	No
N-INS-08920-10002	Simulator-Based Initial Certification Examinations for Shift Personnel	No
N-INS-08920-10001	Requalification Testing of Certified Shift Personnel	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	RD-204	Certification of Persons Working at Nuclear Power Plants	2008	2013-09-01

Personnel Certification and Initial Certification Examinations and Requalification Tests

Training and Certification for Staff Appointed to Certified Positions

The licensee shall implement and maintain a certification training and examination program in accordance with RD-204, including any transitional provisions. RD-204 defines the requirements regarding certification of persons working at NPP in positions that have a direct impact on nuclear safety.

Certified personnel shall carry out their authorities and responsibilities as per their respective role documents.

The licensee shall ensure persons appointed to the position of responsible health physicist, authorized nuclear operator, control room shift supervisor or shift manager, at the nuclear facility hold a certification for the position to which they have been appointed, in accordance with the requirements of the *Nuclear Safety and Control Act*.

Each personnel certification is issued for a specific plant design (i.e., the Pickering NGS-A side (units 1 to 4) or the Pickering NGS-B side (units 5 to 8)). A person shall be appointed only to the units for which the certificate has been issued.

The Senior Health Physicist referred to in RD-204 is equivalent to the Responsible Health Physicist position at Pickering NGS-A (units 1 to 4) and Pickering NGS-B (units 5 to 8).

The Plant Shift Supervisor referred to in RD-204 is equivalent to the Shift Manager position at Pickering NGS-A (units 1 to 4) and Pickering NGS-B (units 5 to 8). Any person who holds a certification as Shift Manager shall also be qualified to act in the Control Room Shift Supervisor position.

The Control Room Shift Supervisor position may also be filled by a certified Shift Manager.

The Reactor Operator referred to in RD-204 is equivalent to the Authorized Nuclear Operator position at Pickering NGS-A (units 1 to 4) and Pickering NGS-B (units 5 to 8).

When applying for certification or renewal of certification of a person for the positions listed, the licensee shall submit the information required pursuant to section 9 of *Class I Nuclear Facilities Regulations* and shall confirm that the person meets the relevant certification requirements applicable to that position, specified in RD-204.

The authorities and responsibilities of the certified positions listed above are considered safety and control measures. Any changes to them will be reviewed by CNSC staff to confirm they remain within the licensing basis in accordance with LCs G.1 and G.2, in consultation with the designated officer to certify and decertify persons referred to in sections 9 and 12 of the *Class I Nuclear Facilities Regulations* and the Director of the Personnel Certification Division.

Until further notification, the incumbent in paragraphs 25.2.6 and 26.7 of RD-204 may either be a certified:

a) Control Room Shift Supervisor (CRSS) who is working in the certified position of CRSS (duty CRSS), or

b) Shift Manager (SM) who is assigned to work in the certified position of CRSS (duty CRSS)

and must be qualified to evaluate the performance of the candidate as per section 6.0 of RD-204.

Until the revision of RD-204, the procedures specified in section 6.0 shall include the qualification requirements specifying the prerequisite knowledge and level of experience required for the certified incumbent to effectively monitor and evaluate candidate knowledge and performance in that position.

Note: Paragraph 13.1.6 of RD-204 will be amended during the next regulatory document revision to align with the written requalification test requirements in CNSC document, Requirements for the Requalification Testing of Certified Shift Personnel at Nuclear Power Plants, Revision 2. In the interim, for RD-204 paragraph 13.1.6, CNSC staff will apply the following compliance criteria: “The person must have successfully completed written requalification tests equivalent in number to those referred to in the NPP licence that the person would have had to take during the period of absence, if the person had continued to work in the position.”

<u>Conduct of Examinations and Tests for Certified Personnel</u>

Currently, the following three CNSC internal documents contain the requirements for administering the certification examinations and requalification tests required by RD-204:

- CNSC-EG1, Rev.0: “*Requirements and Guidelines for Written and Oral Certification Examinations for Shift Personnel at Nuclear Power Plants*”,
- CNSC-EG2, Rev.0: “*Requirements and Guidelines for Simulator-based Certification Examinations for Shift Personnel at Nuclear Power Plants*”, and
- CNSC document: “*Requirements for the Requalification Testing of Certified Shift Personnel at Nuclear Power Plants, Revision 2*”.

Guidance:

There is none provided.

3 SCA – OPERATING PERFORMANCE

The operating performance SCA includes the following SpAs:

- Conduct of licensed activity (LC 3.1);
- Procedures (LC 3.1);
- Reporting and trending (LC 3.3);
- Outage management performance (LC 3.1);
- Safe operating envelope (LC 3.1); and
- Severe accident management and recovery (LC 3.1, LC 3.2); and
- Accident management and recovery (LC 3.1, LC 3.2).

3.1 Operations Program

Licence Condition 3.1:

The licensee shall implement and maintain an operations program, which includes a set of operating limits.

Preamble:

The operations program establishes safe, uniform, and efficient operating practices within the nuclear facility, under all operating conditions (routine and non-routine), and provides the ability to ensure the facility is operated in accordance with the licensing basis.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Conduct of Licensed Activity		
N-PROG-OP-0001	Nuclear Operations	Yes
N-STD-OP-0036	Operational Decision Making	No
N-PROG-AS-0008	Heavy Water Management	No
N-PROG-MA-0019	Production Work Management	No
N-STD-OP-0011	Operations Performance Monitoring	Yes
Procedures		

N-STD-AS-0002	Procedure Use and Adherence	No
N-STD-AS-0014	Requirements for Technical Procedures	No
Outage Management Performance		
N-PROC-MA-0013	Planned Outage Management	No
N-PROC-MA-0049	Forced Outage Management	No
N-STD-OP-0025	Heat Sink Management	No
N-STD-OP-0009	Reactivity Management	No
N-STD-OP-0021	Control of Fuelling Operations	No
Safe Operating Envelope (SOE)		
N-STD-MP-0016	Safe Operating Envelope	Yes
Pickering Units 1 and 4		
NA44-OPP-03600	Pickering NGS-A Operating Policies and Principles	Yes
NA44-OSR-08131.02-00001	Pickering A Operational Safety Requirements: Shutdown Systems	Yes
NA44-OSR-08131.02-00002	Pickering A Operational Safety Requirements: Negative Pressure Containment	Yes
NA44-OSR-08131.02-00003	Pickering A Operational Safety Requirements: Fuel and Reactor Physics	Yes
NA44-OSR-08131.02-00004	Pickering A Operational Safety Requirements: Emergency Coolant Injection System	Yes
NA44-OSR-08131.02-00005	Pickering A Operational Safety Requirements: Boiler Emergency Cooling System	Yes
NA44-OSR-08131.02-00006	Pickering A Operational Safety Requirements: Emergency Boiler Water Supply System	Yes
NA44-OSR-08131.02-00007	Pickering A Operational Safety Requirements: Feedwater System	Yes
NA44-OSR-08131.02-00008	Pickering A Operational Safety Requirements: Service Water Systems	Yes
NA44-OSR-08131.02-00009	Pickering A Operational Safety Requirements: Powerhouse Emergency Venting System	Yes
NA44-OSR-08131.02-00010	Pickering A Operational Safety Requirements: Main Steam Supply System	Yes
NA44-OSR-08131.02-00011	Pickering A Operational Safety Requirements: Shutdown Cooling System	Yes

NA44-OSR-08131.02-00012	Pickering A Operational Safety Requirements: Moderator System	Yes
NA44-OSR-08131.02-00013	Pickering A Operational Safety Requirements: Heat Transport System	Yes
NA44-OSR-08131.02-00014	Pickering A Operational Safety Requirements: Reactor Regulating System	Yes
NA44-OSR-08131.02-00015	Pickering A Operational Safety Requirements: Electrical Power System	Yes
NA44-OSR-08131.02-00016	Pickering NGS-A Annulus Gas System	Yes
NA44-OSR-08131.02-00017	Pickering NGS-A Operational Safety Requirements: Fuel Handling System & Irradiated Fuel Bays	Yes
NA44-OSR-08131.02-00018	Pickering NGS-A Critical Safety Parameter Monitoring Instrumentation	Yes
NA44-OSR-08131.02-00019	Pickering NGS-A Operational Safety Requirements: Shield Cooling Systems	Yes
NA44-OSR-08131.02-00021	Pickering NGS-A Operational Safety Requirements: Interstation Transfer Bus (ISTB)	Yes
NA44-OSR-08131.02-00022	Pickering Nuclear 1-4 Operational Safety Requirements: Powerhouse Environmental Protection System	Yes
Pickering Units 5 - 8		
NK30-OPP-03600	Pickering NGS-B Operating Policies and Principles	Yes
NK30-OSR-08131.02-00001	Pickering B Operational Safety Requirements: Emergency Coolant Injection System	Yes
NK30-OSR-08131.02-00002	Pickering B Operational Safety Requirements: Fuel and Reactor Physics	Yes
NK30-OSR-08131.02-00003	Pickering B Operational Safety Requirements: Negative Pressure Containment	Yes
NK30-OSR-08131.02-00004	Pickering B Operational Safety Requirements: Shutdown Systems	Yes
NK30-OSR-08131.02-00005	Pickering B Operational Safety Requirements: Boiler Emergency Cooling System	Yes
NK30-OSR-08131.02-00006	Pickering B Operational Safety Requirements: Feedwater System	Yes
NK30-OSR-08131.02-00007	Pickering B Operational Safety Requirements: Emergency Water Supply System	Yes

NK30-OSR-08131.02-00008	Pickering B Operational Safety Requirements: Service Water Systems	Yes
NK30-OSR-08131.02-00009	Pickering B Operational Safety Requirements: Main Steam Supply System	Yes
NK30-OSR-08131.02-00010	Pickering B Operational Safety Requirements: Moderator System	Yes
NK30-OSR-08131.02-000011	Pickering B Operational Safety Requirements: Powerhouse Emergency Venting System	Yes
NK30-OSR-08131.02-00012	Pickering B Operational Safety Requirements: Shutdown Cooling System	Yes
NK30-OSR-08131.02-00013	Pickering B Operational Safety Requirements: Heat Transport System	Yes
NK30-OSR-08131.02-00014	Pickering B Operational Safety Requirements: Emergency Power Supply	Yes
NK30-OSR-08131.02-00015	Pickering B Operational Safety Requirements: Reactor Regulating System	Yes
NK30-OSR-08131.02-00017	Pickering B Operational Safety Requirements: Group 1 Electrical Power System	Yes
NK30-OSR-08131.02-00018	Pickering B Operational Safety Requirements: Fuel Handling & Irradiated Fuel Bays	Yes
NK30-OSR-08131.02-00019	Pickering NGS Operational Safety Requirements: HPECI Power Supplies	Yes
NK30-OSR-08131.02-00020	Pickering B Operational Safety Requirements: Annulus Gas System	Yes
NK30-OSR-08131.02-00021	Pickering B Operational Safety Requirements: Critical Safety Parameter monitoring Instrumentation	Yes
NK30-OSR-08131.02-00022	Pickering B Operational Safety Requirements: Shield Cooling System	Yes
(Severe) Accident Management and Recovery		
N-STD-OP-0017	Response to Transients	No
N-STD-MP-0019	Beyond Design Basis Accident Management	Yes

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
OPERATING PERFORMANCE				

CNSC	REGDOC-2.3.2	Accident Management: Severe Accident Management Programs for Nuclear Reactors	2013	2018-09-01
CSA	N290.15	Requirements for the safe operating envelope for nuclear power plants	2010 (reaffirmed 2015)	2013-09-01

Conduct of Licensed Activity

The conduct of licensed activity SpA includes the following review topics and requirements from CSA N286:

- Operations program;
- Plant status control (Clauses 7.9.3 and 7.9.3 (a-f)); and
- Infrequently performed operations (Clauses 7.9.8 and 7.9.8 (a-e).

Heavy Water Management

OPG manages heavy water for Pickering NGS in accordance with the N-PROG-AS-0008, Heavy Water Management. As well, the Pickering NGS licence was amended on September 29, 2016 to add a licensed activity to allow Pickering NGS to possess, transfer, manage and store heavy water from other nuclear facilities, such as Darlington NGS during its refurbishment and while Darlington Tritium Removal Facility operational improvements are underway. More information is available in CMD 16-H111, e-Doc 5001701.

Procedures

Plant operations shall be performed in accordance with procedures that contain information and direction for operating workers on understanding and performing their work. Use and adherence direction shall be provided to the operating workers.

Temporary procedures may be issued when existing permanent procedures do not apply to the work being planned. Temporary procedures shall be periodically reviewed for applicability and cancelled when no longer required.

OPG’s procedure development and use program shall ensure that procedures are current, periodically reviewed and updated, as required, and consistent across the site.

Outage Management Performance

The outage management performance SpA is not uniquely covered in the management system, CSA N286; however, many of the requirements of the management system, as well as other requirements in the licensing basis, are especially important during outages and should be considered together in determining the effectiveness of outage management performance. Consequently, the outage management performance SpA includes, as a minimum, the following review topics:

- Management system (LC 1.1);
- Regulatory undertakings (LC 3.3);

- Fitness for service (LC 6.1);
- Radiation protection (LC 7.1);
- Conventional health and safety (LC 8.1);
- Heat sinks;
- Reactivity management; and
- Guaranteed shutdown state (GSS).

The maintenance program, see SpA for Maintenance under LC 6.1, shall include provisions for the management of planned outages.

OPG is to make outage-related information (including Level 1 and Level 2 Outage Plans, detailing all major work on safety related structures, systems and components to be carried out during the planned outage) available to CNSC staff.

Regulatory Undertakings

Section 16 of Table A.1 of REGDOC- 3.1.1 (LC 3.3) requires the licensee to submit specific reports or notifications of regulatory undertakings, as follows:

- A notification of regulatory undertakings (NoRU) that identifies all regulatory undertakings to be completed during the outage within 60 days prior to the outage;
- A notification of any changes to the regulatory undertakings and commitments within 5 business days; and
- An outage completion assurance statement (OCAS) confirming that all regulatory undertakings were successfully completed during the outage within 30 days after the outage.

Heat Sinks

Heat sinks are combination of systems or portions of systems that contribute to conveying heat to the atmosphere or body of water. The goal of the heat sink systems is to provide heat removal from the heat source (reactor core, pump heat, etc).

The outage heat sink management defines the strategy to ensure the plant is safe throughout the outage duration when the normal heat sinks (those used at high power) may not be available.

Reactivity Management and Guaranteed Shutdown State (GSS)

The guaranteed shutdown state (GSS) is an application of physical barriers and procedural controls during an outage to guarantee that a shutdown reactor remains in sub-critical status.

In 2012, the Commission approved (e-Doc 3906406) the implementation of the Rod Based Guaranteed Shutdown State (RBGSS) for the Pickering NGS-B units, as described in CMD 12-H103 (e-Doc 3851015). RBGSS is established through the application of physical barriers and procedural controls guaranteeing that the shutoff rods, control rods and adjuster absorber rods remain in-core to ensure a sub-critical reactor status. In addition to the inserted rods, a concentration of at least 3.5 ppm of Gadolinium (Gd) nitrate is maintained in the moderator as a neutron “poison” providing additional defence-in-depth.

To ensure that at least 3.5 ppm of Gd is maintained at all times in the moderator, 4 ppm of Gd will be added prior to declaring the RBGSS in effect.

OPG has also requested the use of the Rod Based Guaranteed Shutdown State with a drained moderator (RBGSS-DM). OPG performed and submitted an analysis of the RBGSS-DM, indicating that computed sub-criticality margin with rods insertions is adequate to accommodate the estimated uncertainties in the analysis with a wide safety margin for transition from RBGSS to RBGSS-DM and back to RBGSS. During this transition there is no Gadolinium in the moderator. CNSC staff concluded that the RBGSS-DM analysis is bound by the RBGSS analysis. CNSC concurrence with this non-standard RBGSS is provided for the Pickering NGS-B units in e-Doc 4808561.

The licensee shall provide prior WN for changes to operations or procedures for the Rod Based Guaranteed Shutdown State in accordance with LG G.2.

Safe Operating Envelope (SOE)

Operating Policies and Principles (OP&Ps)

The operating policies and principles (OP&P):

- define the operating rules, within which the station will be operated, maintained and modified;
- specify the authorities of the station staff positions to make decisions within the defined boundaries; and
- identify and differentiate between actions where discretion may be applied and where jurisdictional authorization is required.

The operating policies and principles shall provide framework for the safe operation and shall, as a minimum, reflect the safety analyses that have been previously submitted to the Commission.

The licensee shall at all times maintain and operate the nuclear facility within the limits of the OP&Ps and SOE. If operation outside the operating boundaries as defined in the OP&Ps and SOE is discovered, the licensee shall take immediate action to return the facility within the boundaries of safety analyses in a safe manner.

Safe Operating Envelope (SOE)

The SOE is considered part of the licensing basis. The SOE is defined in CSA N290.15 as “the set of limits and conditions within which the nuclear generating station must be operated to ensure compliance with the safety analysis upon which reactor operation is licensed and which can be monitored by or on behalf of the operator and can be controlled by the operator.” The safe operating limits are derived from the safety analysis limits.

The SOE consists of a number of parameters:

- Safe operating limits;
- Conditions of operability;
- Actions and action times; and
- Surveillances.

Such parameters are currently documented in several types of station documents such as the Operating Policies and Principles (OP&P), Operational Safety Requirements (OSR), Instrument Uncertainty Calculations (IUC), the Abnormal Incidents Manual and surveillance documentation.

The limits and conditions defined in the OSRs, including any requirements for corrective or mitigating actions and action times, are specified in the applicable operations and maintenance tests, procedures and processes to ensure compliance with the SOE.

Power Limits

Power limit specifications set limits on parameters that affect reactor core, channel, and fuel bundle powers, to ensure compliance with limits imposed by the design and safety analyses. The magnitude of the initial reactor power, channel powers and bundle powers in the reactor prior to an accident are the fundamental parameters determining whether fuel or fuel channel failure will occur during anticipated transients and the postulated Design Basis Accidents (DBA).

The reactors shall only be operated in states considered in, or bounded by the safety analyses (refer to LC 4.1). The power limits are described below for Pickering NGS.

For Pickering NGS-A (Units 1 and 4):

- The total power generated in any one fuel bundle shall not exceed the Channel-Specific Bundle Power Limits outlined in Figure A.30.4 of the Pickering NGS-A Operating Policies and Principles.
- The total power generated in any fuel channel shall not exceed the Channel-Specific Channel Power Limits outlined in Figure A.30.3 of the Pickering NGS-A Operating Policies and Principles under steady-state operating conditions.
- The total thermal power from the reactor fuel shall not exceed **1744 megawatts** under steady-state operating conditions.

For Pickering NGS-B (Units 5-8):

- The total power generated in any one fuel bundle shall not exceed the Channel-Specific Bundle Power Limits outlined in Figure A.30.1 of the Pickering NGS-B Operating Policies and Principles.
- The total power generated in any fuel channel shall not exceed **6100 kilowatts** under steady-state operating conditions.
- The total thermal power from the reactor fuel shall not exceed **1744 megawatts** under steady-state operating conditions.

The reactor, channel and bundle power limits are considered safety and control measures, which form part of the licensing basis.

Other Limits

OPG is expected to provide program updates on the confirmatory activities related to the enhanced neutron overpower protection (E-NOP) methodology (OPG N-CORR-00531-19139, e-Doc 5516948).

The currently installed trip set points for neutron overpower protection (NOP) to account for heat transport system aging at Pickering NGS are valid as follows (OPG N-CORR-00531-19042, e-Doc 5466274):

- Pickering Units 1, 4 – February 17, 2019 or 6010 Effective Full Power Days; and
- Pickering Units 5-8 – August 29, 2019 or 10300 Effective Full Power Days.

Integrated Accident Management and Recovery (Severe Accident Management and Recovery and Accident Management and Recovery)

Accident management provisions shall ensure effective defences against radiological hazards resulting from DBAs and Beyond Design Basis Accidents (BDBAs). The fundamental premise underlying accident management is that the licensee must establish and maintain overlapping measures for accident prevention and, should an accident occur, is able to:

- Prevent the escalation of the accident;
- Mitigate the consequences of the accident; and
- Achieve a long-term safe stable state after the accident.

OPG has in place Abnormal Incident Manuals (AIMs) and Emergency Operating Procedures (EOPs) to ensure that the operation of the facility can be returned to a safe and controlled state should operation deviate from normal operation.

The licensee shall ensure all abnormal operational scenarios analyzed in the design basis are accounted for in the AIMs and EOPs. In addition, the licensee shall ensure clear instruction is provided directing operations in abnormal conditions to the appropriate set of procedures or guides.

In addition to the operational guidance for abnormal and DBA conditions, the licensee shall implement and maintain an accident management program to address residual risks posed by BDBA. The licensee shall also ensure clear instruction is provided directing operations to use an appropriate set of severe accident management guidelines (SAMGs), if a severe accident is detected.

In addition to SAMGs, OPG has a series of emergency operating procedures i.e. Emergency Mitigating Equipment Guidelines (EMEGs), which have been developed through the incorporation of lessons learned from world events. The SAMGs and EMEGs are licensing basis documents, which are not included in the table of “Licensee Documents that Require Notification of Change”. Any changes to the strategic direction or major revisions/updates to the SAMGs or EMEGs shall be subject to notification of change and shall be reviewed by CNSC staff to confirm they remain within the licensing basis.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
Procedures			
CNSC	G-278	Human Factors Verification and Validation Plans	2003
Outage Management Performance			
CSA	N290.11	Requirements for reactor heat removal capability during outage of nuclear power plants	2013
Integrated Accident Management and Recovery			
CNSC	REGDOC-2.3.2	Accident Management, Version 2	2015
CSA	N290.16	Requirements for Beyond Design Basis Accidents	2016

Procedures

G-278, *Human Factors Verification and Validation Plans*, describes the elements of effective human factors verification and validation planning, including a suggested format for documenting these elements. A verification and validation plan documents the set of activities within a specific project that will be carried out to demonstrate that the human factors considerations of the project conform to accepted human factors principles. This will ensure that the licensee enables personnel to perform their tasks safely and to meet operational goals.

Outage Management Performance

The outage program should have designated criteria that the licensee will follow to confirm that planned and discovery work has been satisfactorily completed during the planned outage, and that all safety-significant structures, systems and components (SSCs) are available to ensure the continued safe operation of the facility.

CNSC staff located at the site offices should be invited to the restart meetings in order to verify that all appropriate reviews for restart of the reactor have occurred.

Outage completion assurance statement should describe the status of all planned work, including activities that were identified in the notification of regulatory undertakings but not completed.

Integrated Accident Management and Recovery (Severe Accident Management and Recovery and Accident Management and Recovery)

Lessons learned from drills, exercises and OPEX, including insights from deterministic and probabilistic analyses, should be incorporated into severe accident analysis and SAMGs updates.

Licensees should take into consideration the 2015 version 2 of CNSC regulatory document REGDOC-2.3.2 on accident management with attention to the requirement to train personnel, test and verify SAMG strategies implementation on a periodic basis. This expectation could be aligned and integrated with the Emergency Preparedness and Fire Protection SCA for drills and exercises in accordance with the requirements of REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*. See LC 10.1 for more information.

In addition, the severe accident management and recovery should include the requirements from CSA N290-16, *Requirements for beyond design basis accidents*.

3.2 Approval to restart after a serious process failure

Licence Condition 3.2:

The licensee shall not restart a reactor after a serious process failure without the prior written approval of the Commission, or the prior written consent of a person authorized by the Commission.

Preamble:

A serious process failure is defined in REGDOC-3.1.1 as "*A failure of a process structure, system or component that leads to a systematic fuel failure or a significant release from the nuclear power plant, or that could lead to a systematic fuel failure or a significant release in the absence of action by any special safety system.*" Serious process failures are reportable in accordance with REGDOC-3.1.1, See LC 3.3.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
N-PROG-MP-0014	Reactor Safety Program	No
N-STD-OP-0017	Response to Transients	No

When an event is found to be a serious process failure or where the determination as to the cause and/or extent of condition has proved inconclusive (i.e. a serious process failure cannot be ruled out), a request for restart of the reactor shall be submitted in writing and approval to restart the reactor must be obtained from the CNSC.

If there is sufficient assurance that the cause of the serious process failure has been resolved and it is now safe to return the facility to service, a CNSC authorized person has the authority to give the consent to the licensee to proceed with the restart of the reactor. See the Introduction of the LCH for details on delegation of authority.

The written request for restart of the reactor shall include the following information:

- description of the event;
- causes of the event;
- consequences and safety significance of the event;
- recovery plan including corrective actions, and fitness for service assessment on the systems/components impacted from the failure if applicable, which shall be completed prior to reactor restart;

- a statement regarding plant readiness to resume safe operation, which shall include any conditions that the licensee proposes to impose upon reactor restart and/or subsequent reactor operation to ensure safe operation of the nuclear facility; and
- extent of completion of the conditions mentioned in the statement regarding plant readiness to resume safe operation.

Guidance:

In addition to the requirements listed above, the written request to restart a reactor after a serious process failure should also include the following information:

- a statement specifying that an assessment of the extent of condition which led or contributed to a serious process failure has been completed;
- documentation and communication to licensee staff addressing the root cause analysis, corrective actions and plant readiness to resume operation (including additional training, if necessary); and,
- applicable historical Operating Experience (OPEX) for review for comparable events (OPEX is further described in LC 1.1).

3.3 Reporting Requirements

Licence Condition 3.3:

The licensee shall notify and report in accordance with CNSC regulatory document REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants*.

Preamble:

CNSC regulatory document REGDOC-3.1.1 has comprehensive reporting requirements (scheduled and unscheduled) for operation of NPPs. It describes information that the CNSC needs to evaluate the performance of the facilities it regulates. This document is complementary to the reporting requirements in the *Nuclear Safety and Control Act* and the associated regulations, as well as to the additional reporting that may be required by specific projects and activities.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
N-PROC-RA-0005	Written Reporting to Regulatory Agencies	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	REGDOC-3.1.1	Reporting Requirements for Nuclear Power Plants, Version 2	2016	2016-01-01

Reporting and Trending

CNSC staff will evaluate whether the reporting requirements as specified by REGDOC-3.1.1 are met as part of the reporting and trending SpA; however, the most applicable SCA and SpA will be used to evaluate the information reported. In addition, information provided in accordance with REGDOC-3.1.1 will be evaluated under the Management System SCA (LC 1.1) and the SpA for performance assessment, improvement and management review, which includes assessment, self-assessment, independent assessment and problem identification and resolution. The following reports relate to the following sections of the LCH:

Quarterly Reports

- Safety Performance Indicators (applies to multiple SCAs/LCs);
- Nuclear Power Plant Pressure Boundaries (LC 5.2);
- Nuclear Power Plant Personnel (LC 2.4);

- Operational Security (LC 12.1);

Annual Reports

- Environmental Protection (LC 9.1);
- Research and Development (LC 4.1);
- Risk and Reliability (LC 7.1); and
- Fuel Monitoring and Inspection (LC 5.1).

Scheduled Specific Periodic Reports

- Updates to Facility Descriptions (LC G.3 and 5.1) and Final Safety Analysis Report (LC 4.1);
- Probabilistic Safety Assessment (LC 4.1);
- Site Environmental Risk Assessment (LC 9.1);
- Station Security Report (LC 12.1); and
- Proposed Decommissioning Plan (LC 11.2).

Event Reports and Notifications

- Preliminary Event Reports and Immediate Notifications (applies to multiple SCAs/LCs); and
- Detailed Event Reports (applies to multiple SCAs/LCs).

Events shall be assessed and reported per Event Notifications criteria as specified in Appendix A of REGDOC-3.1.1, and as clarified in CNSC document "*Interpretation of REGDOC-3.1.1 Reporting Requirements for Nuclear Power Plant*" Rev. 0, provided in CNSC letter e-Doc 4860156.

Specific reporting provisions for outages under Situation No. 16 (a. to c.) in Table A.1 in REGDOC-3.1.1 refer to notifications for regulatory undertakings (NoRU) regarding:

- regulatory undertakings that will be completed during outages;
- changes to regulatory undertakings; and
- outage completion assurance statements (OCAS) confirming all regulatory undertakings were completed during the outage.

Regulatory undertakings for outages are included in the SpA for outage management performance under LC 3.1.

When reporting per the requirements under Situation/Event No. 18 in Table A.1 in REGDOC-3.1.1, the licensee shall include any non-compliance of applicable law at the federal, provincial or municipal level that pertains to the activities licensed under this licence and that has consequences for the environment, health and safety of persons, national security and/or compliance with international obligations to which Canada has agreed. It is unnecessary to report trivial non-compliances.

Sealed source tracking reports shall be filed under Situation/Event No. 25 in Table A.1 in REGDOC-3.1.1 within 48 hours of receipt or import. See LC 15.5 for more information on activities dealing with Cobalt-60 sealed sources.

Guidance:

To ensure consistency of reporting across the fleet of Canadian NPPs, CNSC staff have prepared a document, which provides additional clarification, "*Interpretation of REGDOC-3.1.1 Reporting Requirements for Nuclear Power Plants"* Rev. 0 (e-Doc 4525925).

4 SCA – SAFETY ANALYSIS

4.1 Safety Analysis Program

Licence Condition 4.1:

The licensee shall implement and maintain a safety analysis program.

Preamble:

A deterministic safety analysis evaluates the NPP's responses to events by using appropriate rules, models and assumptions. Deterministic safety analysis allows predicting extent of potential loads, such as temperatures and pressures, on reactor system and structures in assumed accident scenarios. REGDOC-2.4.1 sets out the objectives and requirements for deterministic safety analysis.

Probabilistic safety assessment (PSA) is a comprehensive and integrated assessment of the safety of the nuclear power plant that, by considering the initial plant state and the probability, progression, and consequences of equipment failures and operator response, derives numerical estimates of a consistent measure of the safety of the plant. Such assessments are most useful in assessing the relative level of safety. The objectives of the probabilistic safety analysis are stated in REGDOC-2.4.2.

The safety analysis SCA includes the following SpAs:

- Deterministic safety analysis;
- Hazard analysis;
- Probabilistic safety analysis (PSA);
- Criticality safety;
- Severe accident analysis; and
- Management of safety issues (including R&D).

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Deterministic Safety Analysis		
N-PROG-MP-0014	Reactor Safety Program	No
N-PROC-MP-0086	Safety Analysis Basis and Safety Report	No
N-PROG-MP-0006	Software	No

N-PROC-MP-0096	Use of Scientific, Engineering and Safety Analysis Software	No
Probabilistic Safety Analysis		
N-PROG-RA-0016	Risk and Reliability Program	No
N-STD-RA-0034	Preparation, Maintenance and Application of Probabilistic Risk Assessment	No
Severe Accident Analysis		
N-STD-MP-0019	Beyond Design Basis Accident Management	Yes
N-REP-03491-0650826	Updated Emergency Planning Technical Basis for Provincial Nuclear Emergency Response Plan	Yes
Management of Safety Issues (including R&D programs)		
N-STD-MP-0023	Technology and Research	No
N-PROC-MP-0092	Technology and Research Program Management	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	REGDOC-2.4.1	Deterministic Safety Analysis	2014	2015-12-18
CNSC	S-294	Probabilistic Safety Assessment (PSA) for Nuclear Power Plants	2005	2013-09-01
CNSC	REGDOC-2.4.2	Probabilistic Safety Assessment (PSA) for Nuclear Power Plants	2014	2020-12-31
CSA	N286.7	Quality assurance of analytical, scientific and design computer programs for nuclear power plants	2016	2018-09-01
AECB	1059	Reactor Licensing and Safety Requirements, Hurst and Boyd	1972	N/A

Deterministic Safety Analysis

The licensee shall conduct and maintain a deterministic safety analysis in accordance with applicable requirements and reflecting the actual plant design and conditions. The deterministic safety analysis must demonstrate that the radiological consequences of the postulated initiating events involving a single process failure and events involving a single process failure in conjunction with failure of one of the special safety systems do not exceed the accident-dependent reference public dose limits specified in Appendix A to AECB 1059 *Reactor Licensing and Safety Requirements*, Hurst and Boyd, 1972, otherwise known as the siting guide, and reproduced in the table, below.

	Individual Dose Limit		Population Dose Limit	
	Thyroid Dose (mSv)	Whole Body Dose (mSv)	Thyroid Dose (Person mSv)	Whole Body Dose (Person mSv)
Single Failure	30	5	10^5	10^5
Dual Failure	2500	250	10^7	10^7

Implementation Strategy for REGDOC-2.4.1

OPG has developed a REGDOC-2.4.1 implementation plan (e-Doc 5408759), which defines the REGDOC-2.4.1 compliant analyses to be undertaken in the 2018-2021 timeframe. For Pickering, the analysis scope includes revision of the Pickering Safety Report analyses for the large break LOCA (LBLOCA) events and loss of reactor power regulation (LORPR) events.

For Pickering, analysis for common mode events (CME) was completed; lacking CME analysis represented the single largest gap against REGDOC-2.4.1. A new section documenting the CME analysis is expected to be added into the Pickering NGS-A and Pickering NGS-B Safety Reports to demonstrate the plant design robustness to cope with CME.

The existing OPG Safety Report Update process *N-PROC-MP-0086* shall be followed to comply with the regulatory requirement of updating Safety Reports. If significant design or operational changes are to be made to the plant, the licensee shall update the deterministic safety analysis, while following requirements of REGDOC-2.4.1.

Hazard Analysis

A hazards analysis is used to demonstrate the ability of the design to effectively respond to common-cause events by confirming that the NPP design incorporates sufficient diversity and physical separation to cope with these events. It also confirms that credited SSCs are qualified to survive and can function as required during the event.

For Pickering NGS, hazard analysis is conducted as an initial step to probabilistic safety assessments. This involves the assessment and screening of various types of hazards: internal and external hazards, naturally occurring and human-induced. Based on the hazard screening process, PSAs are developed for internal events, internal floods, internal fires, seismic events, and high winds.

Probabilistic Safety Analysis (PSA)

The licensee is in compliance with S-294 and expected to transition to REGDOC-2.4.2 by December 31, 2020. The planned PSA updates and the implementation strategy for REGDOC-2.4.2 are described in the table, below.

Scope	Requirements	Scheduled PSA Update
Pickering NGS-B PSA Update including detailed risk re-quantification	S-294	End of 2017 - Completed
Pickering NGS-A PSA Update including detailed risk re-quantification	S-294	End of 2018
Pickering NGS-A and -B Update (solely focusing on additional updated requirements of	REGDOC-2.4.2	End of 2020

REGDOC-2.4.2 going beyond S-294 requirements, including for example, irradiated fuel bay risk assessment and other risk contributors of less significance)		
Pickering NGS-B PSA Update	REGDOC-2.4.2	End of 2022
Pickering NGS-A PSA Update	REGDOC-2.4.2	End of 2023

The licensee shall update the PSA if there are significant design or operational changes to the plant.

Criticality Safety

Criticality safety focuses on the prevention of the criticality of fuel outside of the core, for either new or irradiated fuel.

The Pickering NGS reactors use natural uranium fuel which cannot achieve a criticality in air or in light water. New fuel is stored in such a manner that it cannot be made critical.

Irradiated natural uranium fuel is stored under light water and cannot be made critical in any configuration; therefore no criticality risk exists in the irradiated fuel bays of Pickering NGS.

Severe Accident Analysis

Severe accidents represent the set of accidents under beyond design basis accidents that involve significant fuel degradation, either in-core or in fuel storage. Severe accident analysis is performed to identify and characterize these types of accidents to ensure the design is balanced such that no particular design feature or event makes a dominant contribution to the frequency of severe accidents. The analysis can identify challenges to the plant presented by such events and identify equipment that can be included in the severe accident management guidelines.

REGDOC-2.4.1 requires performance of deterministic analysis of beyond design basis accidents (BDBA) to support the evaluation of safety goals (Level 1 and Level 2 PSA) and to demonstrate that the procedures/guidelines and equipment put in place to mitigate consequences of severe accidents can handle the severe accident management needs.

This type of analysis also demonstrates that the existing design, including the post-Fukushima enhancements, is effective to cope with BDBA, including severe accidents with core degradation and melt.

The following can be considered as analysis of BDBA:

- Analysis of low-probability (<10-5) duel-failure events included in the current Safety Reports;
- Recent assessments that consider the conditions beyond the plant original design basis (e.g., sensitivity cases recently performed for low-probability CME);
- MAAP-CANDU severe accident analyses as part of Level 1 and Level 2 PSA;
- MAAP-CANDU severe accident analyses to support the severe accident management technical basis; and
- BDBA/severe accident assessments (e.g., for in-vessel retention, hydrogen control and mitigation, containment performance, etc.) to address post-Fukushima questions and demonstrate the

effectiveness of the design complementary features, including post-Fukushima enhancements for severe accident prevention, mitigation, and management.

Management of Safety Issues (including R&D Programs)

The management of safety issues SpA includes the following review topics:

- Research and Development (Clause 7.11.3 of CSA N286); and
- CANDU Safety Issues.

A Research and Development report is submitted annually in accordance with REGDOC-3.1.1 (see LC 3.3).

OPG is expected to continue R&D activities related to the performance of Passive Autocatalytic Recombiners (PARs) in H_2 and D_2 environments, steel oxidation and hydrogen/deuterium production, MAAP-CANDU modeling improvements, in-vessel retention, hydrogen source term estimation, and long-term monitoring capability for SAM. Completion of these R&D activities will strengthen capability of the nuclear power plant to withstand severe accident conditions.

CNSC staff will track progress on the ongoing R&D topics through either site specific action items or annual reporting under REGDOC-3.1.1.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
Deterministic Safety Analysis			
COG	09-9030	Principles & Guidelines For Deterministic Safety Analysis	R03
COG	11-9023	Guidelines for Application of the LOE/ROE Methodology to Deterministic Safety Analysis	R01
COG	06-9012	Guidelines for Application of the Best Estimate Analysis and Uncertainty (BEAU) Methodology to Licensing Analysis	R01
COG	08-2078	Principles and Guidelines for NOP/ROP Trip Setpoint Analysis for CANDU Reactors	R00
Probabilistic Safety Analysis			
CSA	N290.17	Probabilistic Safety Assessment for Nuclear Power Plants	2017
ASME	ASME/ANS RA-Sa-2013	Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications, Addenda ASME/ANS RA-Sb-2013	2013

IAEA	SSG-3	Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants	2010
IAEA	SSG-4	Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants	2010
Criticality Safety			
CNSC	RD-327	Nuclear Criticality Safety	2010
CNSC	GD-327	Guidance for Nuclear Criticality Safety	2010

Deterministic Safety Analysis

The licensee should use the detailed methodologies and derived acceptance criteria for the conduct of deterministic safety analysis described in the COG documents included as guidance publications.

Updates to deterministic safety analysis should contain a revision summary sheet highlighting the key differences between the existing analyses and updated analysis. The revision summary should include:

- Summary of changes (key differences):
  - In acceptance criteria;
  - In event characterization;
  - In safety analysis assumptions;
  - In methodology, or in elements of a methodology;
  - In plant models;
  - In use of computer codes and embedded models;
  - In trip coverage.
- Reasons for updating the analysis and for updating models, assumptions, initial conditions or boundary conditions;
- Significance of changes, and their justification;
- Significant changes in results that may affect the conclusions of the analysis for the design; operational or emergency safety requirements for a particular situation or event; and
- Impact on operating and safety margins.

The licensee should maintain a Safety Report Basis consisting of Analysis of Record Items and supporting documents. The licensee should continue to provide CNSC staff with regular updates of the Analysis of Record indicating the submissions to be included in the next Safety Report update (Part 3).

When the deterministic safety analysis methodology is modified as a result of improved knowledge, or to address emerging issues, the licensee should assess the impact of such a modification on the operating limits, as well as procedural and administrative rules.

The licensee should not credit results obtained with a modified safety analysis methodology to relax operating conditions and/or change safety margins until the modification of the methodology has been reviewed by CNSC staff. If CNSC staff indicates that the modified methodology is appropriate, the licensee must still fulfill any other requirements or criteria associated with the changes to the operating conditions or safety margins. General criteria that CNSC will consider when reviewing such methodologies are provided in LC G.2.

In addition to industry standards, CNSC staff will refer to the applicable industry verification and validation process practices related to computer codes and software used to support the safe plant operation.

Probabilistic Safety Assessment

Periodic updates of the PSA should follow the guidance given in CSA N290.17, *Probabilistic Safety Assessment for Nuclear Power Plants*.

Severe Accident Analysis

Documentation of severe accident (also referred to as beyond design basis accident) analyses and assessments is currently not consolidated and centralized. REGDOC-2.4.1 section 4.5 provides the requirements for safety analysis documentation; however, the licensee should consider consolidating the existing and new analyses to improve the integration, maintenance, control and further updates to facilitate the regulatory review and verification.

5 SCA – PHYSICAL DESIGN

The physical design SCA includes the following SpAs:

- Design governance (LC 5.1);
- Site characterization (LC G.3, 4.1, 5.1);
- Facility design (LC G.3 and 5.1);
- Structure design (LC 5.1);
- System design (LC 5.1, 5.2, 5.3 10.2); and
- Component design (addressed under System design).

5.1 Design Program

Licence Condition 5.1:

The licensee shall implement and maintain a design program.

Preamble:

A design program ensures that the plant design is managed using a well-defined systematic approach. Implementing and maintaining a design program confirms that safety-related SSCs and any modifications to them continue to meet their design bases given new information arising over time and taking changes in the external environment into account. It also confirms that SSCs continue to be able to perform their safety functions under all plant states. An important cross-cutting element of a design program is design basis management.

A design program should be composed of elements that consider topics including but not limited to: pressure boundary design, civil structure design, seismic design, mechanical design, fuel design, core nuclear design, core thermal-hydraulic design, safety system design, fire protection design, electrical power system design, instrumentation and control system design, as well as equipment and structure qualification .

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Design Governance		
N-STD-MP-0028	Conduct of Engineering	No
N-PROG-MP-0009	Design Management	No

N-PROG-MP-0006	Software	No
N-LIST-00590-00001	List of Significant Technical Changes from Code-Over-Code Review	Yes
Site Characterization		
P-REP-07701-00002	Predictive Effects Assessment For Pickering Nuclear Safe Storage	No
W-PROC-WM-0093	Planning for Decommissioning	No
System Design		
N-PROG-MA-0016	Fuel	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
Design Governance				
CSA	N286.7	Quality assurance of analytical, scientific and design computer programs for nuclear power plants	2016	2018-09-01
CSA	N290.12	Human factors in design for nuclear power plants	2014	2018-09-01
Structure Design				
CSA	N291	Requirements for safety-related structures for CANDU nuclear power plants	2008	2018-09-01*

** See Structure Design section below for more information.*

Design Governance

The design governance SpA includes the following review topics and requirements from CSA N286:

- Design Program:
  - Design process (Clauses 7.3, 7.3.1);
  - Design inputs (Clauses 7.3.2, 7.3.2 (a) to (t));
  - Design requirements (Clause 7.3.3);
  - Tools (Clause 7.3.4 as well as CSA N286.7);
  - Design (Clause 7.3.5);
  - Documents (Clause 7.3.6, 7.3.6 (a) to (g)); and
- Human factors in design (Clause 7.3.2 (k), as well as CSA N290.12).

The design of the existing nuclear facility including safety-related SSCs and any modification shall comply with applicable codes, standards and regulations including adequate consideration of human factors principles and practices in order to minimize the potential for human error and promote safe and reliable system performance through the consideration of human factors in the design of facilities, systems, and equipment.

The design basis for reliability targets shall meet the requirements in RD/GD-98 (LC 6.1).

OPG shall continue providing the CNSC with the code-over-code reviews conducted for any subsequent editions, addendums and/or updates of the codes and standards that were agreed upon, with OPG's assessment of the changes and their significance upon completion of the review and assessment of significance. OPG is required to submit such assessments on an annual basis. N-LIST-00590-00001, *List of Significant Technical Changes from Code-Over-Code Review*, identifies which requirements shall apply to design modifications.

The licensee shall ensure that plant design and changes to plant design are accurately reflected in the safety analysis. Furthermore, the licensee shall ensure that plant status changes (design modifications) are controlled such that the plant is maintained and modified within the limits prescribed by the design and licensing basis.

Aspects of design are considered safety and control measures if changes to them would:

- Invalidate the limits documented in the operating policies and principles or safe operating envelope referred to in LC 3.1,
- Introduce hazards different in nature or greater in probability or consequence than those considered by the safety analyses and probabilistic safety assessment and/or,
- Adversely impact other important safety and control measures, such as those related to operations, radiation protection, emergency preparedness, etc.

The licensee shall ensure that any changes to those aspects remain within the limits established by the licensing basis. Changes affecting the licensing basis (including those that would invalidate limits or introduce different hazards) require prior written approval by the Commission.The design program should minimize the potential for human error and promote safe and reliable system performance through the consideration of human factors in the design of facilities, systems, and equipment.

For proposed modifications, modern requirements that are consistent with the current licensing basis of the plant shall be applied to the extent practicable.

Site Characterization

The site characterization SpA includes the following review topics and requirements from CSA N286:

- Site selection (Clauses 7.2, 7.2 (a) to (f)) also see SpA for Hazard Analysis (LC 4.1);
- Relevant:
    - environmental assessments, environmental impact statements, geological, geotechnical, seismological, hydrological, hydrogeological and meteorological data;
    - site plan and description, and site reference data (LC G.3);
    - exclusion zone authority and control (LC G.3); and

- proximity of industrial, transport and military facilities (LC G.3).

Facility Design

The facility design SpA includes the following review topics:

- Facility design includes, but is not limited to the following:
- Layout of the facility (LC G.3); and
- Site plan and description (LC G.3).

The licensee document that contains the facility description and the final safety analysis report is cited under LCs G.3 and 4.1, respectively.

Structure Design

The structure design SpA includes the following review topics:

- Structure design and modification (including repairs), which includes but is not limited to the following:
  - Concrete containment structures; and
  - Safety-related structures (CSA N291).

OPG shall comply with CSA N291-08 with the understanding that OPG meets the intent of CSA N291-08 Clause 4.3(d) through the actions completed and to be completed in the Integrated Implementation Plan (IIP) under LC 15.1. In that regards, OPG has completed an inspection of non-containment safety-related civil structure and is expected to develop a risk-based approach for aging management of non-containment safety-related civil structures, and incorporate that approach into OPG governance by September 30, 2018. See OPG's letter dated April 18, 2018 (P-CORR-00531-05360) under e-Doc 5514173 for more information.

System Design

The system design SpA includes the following review topics:

- System design, which includes but is not limited to the following systems or specialized areas:
  - Pressure boundary program CSA N285.0 (LC 5.2);
  - Safety systems
  - Shutdown systems
  - Emergency core cooling systems
  - Containment system
  - Reactor control systems Electrical power and instrument air systems
  - Monitoring and display of nuclear power plant safety functions in the event of an accident
  - Fuel bundles and fuel assemblies;
  - Seismic design and qualification (CSA N289.1 – N289.5) (LC 5.3);

- Environmental qualification of equipment (CSA N286 Clause 7.3.2 (e), CSA N290.13) (LC 5.3); and
- Fire protection systems (CSA N293) (LC 10.2).

Special Safety Systems (SSS)

Modification of the special safety systems (Shutdown System 1, Shutdown System 2, Emergency Core Cooling System and Containment System) or significant changes to systems connected to the special safety systems would require prior notification and engagement of CNSC. When reviewing such changes, CNSC staff will use the criteria in Appendix A of e-Doc 4055483 and any other applicable criteria. Changes of the licensing basis in a potentially unsafe direction would require prior written notification. Prior notification is not required for changes to items that serve the same functional characteristics of the originally designed item and does not result in a change to operating procedures or safety system testing.

All changes or modifications, temporary or permanent, to the special safety systems (SSS) and systems related to safety (SRS) shall be identified in the annual reliability report. See LC 3.3 for details on reporting in accordance with REGDOC-3.1.1.

Electrical Power Systems and Instrumentation and Control (I&C) Systems

The plant electrical power system design shall include the safety classifications of the systems. Its design shall be adequate for all modes of operation under steady-state, voltage and frequency excursion, and transient conditions, as confirmed by electrical analysis. The electrical power systems shall be monitored and tested to demonstrate they comply with the design requirements and to verify the operability for AC systems and DC systems.

The licensee shall ensure that the plant overall instrumentation and control (I&C) system and electrical power systems is designed to satisfy the following:

- Plant level system classification;
- Separation requirements between the groups and channels;
- Safety features for enhancing system reliability and integrity are identified and implemented in the design, for example, fail safe design, redundancy, independence and testing capability;
- System is not vulnerable to common cause failures; and
- I&C and electrical power systems of safety systems meet the requirements of single failure criteria.

The licensee shall demonstrate survivability of the I&C systems and components that are critical to the management of BDBAs, and the availability of power supply to equipment and associated I&C necessary for management of BDBAs.

Fuel Bundles

Fuel bundles are important examples of designs that are considered safety and control measures. When considering possible design changes to fuel bundles the licensee shall engage CNSC staff reasonably in advance to confirm that the changes are within the licensing basis before implementing the change. Prior to making use of a new fuel bundle design in the reactor, design verification activities, analyses and testing are to be performed to demonstrate that design requirements are met. The length and complexities of those activities depend on the novelty of the design.

The annual report on fuel monitoring and inspection is submitted in accordance with REGDOC-3.1.1 (See LC 3.3). The details of this report are relevant to this SpA whereas the compliance with REGDOC-3.1.1 is considered to be part of the reporting and trending SpA (LC 3.3).

Reactor Core Design

The licensee shall update and maintain the reactor core nuclear design information found in the SOE documentation (LC 3.1), safety report (LC 4.1) and supporting design manuals. Core surveillance activities shall be implemented to ensure compliance with reactor core nuclear design and operation within the design envelope. Significant changes to core nuclear design would require prior notification and engagement of the CNSC. When reviewing such changes, CNSC staff will use the criteria in Appendix A of e-Doc 4055483 and any other applicable criteria.

Component design

Compliance verification criteria set out for system design also apply to component design.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
Design Governance			
CNSC	REGDOC-1.1.3	Licence Application Guide: Licence to Operate a Nuclear Power Plant	2017
CNSC	REGDOC-2.5.2	Design of Reactor Facilities: Nuclear Power Plants	2014
CSA	N291	Requirements for safety-related structures for CANDU nuclear power plants	2015
CNSC	G-276	Human Factors Engineering Program Plans	2003
CNSC	G-278	Human Factors Verification and Validation Plans	2003
System Design			
CSA	N290.0	General Requirements for Safety Systems of Nuclear Power Plants	2011
CSA	N290.1	Requirements for the shutdown systems of nuclear power plants	2013

CSA	N290.2	Requirements for emergency core cooling systems for nuclear plants	2011
CSA	N290.3	Requirements for the containment system of nuclear power plants	2016
CSA	N290.4	Requirements for reactor control systems of nuclear power plants	2011
CSA	N290.5	Requirements for electrical power and instrument air systems of CANDU nuclear power plants	2006
CSA	N290.6	Requirements for monitoring and display of nuclear power plant safety functions in the event of an accident	2009
CSA	N290.14	Qualification of Digital Hardware and Software for Use in Instrumentation and Control Applications for Nuclear Power Plants	2015

Design Governance

The design program should include, but is not limited to the following:

- Safety objectives, which include general nuclear safety objectives, radiation protection objectives, technical safety objectives and environmental protection objectives;
- Safety goals, which include qualitative and quantitative safety goals, core damage frequency, and small and large release frequencies;
- The identification of the design authority for the overall design (see also SpA for Organization under LC 1.1.). The design authority should have the authority to review, verify, approve (or reject), document the design changes and maintain design configuration control;
- The design approach for defence-in-depth including the approach adopted to include multiple and (to the extent practicable) independent levels and barriers for defence for all operational states including accidents;
- A systematic process throughout the design phase to show that the design meets all relevant safety requirements, and that the plant design process has followed proven engineering practices;
- Fundamental safety functions incorporated into the design including SSCs used to perform necessary safety functions; and
- Considerations for robustness against malevolent acts.

5.2 Pressure Boundary Program

Licence Condition 5.2:

The licensee shall implement and maintain a pressure boundary program and have in place a formal agreement with an Authorized Inspection Agency.

Preamble:

Pressure boundary is defined as a boundary of any pressure-retaining vessel, system or component of a nuclear or non-nuclear system, where the vessel, system or component is registered or eligible for registration.

A pressure boundary program is comprised of the many programs, processes and procedures and associated controls that are required to ensure compliance with all the requirements of CSA N285.0.

This LC also ensures that the Authorized Inspection Agency (AIA) will be subcontracted directly by the licensee. An AIA is an organization recognized by the CNSC as authorized to register designs and procedures, perform inspections, and other functions and activities as defined by the CSA N285.0 and its applicable referenced publications (e.g. CSA B51, ASME Boiler & Pressure Vessel Code, National Board Inspection Code). The AIA is accredited by the American Society of Mechanical Engineers (ASME) as stipulated by NCA-5121 of the ASME Boiler & Pressure Vessel Code. In order for the licensee to fulfill its obligations under this licence condition, it must obtain the services of an AIA to perform activities as defined by the relevant standards.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
System Design		
N-PROG-MP-0004	Pressure Boundary	Yes
N-PROC-MP-0040	System and Item Classification	Yes
N-PROC-MP-0082	Design Registration	Yes
N-MAN-01913.11-10000	Pressure Boundary Program Manual	No
N/A	Authorized Inspection Agency Service Agreement	Yes
N-LIST-00531-10003	Index to OPG Pressure Boundary Program Elements	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
System Design				
CSA	N285.0/N285.6	General requirements for pressure-retaining systems and components in CANDU nuclear power plants/Materials Standards for reactor components for CANDU nuclear power plants, issued June 2008 - Annex K and Annex M are accepted to be used as "Normative" Annexes.	2008 and Update No. 2* (August 2010)	2013-10-30
CSA	N285.0/N285.6	General requirements for pressure-retaining systems and components in CANDU nuclear power plants/ Materials Standards for reactor components for CANDU nuclear power plants, issued August 2012 – Annex N (only)	2012 and Update No. 1 (Sept. 2013)	2018-09-01
CSA	B51	Boiler, pressure vessel, and pressure piping code	2009 and Update No. 1 (March 2009)	2013-10-30
ASME	BPVC	ASME Boiler and Pressure Vessel Code with Addenda	2010 Edition with 2011 Addendum	2013-10-30
ASME	B31.1	Power Piping	2010	2013-10-30
ASME	B31.3	Process Piping	2010	2013-10-30
ASME	B31.5	Refrigeration Piping and Heat Transfer Components	2010	2013-10-30

CSA N285.0 includes references to other applicable codes and standards. Any additional CSA or ASME code references are included in the list only if they are not the version referred to in CSA N285.0-08.

Compliance Verification Criteria:

The pressure boundary program is a one of several review topics for the system design SpA, as discussed under LC 5.1. The licensee is responsible for all aspects of pressure boundary registration and inspections.

The following transitional provisions apply to CSA N285.0-08 with Update No. 2:

a) Work packages compliant with CSA N285.0-08 and Update No.1, being produced or underway prior to October 30, 2013 will remain valid for implementation until June 30, 2019.

b) Design modifications classified (approved by CNSC or using the OPG Classification procedure) after January 1, 2011 and before October 30, 2013, but no later than June 30,

PHYSICAL DESIGN

2019, will be designed and installed to the CSA N285.0 and ASME edition or version specified in the System Classification List.

c) Purchase Orders compliant with CSA N285.0-08 and Update No. 1 issued prior to October 30, 2013 will remain valid for installation.

d) The code effective dates do not apply to "non design-related" requirements under the codes and standards listed above. CNSC may require OPG's programs or processes to be updated for "non design-related" requirements to meet the new version of the standards once it is published.

The licensee shall maintain a pressure boundary program document roadmap in compliance with Annex N of CSA N285.0-12 and Update No. 1.

OPG is to provide the CNSC with the code-over-code reviews (See LC 5.1 for more information).

The licensee shall operate vessels, boilers, systems, piping, fittings, parts, components, and supports safely and maintain them in a safe condition. OPG shall:

- Follow work plans and procedures, accepted by the AIA, to test, maintain, or alter over-pressure protection devices;
- Comply with operating limits specified in certificates, orders, designs, overpressure protection reports, and applicable codes and standards; and
- Have any certified boiler or vessel that is in operation or use inspected and certified by an authorized inspector according to an accepted schedule.

Personnel conducting non-destructive examinations shall be certified in accordance with the edition of CAN/CGSB 48.9712/ISO 9712 currently adopted for use by the National Certification Body (NCB) of Natural Resources Canada for the appropriate examination method. If the NCB does not offer certification for a specific inspection method, the relevant alternate requirements of Clause 11.3 of CSA N285.0 shall apply to ensure that personnel are appropriately trained and qualified.

Classification, Registration and Reconciliation Procedures

Licensee procedures describing the classification, registration and reconciliation processes and the associated controls shall form part of the pressure boundary program. The licensee shall provide prior notification of any changes to the procedures describing the classification, registration and reconciliation processes.

Overpressure Protection Reports

The licensee shall provide WN to CNSC staff, of new or revised overpressure protection reports, after the final registration of the system.

Quality Assurance Program

The licensee's pressure boundary quality assurance program shall comply with clause 10 of CSA N285.0 with the exception of sub-clause 10.2.6. Repair and replacement activities shall comply with sub clause 10.3 of CSA N285.0.

Classification and Registration of Fire Protection Systems

Fire protection systems and associated fittings and components are to be classified at least as Code Class 6, designed to the ASME B31.1 and registered, unless the exemption criteria noted below are met.

The following fittings and components may be exempt from requiring a Canadian Registration Number (CRN) provided they meet the following exemption criteria:

a) deluge, fire hose control, pressure control, drain, pre-action, alarm and dry pipe valves and devices, provided they are cUL or ULC (Underwriters Laboratory of Canada) listed and suitable for the expected environmental conditions and maximum pressure; or
b) fire and jockey pumps and their controllers that meet the requirements of the National Fire Protection Association (NFPA)-20, are cUL or ULC listed and are suitable for the expected environmental conditions and maximum pressure; or
c) sprinkler, nozzles, inductors, proportioners, hoses, strainers and other spray and distribution devices, that are cUL or ULC listed and suitable for the expected environmental conditions and maximum pressure; or
d) pressurized cylinders and tubes, such as extinguishers, inert gas and foam tanks, that bear Transport Canada approvals and suitable for the expected environmental conditions and maximum pressures; or
e) buried fire protection piping that is in compliance with NFPA-24.

Buried fire protection piping designed to the ASME piping code may be exempt from the ASME pressure testing requirements if the pressure testing is performed to NFPA-24.

The requirements of CSA N285.0 apply for components higher than Code Class 6.

Formal Agreement with an Authorized Inspection Agency (AIA)

The licensee shall always have in place a formal agreement with an AIA to provide services for the pressure boundaries of the nuclear facility as defined by CSA N285.0 and its applicable referenced publications. The AIA must be accredited by the ASME as stipulated by NCA-5121 of the ASME Boiler and Pressure Vessel Code.

Design registration services for pressure boundaries shall be provided by an AIA legally entitled under the Provincial Boilers and Pressure Vessels Acts and Regulations to register designs. Registration of piping systems shall be done by the Technical Standards and Safety Authority (TSSA), who is legally entitled to register designs in Ontario.

A copy of the signed agreement shall be provided to the CNSC. During the licence period, the licensee shall notify the CNSC in writing of any change to the terms and conditions of the agreement, including termination of the agreement.

The licensee shall arrange for the AIA inspectors to have access to all areas of the facility and records, and to the facilities and records of the licensee's pressure boundary contractors and material organizations, as necessary for the purposes of performing inspections and other activities required by the standards. Inspectors of the AIA shall be provided with information, reasonably in advance with notice and time necessary to plan and perform inspections and other activities required by the standards.

For a variance or deviation from the requirements of the CSA N285.0 standard, except as noted below, the licensee must first submit the proposed resolution to the AIA for evaluation, and then to the CNSC for consent. The licensee must demonstrate that meeting the code requirement is impracticable and the proposed resolution will provide adequate safety. Per the agreement with the AIA, the evaluated resolution shall not be implemented without the prior written consent of CNSC staff. A variance or deviation related to Code Edition, Code Classification, and Legacy Registration issues may be submitted directly to the CNSC without prior AIA evaluation. General criteria for obtaining prior written consent/approval for a proposed resolution from the CNSC can be found in LC G.2.

Guidance:

There is none provided.

5.3 Equipment and Structure Qualification Program

Licence Condition 5.3:

The licensee shall implement and maintain an equipment and structure qualification program.

Preamble:

Environmental qualification (EQ) ensures that all required equipment in a nuclear facility are qualified to perform their safety functions if exposed to harsh environmental conditions resulting from Design Basis Accidents (DBA) and that this capability is preserved for the life of the plant.

Seismic qualification (SQ) ensures that all seismically credited safety-related SSCs in a NPP are designed, installed and maintained to perform their safety function during and/or after (as needed and pre-defined) earthquakes.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
N-PROG-RA-0006	Environmental Qualification	No
N-STD-MP-0016	General Requirements for Seismic Qualification of OPG Nuclear Facilities	No
N-PROC-RA-0051	Environmental Qualification Lists	No
N-PROC-RA-0044	Environmental Qualification Assessment	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
Component Design				
CSA	N289.1	General requirements for seismic design and qualification of CANDU nuclear power plants	2008	2018-09-01
CSA	N290.13	Environmental qualification of equipment for CANDU nuclear power plants	2005 & Update 1 (2009), Re-affirmed in 2015	2013-09-01

Environmental Qualification:

In addition to the criteria set out in N290.13, the EQ program shall include monitoring consisting of condition monitoring and environmental monitoring, to measure degradation and failures of qualified equipment, including cables. Condition monitoring assesses variables that indicate the physical state of the equipment, and assesses its ability to perform its intended function following the period of observation. Environmental monitoring measures environmental stressors, such as temperature, radiation and operational cycling during normal operating conditions.

Seismic Qualification:

Seismically credited safety-related SSCs in a nuclear facility shall be designed, installed and maintained to perform their safety function against earthquakes. Any changes to seismic qualification that impact the licensing basis would require prior notification of the CNSC.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CSA	N289.2	Ground motion determination for seismic qualification of nuclear power plants	2010
CSA	N289.3	Design procedures for seismic qualification of nuclear power plants	2010
CSA	N289.4	Testing procedures for seismic qualification of nuclear power plant structures, systems, and components	2012
CSA	N289.5	Seismic instrumentation requirements for nuclear power plants and nuclear facilities	2012

The processes and procedures related to the SQ program should:

- Identify the methods for establishing SQ, including code effective dates;
- Identify the SSCs for which evaluation of their capacity beyond the Design Basis Earthquake has been done;
- Identify the methods used for Beyond Design Basis Earthquake evaluation;
- Include procedural controls to address aging-related degradation (aging management) to ensure SQ of existing SSCs for the life of the plant (See also LC 6.1 and the requirements for REGDOC-2.6.3, *Aging Management*);
- Identify the seismic monitoring system and its design and maintenance requirements; and
- Include procedural controls for establishing SQ for new and replacement items.

6 SCA – FITNESS FOR SERVICE

6.1 Fitness for Service Program

Licence Condition 6.1:

The licensee shall implement and maintain a fitness for service program.

Preamble:

The fitness for service SCA includes the following SpAs:

- Equipment fitness for service/equipment performance (Reliability);
- Maintenance;
- Structural integrity (Addressed in other SpAs);
- Aging management;
- Chemistry control; and
- Periodic inspection and testing.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Equipment Fitness for Service/Equipment Performance (Reliability)		
N-PROG-MA-0026	Equipment Reliability	No
N-PROG-RA-0016	Risk and Reliability Program	No
N-STD-RA-0033	Reliability and Monitoring of Systems Important to Safety	No
P-REP-03611-00012	PNGS Systems and Components Important to Safety	Yes
P-LIST-06937-00001	Pickering A and B List of Safety Related Systems	Yes
Maintenance		
I-PROG-AS-0001	Conduct of Inspection and Maintenance Services	No
N-PROG-MA-0004	Conduct of Maintenance	No

N-PROG-MA-0017	Component and Equipment Surveillance	Yes
N-PROG-MA-0025	Major Components	No
N-PROC-MA-0024	System Performance Monitoring	No
Aging Management		
N-PROG-MP-0008	Integrated Aging Management	No
N-PROC-MP-0060	Aging Management Process	No
N-STD-MA-0024	Obsolescence Management	No
N-PLAN-01060-10003	Reactor Components and Structures Life Cycle Management Plan	Yes
N-PLAN-01060-10008	Reactor Components and Structures Life Cycle Management Plan: Technical Basis Document	No
N-PROC-MA-0044	Fuel Channel Life Cycle Management	No
N-PLAN-01060-10002	Fuel Channels Life Cycle Management Plan	Yes
N-PLAN-01060-10001	Feeders Life Cycle Management Plan	Yes
N-PLAN-01060-10007	Feeders Life Cycle Management Plan: Technical Basis Document	No
N-PLAN-33110-10009	Steam Generators Life Cycle Management Plan	Yes
NA44-PLAN-33110-10003	Pickering Units 1 and 4 Steam Generator Life Cycle Management Plan (Except Appendix B)	No
NK30-PLAN-33110-10008	Pickering Units 5-8 Steam Generator Life Cycle Management Plan (excluding Sheet Sections 001 to 007)	No
N-PLAN-01060-10004	Aging Management Plan for Containment Structures	Yes
NA44-PLAN-34220-00002	Life Cycle and Aging Management Program Plan for Fiberglass-Reinforced Plastic Components in the Pickering NGS Vacuum Building	Yes
Chemistry Control		
N-PROG-OP-0004	Chemistry	No
Periodic Inspection and Testing		
I-STD-AS-0003	Non-Destructive Examination	No
I-PROG-AS-0001	Conduct of Inspection and Maintenance Services	No
N-PROC-MA-0052	Flaw Dispositioning	No

General Pressure Boundaries		
NA44-PIP-03641.2-00001	Pickering Nuclear Generating Station A Periodic Inspection Plan For Unit 1	Yes
NA44-PIP-03641.2-00007	Pickering Nuclear Generating Station A Periodic Inspection Plan For Unit 4	Yes
NK30-PIP-03641.2-00001	Pickering B Periodic Inspection Program Unit 5	Yes
NK30-PIP-03641.2-00002	Pickering B Periodic Inspection Program Unit 6	Yes
NK30-PIP-03641.2-00003	Pickering B Periodic Inspection Program Unit 7	Yes
NK30-PIP-03641.2-00004	Pickering B Periodic Inspection Program Unit 8	Yes
Fuel Channels		
N-REP-31100-10041	Acceptance Criteria and Evaluation Procedures for Material Surveillance Pressure Tube	Yes
NA44-PIP-31100-00001	Pickering Nuclear 1-4, Unit 1 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	Yes
NA44-PIP-31100-00004	Pickering Nuclear 1-4, Unit 4 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	Yes
NK30-PIP-31100-00001	Pickering Nuclear 5-8, Unit 5 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	Yes
NK30-PIP-31100-00002	Pickering Nuclear 5-8, Unit 6 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	Yes
NK30-PIP-31100-00003	Pickering Nuclear 5-8, Unit 7 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	Yes
NK30-PIP-31100-00004	Pickering Nuclear 5-8, Unit 8 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	Yes
N-REP-31100-10061	Compliance Plan for Long-Term Use of CSA N285.8 For In-Service Evaluation of Zirconium Alloy Pressure Tubes	Yes
Feeders		
NA44-PIP-33126-00002	Pickering Nuclear Unit 1 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	Yes
NA44-PIP-33126-00001	Pickering Nuclear Unit 4 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	Yes
NK30-PIP-33126-00001	Pickering Nuclear Unit 5 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	Yes

NK30-PIP-33126-00002	Pickering Nuclear Unit 6 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	Yes
NK30-PIP-33126-00003	Pickering Nuclear Unit 7 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	Yes
NK30-PIP-33126-00004	Pickering Nuclear Unit 8 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	Yes
COG-JP-4107-V06	Fitness-for-Service Guidelines for Feeders in CANDU Reactors	Yes
Steam Generators		
Appendix B in NA44-PLAN-33110-10003	Pickering Units 1 and 4 Steam Generator Life Cycle Management Plan - Appendix B: Pickering Units 1 and 4 Steam Generators In-Service Inspection Plan	Yes
NK30-PLAN-33110-10008 Sheet Section 006	Pickering Units 5-8 In-Service Inspection Plan	Yes
COG Report 07-4089	Fitness-For-Service Guidelines for Steam Generator and Preheater Tubes	Yes
Containment Components		
NA44-PIP-03642.2-00001	Pickering Nuclear Generating Station A Periodic Inspection Program For Containment Components	Yes
NK30-PIP-03642.2-00001	Pickering Nuclear Generating Station “B” Periodic Inspection Program For Containment Components	Yes
P-PIP-03642.2-00001	Pickering Nuclear Generating Station A Periodic Inspection Program For Unit 0 Containment Components	Yes
Concrete Containment Structures		
N-PROC-MA-0066	Administrative Requirements for In-Service Examination and Testing for Concrete Containment Structures	Yes
NA44-PIP-03643.2-00001	Pickering Nuclear GSA – Reactor Building Periodic Inspection Program	Yes
NK30-PIP-03643.2-00001	Pickering Nuclear GSB – Reactor Building Periodic Inspection Program	Yes
NA44-PIP-03643.2-00002	Pickering Nuclear GS – PRD & VB Periodic Inspection Program	Yes
NA44-PIP-03643.2-00003	Pickering Nuclear GS – Vacuum Building Post	Yes

	Tensioning Rods Periodic Inspection Program	
NA44-REP-34200-00017	Pickering NGS "A" Reactor Building and Pressure Relief Duct In-service Leakage Rate Test Requirements in accordance with CSA N287.7-08	Yes
NA44-REP-25100-00009	Pickering NGS Vacuum Building In-service Leakage Rate Test Requirements in Accordance with CSA N287.7-08	Yes
Balance of Plant		
N-PROC-MP-0060	Aging Management Process	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
Equipment Fitness for Service/Equipment Performance (Reliability)				
CNSC	RD/GD-98	Reliability Programs for Nuclear Power Plants	2012	2013-09-01
Maintenance				
CNSC	RD/GD-210	Maintenance Programs for Nuclear Power Plants	2012	2018-09-01
Aging Management				
CNSC	REGDOC 2.6.3	Aging Management	2014	2017-12-14
Periodic Inspection and Testing				
CSA	N285.4	Periodic Inspection of CANDU Nuclear Power Plant Components	2005	2013-09-01
CSA	N285.8	Technical Requirements for In-Service Inspection Evaluation of Zirconium Alloy in Pressure Tubes in CANDU Reactors	2015	2016-12-05
CSA	N285.5	Periodic Inspection of CANDU Nuclear Power Plant Containment Components	2008	2013-09-01
CSA	N287.1*	General requirements for concrete containment structures for nuclear power plants	2014	2013-09-01
CSA	N287.2*	Material requirements for concrete containment structures for CANDU nuclear power plants	2008	2013-09-01
CSA	N287.7	In-service Examination and Testing Requirements for Concrete	2008	2013-09-01

		Containment Structures for CANDU Nuclear Power Plants		
CSA	N291	Requirements for safety-related structures for CANDU nuclear power plants	2008	2018-09-01**

** The CSA N287.1 and N287.2 are required by CSA N287.7 Clauses 5.3.1 (qualified personnel) and 6.5.1(repair materials).*
*** See LC 5.1 for more additional details.*

Equipment Fitness for Service/Equipment Performance (Reliability)

The equipment fitness for service/equipment performance relates to the reliability of the facility's SSCs. These requirements help to assure that the systems important to safety (SIS) can meet their defined design, and performance criteria throughout the lifetime of the facility.

The equipment fitness for service/equipment performance SpA includes the following review topics and requirements from CSA N286 (clauses identified below) and RD/GD-98:

- Reliability Program (N286 Clauses 7.9.5, 7.9.5 (a) – (d)):
    - Systems Important to Safety (SIS);
    - Reliability of SIS;
    - Reliability Targets; and
    - Reliability Assessments.

<u>Reliability Program</u>

The licensee shall establish a reliability program in accordance with RD/GD-98 that includes setting reliability targets, performing reliability assessments, testing and monitoring, and reporting for plant systems whose failure affect the risk of a release of radioactive or hazardous material.

<u>Systems Important to Safety and Reliability Targets</u>

OPG has developed the lists of systems important to safety for both Pickering NGS-A and Pickering NGS-B as required by RD/GD-98. The systems important to safety, along with their unavailability target, are documented in P-REP-03611-00012 "*PNGS Systems and Components Important to Safety*".

CNSC staff will review the annual report on risk and reliability required by REGDOC-3.1.1 to ensure the performance of systems important to safety meets their reliability requirements and if not, that the licensee has taken appropriate corrective actions. See LC 3.3 for more information on this report.

Maintenance Program

A nuclear power plant maintenance program consists of policies, processes and procedures that provide direction for maintaining SSCs of the plant. The intent of a maintenance program is to ensure that the SSCs remain capable of maintaining their function as described in the safety analysis. A maintenance program uses organized activities, both administrative and technical, to keep SSCs in good operating condition, and to ensure that they function as per design.

The maintenance SpA includes the following review topics and requirements from CSA N286 (clauses identified below) and RD/GD-210:

- Maintenance Program (Clauses 7.9.9, 7.9.9 (a) – (d)):
  - Work management (Clauses 4.8, 4.8.1, 4.8.2, 4.8.3);
  - Preventive Maintenance;
  - Corrective Maintenance;
  - System Health Monitoring (7.9.10, 7.9.10 (a) – (c), 7.9.4, 7.9.4 (a) – (c)); and
  - Maintenance records (Clause 4.7.4).

Aging Management

The aging management SpA includes the following review topics and requirements:

- Integrated Aging Management (REGDOC-2.6.3):
  - Lifecycle Management:
    - Major pressure boundary components (fuel channels, feeders and steam generators) and reactor components and structures;
    - Concrete Containment Structures; and
  - Periodic Inspection (See SpA for Periodic Inspection).

Aging management is comprised of activities (engineering, operational, inspection, and maintenance actions) implemented proactively to ensure the reliability and availability of required safety functions of SSCs throughout the life of a nuclear power plant. Consistent with the intent of the *Class I Nuclear Facilities Regulations*, licensees are expected to establish, implement, and improve programs for managing aging, including obsolescence, of SSCs to ensure that required safety functions are maintained.

Managing the aging effects of a reactor facility is necessary to ensure the availability of required safety functions throughout the facility's service life, with consideration given to changes that occur over time and with use. This requires addressing both physical aging and obsolescence of SSCs that can, directly or indirectly, have an adverse effect on the safe operation of the reactor facility.

The following SSC-specific aging management programs (or LCMPs) shall be submitted to CNSC for review as a "prior notification" documents:

- Reactor Components and Structures Life Cycle Management Plan;
- Fuel Channels Life Cycle Management Plan;
- Feeders Life Cycle Management Plan;
- Steam Generators Life Cycle Management Plan;
- Aging Management Plan for Containment Structures; and
- Life Cycle and Aging Management Program Plan for Fiberglass-Reinforced Plastic Components in the Pickering NGS Vacuum Building.

The SSC-specific aging management programs, which are submitted in accordance with LC G.2, are licensing basis documents. As such any changes to the SSC-specific aging management plans will be reviewed by CNSC staff to confirm that they remain within the licensing basis and include all prior OPG commitments with respect to the inspection scope and other relevant commitments related to the continued operation of the Pickering Units. When considering possible changes to activities identified in the LCMPs, the licensee shall engage CNSC staff early enough to confirm that the changes are within the licensing basis. Administrative or other such changes to the documents are subject to normal notification requirements as indicated in the written notification table for this section.

In addition, the aging management plans are also subject to the integrated implementation plan actions, which are detail under LC 15.1.

Fuel Channel Aging Management

The current operating limit for the Pickering NGS-A Units 1 and 4 pressure tubes is 182,000 and 159,000 Effective Full Power Hours (EFPH), respectively. The current operating limit for Pickering NGS-B Units 5 to 8 pressure tubes is 295,000 EFPH for the lead Unit, which was approved by the Commission on Month Date Year. For further details see the Record of Decision, e-Doc xxxxxxx.

Continued use of Fracture Toughness Model(s)

Licensee shall submit an impact assessment for CSA N285.8-15 Clause 7 evaluations whenever a fracture toughness test result challenges the model's lower prediction bound, and where the model is applied in the Clause 7 evaluation(s).

Validation of the Cohesive Zone-based Fracture Toughness Model (Clause D13.2.3 of CSA N285.8-15)

To support the use of the Cohesive Zone-based fracture toughness model specified in Annex D of CSA N285.8-15 the licensee shall submit (for CNSC staff acceptance) a quantitative assessment of uncertainties in the Model by December 15, 2018.

The licensee shall, on a semi-annual basis submit the following until all the activities under the R&D test plan have been completed:

- the latest fracture toughness test results from the executed R&D test plan pertaining to the Cohesive Zone-based fracture toughness Model;
- an assessment of the fracture toughness test results against the applicable model predictions; and
- any updates to the test plan and schedule.

Specific CVC for Pickering pressure tubes predicted to exceed an Heq concentration of 120 parts per million is included under LC 15.3.

Chemistry Control

The licensee's chemistry control SpA includes the following review topics and requirements from CSA N286:

- Chemistry Control Program (Clauses 7.9.11, 7.9.11 (a) – (c)):

  - Preserve integrity of SSCs important to safety;
  - Manage the harmful effects of chemical impurities and corrosion on plant SSCs; and
  - Implement the ALARA principle to manage the buildup of radioactive material and occupational radiation exposure.
  - Limit the release of chemicals and radioactive materials to the environment.
- Chemical Surveillance (effectiveness of chemistry control in plant systems):
  - Chemical parameters;
  - Operational specifications;
  - Parameter monitoring, measurement and sampling including post-accident sampling; and
  - Trending.
- Chemistry Specifications for systems, and
- Storage and Handling.

Chemistry Control and Monitoring Program

Chemistry control and monitoring program establishes processes and overall requirements to ensure effective control and monitoring of plant chemistry during operational and lay-up conditions, to ensure critical plant equipment performs safely and reliably over the life of the stations.

The chemistry control program shall specify processes, specifications, overall requirements, parameter monitoring, data trending and evaluation to ensure effective control of plant chemistry during operational and lay-up conditions.

The licensee shall also maintain a set of technical basis documents for chemistry control and monitoring.

Periodic Inspection and Testing

The purpose of a periodic inspection program (PIP) or an in-service inspection (ISI) program is to provide assurance that the likelihood of a failure that could endanger the environment and/or radiological health and safety of persons has not increased significantly since the plant was put into service.

The periodic inspection and testing SpA includes the following review topics and requirements:

- Periodic Inspection/In-Service Inspection:
  - General Pressure Boundaries (CSA N285.4);
  - Fuel Channels (CSA N285.4);
  - Feeders (CSA N285.4);
  - Steam Generators (CSA N285.4);
  - Containment Components (CSA N285.5);
  - Concrete Containment Structures (CSA N287 Series);
  - Safety-related Structures (CSA N291); and
  - Balance of Plant Systems and Components.

Periodic and in-service inspection programs are established to confirm that pressure-boundary components; containment structures and components, continue to meet their design requirements. The condition of safety significant balance of plant pressure retaining systems and components, as well as, safety-related structures are monitored for degradation through in-service inspection programs.

Personnel conducting non-destructive examinations shall be certified in accordance with the edition of CAN/CGSB 48.9712/ISO 9712 currently adopted for use by the National Certification Body (NCB) of Natural Resources Canada for the appropriate examination method. If the NCB does not offer certification for a specific inspection method, the relevant alternate requirements of Clause 5 of CSA N285.4 or Clause 6 of N285.5 shall apply to ensure that personnel are appropriately trained and qualified.

OPG shall prepare, update and revise, as necessary, PIP documents in accordance with the requirements of the applicable CSA Standards listed in the licence condition. The currently accepted PIP documents are listed in the written notification table for this section. Revisions to OPG's PIP documents require CNSC acceptance prior to implementation.

OPG shall carry out periodic inspections in accordance with CNSC accepted PIP documents. If a deviation from the accepted PIP program is anticipated during inspection planning activities, OPG shall obtain CNSC acceptance prior to conducting the affected inspection. However, for any findings, discoveries or deviations from the accepted PIP that are identified during an inspection, OPG shall inform the CNSC and provide justification in the corresponding inspection report submission.

<u>CVC Related to CSA N285.4-05 and N285.4-14</u>

Permanent exemptions to the requirements of the standard that receive regulatory acceptance shall be incorporated, including supporting technical basis, into the PIP documents, listed in the "Written Notification" table for this section.

OPG shall disposition all gaps as committed in December 15, 2017 letter (e-Doc 5419126) concerning compliance with the requirements of CSA N285.4-14 Update No. 1. OPG shall submit the disposition for CNSC staff review and acceptance by June 29, 2018. A transition plan to adopt any required safety improvements deemed necessary should be included in the submission.

If it is determined that deterioration related to erosion-corrosion or environmentally assisted cracking is credible on systems covered by the current PIPs at the Pickering units, OPG shall evaluate the need to adopt the requirements of Clauses 7.4.7 or 7.4.8 of CSA N285.4-14 Update No. 1 into their existing PIP and submit the evaluation for CNSC staff review and acceptance.

<u>General Pressure Boundaries (N285.4 Clauses 3 to 11):</u>

CNSC staff have accepted the Pickering-A NGS PIP documents (e-Doc 3345880) and the Pickering-B NGS PIP documents (e-Doc 1379036).

<u>Fuel Channel (FC) Pressure Tubes (PT) (CSA N285.4 Clause 12):</u>

CNSC staff have accepted the Pickering NGS-A and the Pickering-B NGS PIP documents (e-Doc 4190308).

<u>Evaluation of results and dispositions for Pickering NGS pressure tubes</u>

With respect to N285.4-05 clause 12.2.5.1.3, CNSC staff have accepted (e-Doc 5126091) with conditions, the OPG's revised compliance plan N-REP-31100-10061 R002 (N-CORR-00531-17932, e-Doc 4895642) for the use of CSA N285.8-15 "In-Service Evaluation of Zirconium Alloy Pressure Tubes", as the evaluation method used for the fitness-for-service assessment of the Fuel Channels in Pickering 1 & 4 and 5 to 8 units.

Pressure Tube-Calandria Tube (PT-CT) contact assessment for Pickering NGS-B inspected channels

With respect to N285.4-05 clause 12.2.5.2.3 (d), when PT-CT contact cannot be precluded, a disposition following a CNSC accepted methodology is required. The licensee shall use "Heq concentration less than Blister Formation Threshold" as the evaluation failure criteria. Further, the maximum allowable evaluation period shall not exceed two hot years, from the last Body-of-Tube Heq concentration measurement in the affected Unit (or otherwise justified).

Licensee may operate a unit beyond the maximum evaluation period of two hot years, provided that a "time at risk" assessment is performed for the requested extension of the evaluation period, and submitted to the CNSC for acceptance. The "time at risk" assessment shall demonstrate that the predicted hydride blister depth will be less than 0.10 mm when the tube-specific Heq is unknown at the start of the evaluation period, and 0.15 mm when the tube-specific Heq is known at the start of the evaluation period.

PT Flaw Assessments (hydrided region overload)

With respect to CSA N285.8-15 Clause 5.4.3.1 (g), regarding the evaluation of the initiation of delayed hydride cracking of detected flaws during Service Level B transients , due to fracture of hydrided region, OPG has submitted a short term and long term plan (e-Doc 5223024).

PT Material Testing

With respect to N285.4-05 clause 12.4.4.2, CNSC staff have accepted (e-Doc 3895468) OPG's procedural updates and technical justifications for pressure tube material testing submitted in e-Doc 3848127, N-CORR-00531-05488.

Probabilistic Leak-Before-Break (PLBB) Assessments (CSA N285.8)

With respect to Clause 7.4.3.2 of CSA N285.8-15, the maximum allowable conditional probability over the evaluation period of pressure tube failure caused by a growing axial crack exceeding the critical crack length during the sequence of events from pressure tube through-wall penetration to reactor shutdown shall be less than or equal to 0.10 ruptures per through-wall crack, This applies to the assessed most limiting pressure tube in the reactor core. CNSC staff reserve the right to revisit the acceptance criterion periodically, and to make adjustments as needed.

Fuel Channel Feeder Pipes (N285.4 Clause 13):

CNSC staff have accepted the Pickering NGS-A PIP and the Pickering NGS-B PIP documents (e-Doc 5331943 and 4780461).

With respect to N285.4-05 clause 13.2.5.1.3, CNSC staff have accepted OPG's request to use the updated feeder fitness-for-service guidelines: COG-JP-4107-V06 Revision 3, "Fitness-for-Service Guidelines (FFSG) for Feeders in CANDU Reactors" (e-Doc 3922168 and e-Doc 4001054).

Steam Generator Tubes (N285.4 Clause 14):

CNSC staff have accepted the Pickering NGS-A PIP documents (e-Doc 3570040) and the Pickering NGS-B PIP documents (e-Doc 3567593) subject to the following exemptions:

CNSC staff have accepted the *"performance based disposition process*" (e-Doc 3615950) for steam generator inspections and dispositions, which allows the restart of the NGS without a formal CNSC approval of the disposition before restart, subject to an agreed upon set of conditions. Under this process, OPG will analyze and assess the inspection results and disposition the findings using the applicable FFSG. Prior to returning the steam generators to service, OPG is required to confirm, in writing, that the current CNSC accepted disposition for the unit has not been invalidated by the latest inspection findings.

With respect to N285.4-05 clause 14.2.5.1.3, CNSC staff have accepted OPG's request to use COG Report 07-4089 R1"Fitness-for-Service Guidelines for Steam Generator and Preheater Tubes, with one exception pertaining to the use of the Level D safety factors stipulated in ID 2.3.2.2 Paragraph (a), *Deterministic Leak-Before-Break,* to other load levels (levels A, B, C) and any other portions of the FFSG that invoke the use of ID-2.3.2.2 (See CNSC letter e-Doc 4298097). Instead, OPG is required to continue using the safety factors defined in ID 2.3.2.2 Paragraph (a) of Revision 0 of the fitness-for-service guidelines for the appropriate load levels.

CVC Related to CSA N285.5-08

CNSC staff have accepted the Pickering NGS A, B and Unit 0 PIP Programs meeting the requirements of N285.5-08 (e-Doc 4038995).

CVC Related to CSA N287.7-08

CNSC staff have accepted the Pickering NGS-A and B PIP documents (e-Doc 4452432).

OPG shall carry out the inspections and tests of the vacuum building, the dousing system and the pressure relief duct at least once every ten years. The next inspections and tests for these structures shall be carried out before December 31, 2020 and shall be in accordance with the requirements of CSA N287.7-08.

OPG shall perform a test to measure the leakage rate, at full design pressure, of the operating reactor buildings and inspect the reactor building concrete structures and components of all units once every six years.

The leakage rate test schedule for Pickering NGS-A units is as follows:

- Unit 1 before the end of 2023
- Unit 4 before the end of 2022

The leakage rate test schedule for Pickering NGS-B units is as follows:

- Unit 5, before the end of 2023
- Unit 6, before the end of June 2018 (see CNSC letter, e-Doc 5308799)

- Unit 7, before the end of December 2018
- Unit 8, before the end of 2022

In-Service Inspection of Safety-Related Structures (CSA N291)

For safety-significant safety-related structure(s) OPG shall implement and maintain an in-service inspection program(s) in accordance with industry best practices.

The licensee shall have adequate knowledge of the current state of safety-related structures to ensure that they are capable of operating within their design intent and perform required safety functions if called upon.

The licensee shall develop, implement and maintain in-service inspection program(s) and LCMPs for BOP safety-related structures, excluding concrete containment structures in accordance with CSA N291 *Requirements for safety-related structures for CANDU nuclear power plants*, keeping with industry best practices.

The in-service inspection program(s) developed to satisfy this licence requirement will ensure safety-related structures are monitored for credible degradation.

In-Service Inspection of Balance of Plant Systems and Components

For safety-significant BOP pressure retaining systems and components OPG shall implement and maintain an in-service inspection program(s) in accordance with industry best practices.

The licensee shall have adequate knowledge of the current state of BOP pressure retaining systems, components to ensure that they are capable of operating within their design intent and perform the required safety functions if called upon.

The licensee shall develop, implement and maintain in-service inspection program(s) and LCMPs for safety-significant BOP pressure retaining systems and components, keeping with industry best practices.

The in-service inspection program(s) developed to satisfy this licence requirement will ensure balance-of-plant (BOP) safety-significant pressure retaining systems and components are monitored for credible degradation.

Under normal operation and upset conditions, the plant safety analyses may take direct and/or indirect credit for the operation of some of the BOP SSCs, which are outside the scope of CSA N285.4, CSA N285.5 and CSA N287.7 standards and not inspected in accordance with these standards. The condition of these SSCs may have an indirect, but significant, impact on nuclear safety if they are permitted to degrade over time.

These programs shall incorporate the inspection requirements for SSCs important to safety based upon industry best practices appropriate to the design and operation of the SSCs.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	REGDOC-2.6.1	Reliability Programs for Nuclear Power Plants	2017
CNSC	REGDOC-2.6.2	Maintenance Programs for Nuclear Power Plants	2017
CSA	N285.4	Periodic Inspection of CANDU Nuclear Power Plant Components	2014 and Update No. 1 May 2016
CSA	N285.5	Periodic Inspection of CANDU Nuclear Power Plant Containment Components	2013
CSA	N287.1	General requirements for concrete containment structures for nuclear power plants	2014
CSA	N287.2	Material requirements for concrete containment structures for CANDU nuclear power plants	2008
CSA	N287.3	Design requirements for concrete containment structures for nuclear power plants	2014
CSA	N287.4	Construction, fabrication, and installation requirements for concrete containment structures for CANDU nuclear power plants	2008
CSA	N287.5	Examination and testing requirements for concrete containment structures for nuclear power plants	2011
CSA	N287.8	Aging Management for Concrete Containment Structures for Nuclear Power Plants	2015
CSA	N285.7	Periodic Inspection of CANDU Nuclear Power Plants Balance of Plant Systems and Components	2015
CSA	N291	Requirements for safety-related structures for CANDU nuclear power plants	2015
CNSC	REGDOC-1.1.3	Licence Application Guide: Licence to Operate a Nuclear Power Plant	2017

Maintenance

The scope of the maintenance program covers all SSCs within the bounds of the nuclear power plant, which includes activities for monitoring, inspecting, testing, assessing, calibrating, servicing, overhauling, repairing, and parts replacing. The type of maintenance activity and frequency applied to each SSC should be commensurate with importance to safety, design function and required performance.

Aging Management

For balance of plant pressure boundary component inspection programs non-destructive examination (NDE) procedures used in the Components and Equipment Surveillance sub-program should be developed and implemented using a level of rigour consistent with the safety significance of systems and components and the nature of the degradation. For NDE procedures necessary to carry out inspections in the BOP programs, guidance may be obtained from NDE requirements for the PIP program addressed in CSA N285.4.

Periodic Inspection and Testing

Periodic Inspection Programs

OPG should review the compliance matrices for periodic inspection programs on an annual basis to confirm the programs reflect current practices.

Balance of Plant Pressure Retaining Components

Given the limited planned operating time remaining for the Pickering NGS it would be impractical for OPG to develop and implement a CSA N285.7-15 compliant periodic inspection program for balance of plant pressure boundary components. However, the licensee should be capable of demonstrating that existing inspection programs meet the objectives of the CSA standard.

7 SCA – RADIATION PROTECTION

7.1 Radiation Protection Program and Action Levels

Licence Condition 7.1:

The licensee shall implement and maintain a radiation protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

Preamble:

The *Radiation Protection Regulations* require that the licensee implement a radiation protection program and also ascertain and record doses for each person who perform any duties in connection with any activity that is authorized by the *NSCA* or is present at a place where that activity is carried on. This program must ensure that doses to persons (including workers) do not exceed prescribed dose limits and are kept As Low As Reasonably Achievable (the ALARA principle), social and economic factors being taken into account.

The regulatory dose limits to workers and the general public are explicitly provided in sections 13, 14 and 15 of the *Radiation Protection Regulations*.

Specific regulatory requirements related to the implementation of all aspects of a radiation protection program, including action levels, are found in the *Radiation Protection Regulations*, *Class I Nuclear Facilities Regulations*, *General Nuclear Safety and Control Regulations, Nuclear Substances Radiation Devices Regulations*, REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants* (LC 3.3), and CSA N286, *Management Systems Requirements for Nuclear Power Plants* (LC 1.1.). For this licence, the compliance verification criteria are identified in these requirements as well as in the compliance verification criteria below.

In accordance with the CNSC regulatory framework, the Safety and Control Area "*Radiation Protection*" covers the implementation of a radiation protection program as required by the Radiation Protection Regulations.

The radiation protection SCA includes the following SpAs:

- Application of ALARA;
- Worker dose control;
- Radiation protection program performance;
- Radiological hazard control; and
- Estimated dose to public.

The development of the action levels referred to in the LC is captured in the radiation protection program performance SpA.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
N-PROG-RA-0013	Radiation Protection	Yes
N-STD-RA-0018	Controlling Exposure As Low As Reasonably Achievable	No
N-REP-03420-10001	Occupational Radiation Protection Action Levels for Power Reactor Operating Licences	Yes
N-PROC-RA-0019	Dose Limits and Exposure Control	Yes
N-MAN-03416-10000	Radiation Dosimetry Program – General Requirements	No
OPG-PROC-0132	Respiratory Protection	No

Application of ALARA

The purpose of this specific area is to verify efforts towards maintaining radiation doses ALARA, social and economic factors taken into account. Review topics captured in this specific area include:

- ALARA in design of facilities, processes, structures, systems and components;
- ALARA optimization process; and
- ALARA program.

Worker Dose Control

The purpose of this specific area is to verify the control of occupational exposures to radiation and to report on radiation doses received by workers. Review topics captured in this specific area include:

- Bioassays (in vivo and in vitro) and radiation dose devices;
- Nuclear Energy Worker policy and procedures;
- Planning for unusual situations;
- Radiation dose targets and tracking/trending;
- Radiation exposures and radiation dose assessments;
- Radiation work planning;
- Reporting and performance trending of worker doses; and
- Selection, use (donning and doffing), and maintenance of radiation personal protective equipment (PPE).

Radiation Protection Program Performance

The purpose of this specific area is to verify the effectiveness of the radiation protection program in protecting the health and safety of persons, including performance against objectives, goals and targets, and continuous improvement initiatives. Review topics captured in specific area include:

- Content for radiation protection (RP) training and qualification of management, workers, and all other persons (i.e. visitors, contractors);
- Effectiveness reviews of the RP program;
- Management oversight of the RP program;
- Quality management of RP procedures and practices;
- Organization and administration of the RP program;
- The establishment and implementation of RP Action and Administrative Levels (described in more detail, below); and
- Self-assessment process/audits and corrective action feedback of the RP program.

Radiation Protection Action Levels

Action Levels (ALs) are designed to alert licensees before regulatory dose limits are reached. By definition, if an action level referred to in a licence is reached, a loss of control of some part of the associated radiation protection program may have occurred, and specific action is required, as defined in the *Radiation Protection Regulations* and the licence. Dose performance history should be considered when establishing ALs. ALs should be reviewed on a routine basis to ensure that they remain appropriate.

At OPG, Administrative Dose Limits (ADLs) are the licensee's internal dose limits designed to ensure individuals do not exceed regulatory dose limits.

Section 6 of the *Radiation Protection Regulations* specifies the requirements related to action levels and indicates that the licence will be used to identify action levels and their notification timeframes. For this licence, the action levels and notification time frames are provided in the following tables.

The current ALs and ADLs for this facility are extracted from N-REP-03420-10001 and N-PROC-RA-0019 and are summarized in the following tables. OPG's ALs and ADLs are considered part of the licensing basis. Changes to these limits are subject to notification of change. In the event of a discrepancy between the tables below and the licensee documentation upon which they are based, the licensee documentation shall be considered the authoritative source (assuming that the licensee has followed its own change control process).

Action Levels for Dose to Workers		
Field of application	**Value**	**Action Level**
DOSE TO WORKERS: Individual worker external radiation dose received on a job greater than planned	2mSv (200 mrem)	A person receives an external whole body dose that equals or exceeds 2 mSv (200 mrem) above the Electronic Personal Dosimeter (EPD) dose alarm set point.

Action Levels for Dose to Workers		
Field of application	**Value**	**Action Level**
DOSE TO WORKERS: Individual worker internal exposures to tritium oxide greater than planned	2400 kBq/L (65 µCi/L) [2 mSv or (200 mrem)]	A person receives a single intake of tritium oxide (tritiated water) in which the unplanned component of the initial concentration immediately after intake is estimated to equal or exceed 2400 kBq/L (65 µCi/L) (representing a nominal unplanned exposure of 2 mSv (200 mrem)).
DOSE TO WORKERS: Individual worker internal exposure to radionuclides (other than tritium as tritium oxide) greater than planned	0.1 ALI for a radionuclide other than tritium (tritium oxide). [2 mSv or (200 mrem)]	A person receives an intake of a radionuclide other than tritium (in the form of tritium oxide) attributable to a single event that equals or exceed 0.1 of an Annual Limit of Intake (ALI) as defined in ICRP Publication 68, *Dose Coefficients for Intakes of Radionuclides by Workers*, (representing a nominal unplanned exposure of 2 mSv [200 mrem].
DOSE TO WORKERS: Cumulative annual individual radiation dose exceeds annual administrative dose limits without approval.	The Administrative Dose Limits (ADLs) are shown in the table below.	An individual's total whole body radiation dose accumulated over a calendar year exceeds his annual Administrative Dose Limit (ADL) without approval.

Administrative Dose Limits			
Whole Body Dose (Effective) limits (one calendar year)			
Category of Worker	**Nuclear Part D&G Employees**	**Other Ontario Power Generation Employees**	**Contract and Building Trades Union Employees**
Nuclear Energy Workers (NEW)	20 mSv (2 rem)	20 mSv (2 rem)	40 mSv (4 rem)
NEW with a lifetime whole body dose greater than 500 mSv (50 rem)	10 mSv (1 rem)	10 mSv (1 rem)	Not applicable
Non-NEW	0.5 mSv (0.05 rem)	0.5 mSv (0.05 rem)	0.5 mSv (0.05 rem)
Whole Body Dose (Effective) limits (rolling 5 calendar years)			
NEW	50 mSv (5 rem)	90 mSv (9 rem)	90 mSv (9 rem)

Action Level for Surface Contamination Levels		
Field of application	**Action Level**	**Observations**
CONTAMINATION CONTROL: Alpha or Beta-gamma surface contamination levels beyond limits in Zone 1.	37 kBq/m^2 (1 µCi/m^2) (beta-gamma); 3.7 kBq/m^2 (0.1 µCi/m^2) (alpha)	Total (fixed and loose) surface contamination levels greater than 37 kBq/m^2 (1 µCi/m^2) (beta-gamma) or 3.7 kBq/m^2 (0.1 µCi/m^2) (alpha) are found in Zone 1.

Radiological Hazard Control

The purpose of this specific area is to verify efforts to control radiological hazards, preventing unnecessary radioactive releases and radiation exposures. Review topics to verify compliance in this specific area include:

- Classification of areas and zoning, including area posting, policies and procedures;
- Radiation monitoring equipment and instrumentation;
- Radiological hazard characterization and assessment;
- Radiological hazard non-conformances with RP program requirements;
- Radiological hazard surveys and control programs; and
- Labeling of containers and devices.

Estimated Dose to Public

The *Radiation Protection Regulations* prescribe the radiation dose limits for the general public of 1 mSv per calendar year. The licensee reports the estimated dose to the public from the Pickering site annually, in accordance with REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants* (See LC 3.3), in the Environmental Protection report.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	G-129	Keeping Radiation Exposures and Doses “As Low As Reasonably Achievable (ALARA)”	2004
CNSC	G-228	Developing and Using Action Levels	2001

The licensee should conduct a documented review and, if necessary, revise the ALs specified above at least once every five years in order to validate their effectiveness. The results of such reviews should be provided to CNSC staff.

8 SCA – CONVENTIONAL HEALTH AND SAFETY

8.1 Conventional Health and Safety Program

Licence Condition 8.1:

The licensee shall implement and maintain a conventional health and safety program.

Preamble:

As of April 1, 1998, nuclear facilities owned and operated by Ontario Hydro were exempted from application of Part I, Part II and Part III of the *Canada Labour Code*. This was established as per the following Consolidated Regulations: *SOR/98-179, SOR/98-180* and *SOR/98-181*. Pickering NGS is now regulated by the *Occupational Health and Safety Act of Ontario* and the *Labour Relations Act*. Related legislation includes the *Ontario Workplace Safety and Insurance Act (WSIA)* and the *Ontario Human Rights Code*.

The conventional health and safety SCA includes the following SpAs:

- Performance;
- Practices; and
- Awareness.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
OPG-POL-0001	Employee Health and Safety Policy	No
OPG-PROG-0010	Health and Safety Management System Program	No
N-PROG-MA-0015	Work Protection	No
OPG-PROC-0132	Respiratory Protection	No

Conventional Health and Safety Program (Performance, Practices and Awareness)

The licensee's approach to worker safety is governed by OPG-PROG-0010, *Safety Management System Program*, which defines the overall process for managing safety and the responsibilities of the parties, specifically at the corporate level. The licensee shall ensure that contractors and other organizations present on site are informed of and uphold their roles and responsibilities related to conventional health and safety.

The licensee reports on safety performance indications related to conventional health and safety on a quarterly basis in accordance with REGDOC-3.1.1 (See LC 3.3). The following indicators are relevant to Conventional Health and Safety:

- Spills, and
- Conventional Health and Safety.

Guidance:

There is none provided.

9 SCA – ENVIRONMENTAL PROTECTION

9.1 Environmental Protection Program

Licence Condition 9.1:

The licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days.

Preamble:

Licensees set Environmental Action Levels (EAL) and related parameters, so as to provide early warnings of any actual or potential losses of control of the Environmental Protection Program. EALs are precautionary levels and are set far below the actual Derived Release Limits (DRLs). EALs are designed to alert licensees before DRLs are reached. They are specific doses of radiation or other parameter that, if reached, may indicate a loss of control of the licensee's Environmental Protection Program.

CNSC Regulatory Policy P-223, *Protection of the Environment*, describes the principles and factors that guide the CNSC in regulating the development, production and use of nuclear energy and the production, procession and use of nuclear substances, prescribed equipment and prescribed information in order to prevent unreasonable risk to the environment in a manner that is consistent with Canadian environmental policies, acts and regulations and with Canada's international obligations.

The environmental protection SCA includes the following SpAs:

- Effluent and emissions control (releases);
- Environmental management system (EMS);
- Assessment and monitoring;
- Protection of the public; and
- Environmental Risk Assessment.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
Effluent and Emissions Control (Releases)		
N-STD-OP-0031	Monitoring of Nuclear and Hazardous Substances in Effluents	No
NA44-REP-03482-00001	Derived Release Limits and Environmental Action Levels for Pickering Nuclear Generating Station A	Yes

NK30-REP-03482-00001	Derived Release Limits and Environmental Action Levels for Pickering Nuclear Generating Station B	Yes
P-REP-03482-00001	Derived Release Limits and Environmental Action Levels for Pickering Nuclear Sewage Effluent	Yes
Environmental Management System (EMS)		
OPG-POL-0021	Environmental Policy	No
N-PROG-OP-0006	Environmental Management	No
N-PROC-OP-0044	Contaminated Lands and Groundwater Management	No
N-INS-07080-10000	Hazardous Material Control	No
N-PROC-OP-0038	Abnormal Waterborne Tritium Emission Response	No
Assessment and Monitoring		
N-PROC-OP-0025	Management of the Environmental Monitoring Programs	No
P-MAN-03443-00002	Pickering Environmental Monitoring Program	No
N-PROC-OP-0037	Environmental Approvals	No
Environmental Risk Assessment (ERA)		
P-REP-07701-0001	Environmental Risk Assessment Report for Pickering Nuclear	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
Effluent and Emissions Control (Releases)				
CSA	N288.5	Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills	2011	2015-12-31
CSA	N288.1	Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities	2008	2013-09-01
CSA	N288.1	Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities	2014 and Update No. 1 & 2 (May & November 2017)	2019-01-01*
CSA	N288.3.4	Performance Testing of Nuclear Air-Cleaning Systems at Nuclear Facilities	2013	2018-09-01

Environmental Management System (EMS)				
CNSC	REGDOC-2.9.1	Environmental Protection Policies, Programs and Procedures	2013	2018-09-01
CSA	N288.7	Groundwater protection programs at Class I nuclear facilities and uranium mines and mills	2015	2020-12-31
Assessment and Monitoring				
CSA	N288.4	Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills	2010	2013-09-01
Environmental Risk Assessment (ERA)				
CSA	N288.6	Environmental risk assessments at Class I nuclear facilities and uranium mines and mills	2012	2018-09-01

**The revised Derived Release Limits (DRLs) including Environmental Release Limits (EALs) will be updated in the LCH for 2019-01-01. See CNSC letter for more information (e-Doc 5494898).*

Effluent and Emissions Control (Releases)

The licensee shall ensure effluent monitoring for nuclear and hazardous substances is designed, implemented and managed to respect applicable laws and to incorporate best practices. The effluent monitoring program shall provide for control of airborne and waterborne effluents. Effluent monitoring is a risk-informed activity which assures quantifying of the important releases of the nuclear and hazardous substances into the environment.

Nuclear Substances – Derived Release Limits (DRL)

The licensee shall control radiological releases to ALARA, within the DRLs, and take action to investigate and correct the cause(s) of increased releases should they occur. The licensee shall report the releases in accordance with REGDOC-3.1.1 (LC 3.3).

The licensee shall establish the DRLs in accordance with CSA N288.1. If any of the individual radionuclide DRLs are exceeded, or if the sum of individual releases (expressed as a fraction of the relevant DRL) exceeds unity, it indicates that the public dose limit of 1mSv/year set in the CNSC *Radiation Protection Regulations* may be exceeded.

The DRLs are considered part of the licensing basis. The DRLs for this facility are summarized in the table below.

Release Category	Radionuclide	DRL(Becquerel/year) Pickering A	DRL(Becquerel/year) Pickering B
Air	Tritium (HTO)	$1.2x10^{17}$	$1.9x10^{17}$
	Iodine (mixed fission products)	$9.8x10^{12}$	$8.9x10^{12}$
	Carbon-14(CO2)	$2.2x10^{15}$	$2.0x10^{15}$
	Noble Gases*	$3.2x10^{16}$	$4.7x10^{16}$
	Particulate – Gross Beta-Gamma (Co-60)	$4.9x10^{11}$	$7.2x10^{11}$

	Particulate – Gross Alpha (Pu-239, Pu-240)	$8.7x10^{10}$	$1.2x10^{11}$
Water	Tritium	$3.7x10^{17}$	$7.0x10^{17}$
	Carbon-14 (as carbonate)	$3.2x10^{13}$	$6.0x10^{13}$
	Gross Alpha (Pu-239/Pu-240)	$1.4x10^{13}$	$2.6x10^{13}$
	Gross Beta-Gamma (P-32)	$1.7x10^{12}$	$3.2x10^{12}$
Sewage**	Tritium	$5.4x10^{16}$	
	C-14	$9.9x10^{13}$	
	Gross beta-gamma (limited by Co-60)	$1.2x10^{11}$	

**Units for noble gases DRLs are Bq-MeV*
*** All sewage from the Pickering Nuclear site is reported as a release from Pickering Nuclear Generating Station A*

These DRLs for radionuclides and radionuclide groups account for the most significant nuclear substances which can be released and are the focus of monitoring and reporting requirements.

Based on the information provided in OPG letter P-CORR-00531-04657, e-Doc 4955185, OPG is no longer expected to monitor and report on C-14 in sewage.

Nuclear Substances – Environmental Action Levels (EAL)

For OPG, the established EALs are ~10% of the DRLs for respective radionuclides released via airborne, waterborne or sewage discharge pathways.

OPG's EALs are documented in the reports NA44-REP-03482-00001 "Derived Release Limits and Environmental Action Levels for Pickering Nuclear Generating Station A", NK30-REP-03482-00001 "Derived Release Limits and Environmental Action Levels for Pickering Nuclear Generating Station B", and P-REP-03482-00001 "Derived Release Limits and Environmental Action Levels for Pickering Nuclear Sewage Effluent".

Further to the requirements of LC 3.3 that cites CNSC REGDOC-3.1.1, OPG shall notify the Commission within seven days of becoming aware that an action level has been reached.

The EALs are considered part of the licensing basis. The EALs for this facility are summarized in the table below.

The current EALs for Pickering NGS are given in the following table:

Release Category	Radionuclide	Action Levels: Gaseous releases (Pickering A) (Becquerel/week)	Action Levels: Gaseous releases (Pickering B) (Becquerel/week)
Air	Tritium (HTO)	$2.5x10^{14}$	$3.7x10^{14}$
	Iodine	$2.0x10^{10}$	$1.8x10^{10}$
	Carbon-14	$4.4x10^{12}$	$4.0x10^{12}$
	Noble Gases*	$6.3x10^{13}$	$9.4x10^{13}$
	Particulates	$9.8x10^{8}$	$1.4x10^{9}$
Release Category	Radionuclide	Action Levels: Liquid releases (Becquerel/month)	Action Levels: Liquid releases (Becquerel/month)

Water	Tritium (HTO)	$3.0x10^{15}$	$5.6x10^{15}$
	Carbon-14	$2.6x10^{11}$	$4.8x10^{11}$
	Gross Beta-Gamma	$1.4x10^{10}$	$2.5x10^{10}$
Sewage**	Tritium (HTO)	$4.3x10^{14}$	
	Carbon-14	$7.9x10^{11}$	
	Gross beta-gamma	$9.7x10^{8}$	

* Units for noble gas action level are Bq-MeV/week
** All sewage from the Pickering Nuclear site is reported as a release from Pickering Nuclear Generating Station A

Hazardous Substances

The licensee shall control hazardous substance releases according to the limits defined in accordance with the applicable environmental compliance approvals and take action to investigate and correct the cause(s) of increased releases.

Environmental Management System (EMS)

The objective of the environmental protection policies, programs and procedures is to establish adequate provisions for protection of the environment. This shall be accomplished through an integrated set of documented activities that are typical of an environmental management system (EMS).

OPG has established and implemented an environmental management program to assess environmental risks associated with its nuclear activities, and to ensure these activities are conducted in such a way that adverse environmental effects are prevented or mitigated. OPG environmental management program is compliant with REGDOC-2.9.1, *Environmental Protection Policies, Programs and Procedures*, version 2013.

OPG shall ensure that all aspects of its environmental management program are effectively implemented in order to assure compliance with environmental regulatory requirements and expectations, including those set in the International Organization for Standardization 14001, *Environmental Management Systems*. OPG's EMS is registered to the ISO-14001. Having the ISO-14001certification is not part of the CNSC requirement; however it shows that a third party recognized OPG Environmental Management System as being in accordance with the standard.

Groundwater

OPG shall implement CSA N288.7, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills* by December 31, 2020.

Assessment and Monitoring

An environmental monitoring program consists of a risk-informed set of integrated and documented activities to sample, measure, analyze, interpret, and report the following:

- the concentration of hazardous and/or nuclear substances in environmental media to assess one or both of
  - exposure of receptors to those substances; and
  - the potential effects on human health, safety, and the environment;

- the intensity of physical stressors and/or their potential effect on human health and the environment; and
- the physical, chemical, and biological parameters of the environment normally considered in design of the EMP.

Management of adverse effects on fish population

OPG is to submit an annual report on fish impingement and entrainment monitoring at Pickering NGS by May 31 each year. Details on the report content are contained in Attachment 1 of CNSC letter e-Doc 4742751 (P-CORR-00531-04457). OPG shall provide preliminary results by February 28 each year.

Protection of the public

See the SpA for the Estimated Dose to the Public under the SCA for Radiation Protection under LC 7.1.

Environmental Risk Assessment (ERA)

In accordance with CSA N288.4 and N288.5, the ERA establishes the basis for both the environmental monitoring program and the effluent monitoring program. The ERA shall be updated periodically with the results from the environmental and effluent monitoring programs in order to confirm the effectiveness of any additional mitigation measures needed.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	REGDOC-2.9.1	Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.1	2017
CSA	N288.2	Guidelines for Calculating the Radiological Consequences to the Public of a Release of Airborne Radioactive Material for Nuclear Reactor Accidents	2014
CSA	N288.7	Groundwater protection programs at Class I nuclear facilities and uranium mines and mills	2015
CNSC	G-228	Developing and Using Action Levels	2001
CNSC	G-129	Keeping Radiation Exposures and Doses “As Low As Reasonably Achievable (ALARA)”	2004

It is recommended that the licensee provide to the CNSC a copy of the reports sent to the Ontario’s Ministry of the Environment and Climate Change Canada on hazardous releases.

The licensee should review and, if necessary, revise and reissue the DRLs at least once every five years. Similarly, the licensee should review and, if necessary revise the EALs specified above at least once every five years.

CNSC staff use the criteria set out in the CNSC guidance document G-228 *Developing and Using Action Levels* as guidance to help assess the adequacy of EALs established by the licensee.

10 SCA – EMERGENCY MANAGEMENT AND FIRE PROTECTION

The emergency management and fire protection SCA includes the following SpAs:

- Conventional emergency preparedness and response (includes the emergency preparedness program) (LC 10.1);
- Nuclear emergency preparedness and response (LC 10.1); and
- Fire emergency preparedness and response (LC 10.2).

10.1 Emergency Preparedness Program

Licence Condition 10.1:

The licensee shall implement and maintain an emergency preparedness program.

Preamble:

Emergency preparedness allows preparation and management of resources for responding to emergencies, with the aim to reduce the harmful effects of emergency. Specific provisions for dealing with emergencies are required because normal processes are disrupted and a different set of resources is needed to respond to and recover from the disruption.

The licensee also has processes in place to ensure business continuity including a nuclear pandemic plan in the event of an emergency (see LC 1.1).

In addition to the nuclear emergency program, the licensee maintains a set of emergency operating procedures and abnormal plant operating procedures (see LC 3.1).

A security response to malevolent acts is governed by a separate plan under OPG's nuclear security program (see LC 12.1) but provisions of the licensee's site security report apply to any associated potential threat of release of radioactive material - for example, the need for off-site notification, situation updates and confirmation of any radioactive releases.

Liquid release response plan, radioactive materials transportation emergency response plan and security (or hostile action) response plan are also governed by separate plans (see LC 9.1, 12.1and 14.1, respectively).

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
N-PROG-RA-0001	Consolidated Nuclear Emergency Plan	Yes

N-REP-03491-0650826	Updated Emergency Planning Technical Basis for Provincial Nuclear Emergency Response Plan	Yes
N-STD-AS-0010	Nuclear Crisis Communications Standard	No
N-PROC-RA-0045	Emergency Preparedness Drill and Exercises	No
N-PROC-RA-0133	Management of Equipment Important to Emergency Response	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	REGDOC-2.10.1	Nuclear Emergency Preparedness and Response	2014	2017-09-30

Conventional and Nuclear Emergency Preparedness and Response

Emergency Preparedness Program

The emergency preparedness program encompasses emergency preparedness, emergency response and emergency response measures. It ensures that appropriate emergency response capabilities are developed and maintained available for use.

The emergency preparedness program consists of:

- Basis for emergency planning;
- Personnel selection and qualification;
- Emergency preparedness and response organizations;
- Staffing levels;
- Emergency training, drills and exercises;
- Emergency facilities and equipment;
- Emergency procedures;
- Assessment of emergency response capability;
- Assessment of accidents;
- Activation and termination of emergency responses;
- Protection of facility personnel and equipment;
- Interface with off-site organizations;
- Recovery program;
- Public information program (see LC G.6); and
- Public education program (see LC G.6).

The licensee's Consolidated Nuclear Emergency Plan (CNEP) deals with emergency situations that could endanger the safety of on-site staff, the environment and the public. It is predominantly conceived to deal with releases of radioactive materials from fixed facilities and to outline interfaces with the Provincial Nuclear Emergency Response Plan (PNERP). The licensee shall maintain equipment, procedures and staff to support off- site response activities for an accidental release. Infrastructures defined within the PNERP may be used in planning and response to virtually all emergencies. The licensee's CNEP also represents a basis for controlling changes and modifications to the licensee's nuclear emergency preparedness program.

In accordance to REGDOC-2.10.1, the licensee is required to provide regional and provincial offsite authorities with the necessary information to allow for effective emergency planning policies and procedures to be established and updated, if needed or on a periodic basis. This information includes an estimate of the associated radiological consequences, with isotopic release quantities (source term), possible release start time and duration and the geographical area potentially affected.

The licensee shall test all requirements listed in REGDOC-2.10.1 over a five-year period, with a full-scale integrated emergency testing exercise at least once every three years involving, at a minimum, regional and provincial offsite authorities. OPG is required to develop and submit to the CNSC emergency drill and exercise schedules annually. Drills and/or exercises are required at least annually in most areas. The drill and exercise program details the requirements for corporate exercises, testing of drill and exercise objectives, and coordination with non-OPG facilities. Participation by municipal and provincial emergency response groups is scheduled by mutual agreement.

The licensee shall implement and maintain an automated (collected and posted without human intervention) data sharing system for the CNSC EOC, with near real-time (at 15 minute interval or less). Such data-sharing system shall allow posting of a set of pre-determined plant data, with web-based access for viewing and trending, including the ability to download to support CNSC emergency response mandate.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	REGDOC 2.3.2	Accident Management, Version 2	2015
CNSC	REGDOC-2.10.1	Nuclear Emergency Preparedness and Response, Version 2	2016
CSA	N1600	General requirements for nuclear emergency management programs	2016

10.2 Fire Protection Program

Licence Condition 10.2:

The licensee shall implement and maintain a fire protection program.

Preamble:

Licensees require a comprehensive Fire Protection Program (FPP) to ensure the licensed activities do not result in unreasonable risk to the health and safety of persons and to the environment due to fire and to ensure that the licensee is able to efficiently and effectively respond to emergency fire situations.

Fire protection provisions, including response, are required for the design, construction, commissioning, operation, maintenance, and decommissioning of nuclear facilities. Fire provisions cover structures, systems, and components that support the plant operation and extend within the exclusion area. External events, such as an aircraft crash or threats, are addressed by LC 12.1.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
N-PROG-RA-0012	Fire Protection	Yes

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CSA	N293	Fire protection for CANDU nuclear power plants	2012	2018-09-01*

**With the exception of the Code Compliance Review/Inspection, Testing and Maintenance (CCR/ITM) update. OPG will update the CCR/ITM reports every 5-years beginning in in 2018-09-01. The CCR/ITM will be issued by January 31, 2020.*

Fire Emergency Preparedness and Response

Fire Protection

As required by CSA N293, the licensee shall ensure that a qualified third party performs a plant condition inspection annually and a fire protection program audit every three years. The resulting inspection and audit reports shall be submitted to CNSC staff for review (see OPG letter P-CORR-00531-03922, e-Doc 4164728).

It is expected that OPG will apply the Ontario building and fire codes to SSCs within the exclusion zone but external to the protected area. For fire protection, OPG's documents N-PROG-RA-0012, Fire

Protection, and P-LIST-71400-00001, Application of CSA N293 to Structures, Systems and Components for Pickering Nuclear, may identify specific SSCs in the exclusion zone to which the requirements of CSA N293 are applied. See LC G.3 for more information.

Fire Response

In accordance with CSA N293, the licensee shall arrange for third party audits of one industrial fire brigade fire drill once every two years. The purpose of a Third Party Audit is to provide an in-depth analysis of the Industrial Fire Brigade's (IFB) fire response performance against applicable regulatory criteria. A fire response is a planned, coordinated and controlled activity to provide emergency response to a fire. The audit is to analyze and ensure competencies of the IFB against CSA N293 standard and the referred NFPA 600 and 1081 standards. The resulting audit report shall be submitted to CNSC staff for review.

An independent third party auditor is required to be an expert in their discipline, normally firefighting and qualified through specific education and relevant experience. The third party auditor is required to be independent from the facility to ensure total impartiality. The review shall be of sufficient depth and detail that the reviewer can attest with reasonable confidence on the competencies of the IFB at the facility.

Fire Design

The licensee shall design, build, modify and otherwise carry out work related to the nuclear facility with potential to impact protection from fire in accordance with the CSA N293. Any changes that have the potential to impact fire protection are assessed for compliance with CSA N293 and, if required, an external third party review shall be performed and the results submitted to the CNSC. See also LC 5.1 for additional requirements related to the Physical Design SCA and the design program and LC 5.2 for fire protection system classification and registration.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
NEI	NEI 00-01	Guidance for Post Fire Safe Shutdown Circuit Analysis	Revision 2

Where CSA N293 does not address a fire protection topic or issue in whole, or where additional guidance is beneficial, the standards and recommended practices set out by the National Fire Protection Association are used as guidance by CNSC staff in determining the adequacy of a fire protection measure. The Nuclear Energy Institute guidance in NEI 00-01, *Guidance for Post Fire Safe Shutdown Circuit Analysis*, is used by CNSC staff to help determine the adequacy of safe shutdown electrical circuit analysis.

The results of the Third Party Audit report will typically consist of a report which compares the requirements of the applicable codes and standards against the implementation of the FPP or the Fire Response exercised (based on the scope of the audit). The report should identify any non-compliance and formulate a conclusion if the licensee's FPP or IFB meets the requirements of CSA N293.

As a guideline the report should provide sufficient detail to support the conclusion and to convey that the requirements of CSA N293 are met. As a minimum, the documentation for a Third Party Audit should include:

- Cover page with the name of the facility, date and signature of the authors;
- Name, address and phone number of the preparing agency or organization;
- Names of review team members, including brief descriptions of experience and education;
- Name, address, and phone number of licensee;
- Title of report, name of project, project number(s), date, and document number;
- Introduction briefly describing the project;
- Statement of review scope specifically listing any exclusions;
- Objectives of the review;
- A list of applicable codes and standards;
- Summary of the review methodology, including areas and documents reviewed;
- Detailed observations with relation to standard requirements against the observed response;
- Conclusions, including a statement that the response meets the requirements of the applicable standards, achieves the fire response objectives, and a summary of any non-compliances;
- Recommendations (if any); and
- An issues tracking table.

11 SCA – WASTE MANAGEMENT

The waste management SCA includes the following SpAs:

- Waste characterization (LC 11.1);
- Waste minimization (LC 11.1);
- Waste management practices (LC 11.1); and
- Decommissioning plans (LC 11.2).

11.1 Waste Management Program

Licence Condition 11.1:

The licensee shall implement and maintain a waste management program.

Preamble:

CNSC Regulatory Policy P-290, *Managing Radioactive Waste*, defines radioactive waste as any material (liquid, gaseous or solid) that contains a radioactive "nuclear substance," as defined in section 2 of the *NSCA* and which the owner has declared to be waste. In addition to containing nuclear substances, radioactive waste may also contain non-radioactive "hazardous substances," as defined in section 1 of the *General Nuclear Safety and Control Regulations*.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
W-PROG-WM-0001	Nuclear Waste Management	Yes
N-PROC-OP-0043	Waste Management	No
N-PROC-RA-0017	Segregation and Handling of Radioactive Wastes	No
N-PROC-WM-0001	Disposal of Oil and Chemical Waste	No
N-PROG-OP-0006	Environmental Management	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CSA	N292.2	Interim Dry Storage of Irradiated Fuel	2013	2018-09-01
CSA	N292.3	Management of Low and Intermediate-Level Radioactive Waste	2008	2013-09-01

Waste Characterization/Waste Minimization/Waste Management Practices

Waste Management Program

The licensee shall implement and maintain a program for waste management that includes strategies for waste minimization. Low- and intermediate-level waste shall be managed in accordance with CSA N292.3, *Management of Low and Intermediate-Level Radioactive Waste*.

The licensee shall:

- characterize its waste streams and minimize the production of all wastes taking into consideration the health and safety of workers and the environment;
- integrate waste management programs as a key element of the facility's safety culture; and
- audit, on a regular basis, its program to maximize its efficiency.

Waste management programs shall be developed to control the management of operational wastes (waste associated with normal operation of a facility) at the facility where it is generated or stored.

See LC 15.4 for plans for end of commercial operation that pertain to OPG's long-term plan for waste management.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	G-320	Assessing the Long term Safety of Radioactive Waste Management	2006
CSA	N292.0	General principles for the management of radioactive waste and irradiated fuel	2014
CSA	N292.1	Wet storage of irradiated fuel and other radioactive materials	2016
CSA	N292.3	Management of low- and intermediate-level radioactive waste	2014

CSA	N292.5	Guideline for the exemption of clearance from regulatory control of materials that contain, or potentially contain, nuclear substances	2011

With respect to the storage and management of spent nuclear fuel, the waste management program should reflect the fundamental safety principles as applied to nuclear waste. Namely, the systems that are designed and operated should assure subcriticality, control radiation exposure, assure heat removal, assure containment and allow retrievability.

11.2 Decommissioning Plan

Licence Condition 11.2:

The licensee shall maintain a decommissioning plan.

Preamble:

Paragraph 3(k) of the *Class I Nuclear Facilities Regulations* requires that a licence application contain the proposed plan for decommissioning of the nuclear facility.

This licence condition requires that the licensee maintain a preliminary decommissioning plan (PDP). A PDP provides an overview of the proposed decommissioning approach that is sufficiently detailed to assure that the proposed approach is, in the light of existing knowledge, technically and financially feasible, and appropriate in the interests of health, safety, security and the protection of the environment. The PDP defines areas to be decommissioned and the general structure and sequence of the principle work packages. The PDP forms the basis for establishing and maintaining a financial arrangement (financial guarantee – see LC G.5) that will assure adequate funding of the decommissioning plan.

It is expected that the PDP will be revised as the conditions at the facility change.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
W-PROG-WM-0003	Decommissioning Program	Yes
W-PROC-WM-0093	Planning for Decommissioning	No
W-STD-WM-0005	Conduct of Decommissioning	No
P-PLAN-00960-00001	Preliminary Decommissioning Plan – Pickering Nuclear Generating Stations A and B	Yes

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CSA	N294	Decommissioning of facilities containing nuclear substances	2009	2013-09-01

Decommissioning Plans

The decommissioning plan shall be kept current to reflect any changes in the site or nuclear facility. The decommissioning plan shall be revised at a minimum every five years, unless specified otherwise by the Commission. See REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants* (LC 3.3). The latest revision of OPG's N-PLAN-00960-00001, *Preliminary Decommissioning Plan – Pickering Nuclear Generating Stations A and B* was submitted to the CNSC on January 31, 2017. When the PDP is revised the cost of decommissioning must be reviewed. OPG's next submission of the PDP for the Pickering Nuclear Generating Stations A and B is due to be submitted to CNSC staff in 2022.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	G-206	Financial Guarantees for the Decommissioning of Licensed Activities	2000
CNSC	G-219	Decommissioning Planning for Licensed Activities	2000

CNSC regulatory document G-219 *Decommissioning Planning for Licensed Activities* provides guidance regarding the preparation of decommissioning plans for activities licensed by the CNSC. It also provides the basis for calculating the financial guarantees discussed in the regulatory document G-206 *Financial Guarantees for the Decommissioning of Licensed Activities* (further discussed under licence condition G.5)

12 SCA – SECURITY

12.1 Nuclear Security Program

Licence Condition 12.1:

The licensee shall implement and maintain a security program.

Preamble:

The nuclear security puts in place provisions to prevent, detect and stop malevolent acts, such as theft, sabotage, unauthorized access, illegal transfer or other acts involving nuclear material, other radioactive substances or their associated facilities.

The *Nuclear Security Regulations* require every licensee to: conduct, at least once every 12 months, a threat and risk assessment specific to a facility where it carries on licensed activities in order to determine the adequacy of its physical protection system; make modifications to its physical protection system, as necessary, to counter any credible threat identified as a result of the threat and risk assessment; keep a written record of each threat and risk assessment that it conducts and provide a copy of the written record, together with a statement of actions taken as a result of the threat and risk assessment, to the Commission within (within 60 days) after completion of the assessment.

The security SCA includes the following SpAs:

- Facilities and Equipment;
- Response arrangements;
- Security practices; and
- Drills and exercises.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
N-PROG-RA-0011	Nuclear Security	Yes
TRAN-PLAN-03450-10000	Transport Security Plan	Yes
N-PROC-MP-0103	Security for Real-Time Process Computing System	No
OPG-POL-0035	Cyber Security Policy	No
P-LIST-69000-00001	Significant Cyber Assets	No

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	REGDOC-2.12.1	High-Security Sites: Nuclear Response Force	2013	2016-09-23
CNSC	REGDOC-2.12.2	Site Access Security Clearance	2013	2016-09-23
CNSC	REGDOC-2.12.3	Security of Nuclear Substances: Sealed Sources	2013	2017-06-19
CNSC	RD-321	Criteria for Physical Protection Systems and Devices at High-Security Sites	2010	2013-09-01
CNSC	RD-361	Criteria for Explosive Substance Detection, X-ray Imaging, and Metal Detection Devices at High-Security Sites	2010	2013-09-01
CSA	N290.7	Cyber security for nuclear power plants and small reactor facilities	2014	2019-11-30

Facilities and Equipment/Response Arrangements/Security Practices/Drills and Exercises

<u>Nuclear Security Program</u>

The licensee shall ensure the identified vital areas within the nuclear facility are protected against design basis threats and any other credible threat identified in their Threat and Risk Assessment documentation. The prime functions that must be maintained to prevent unacceptable radiological consequences are those of control, cool, and contain.

The licensee shall maintain the operation, design and analysis provisions credited in the above assessments to ensure adequate engineered safety barriers for the protection against malevolent acts. The provisions for the protection against malevolent acts shall be documented as part of a managed sub-program or process within the management system. The licensee shall summarize changes in design, analysis or operational procedures that are credited for the protection against malevolent acts in the annual threat and risk assessment, and submit a copy to the Commission in accordance with the *Nuclear Security Regulations*.

All detection devices shall be installed, operated and maintained in accordance with manufacturers' specifications and meet the criteria in RD-321 and RD-361.

The licensee shall implement measures for the purpose of preventing and detecting unauthorized entry into a protected area or inner area at a high-security site, including:

- vehicle barriers and vehicle access control points
- perimeter intrusion detection systems and devices
- closed-circuit video systems/ devices for applications in a protected area or inner area
- security monitoring rooms
- security monitoring room systems and devices

Cyber Security

The licensee's cyber-security program shall be implemented and maintained to protect the cyber-essential assets (CEA) for nuclear safety, physical protection and emergency preparedness functions from cyber-attacks.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	G-274	Security Programs for Category I or II Nuclear Material or Certain Nuclear Facilities	2003
CNSC	G-208	Transportation Security Plans for Category I, II or III Nuclear Material	2003
IAEA	IAEA Nuclear Security Series No. 4 Technical Guidance	Engineering Safety Aspects of the Protection of Nuclear Power Plants Against Sabotage	2007
IAEA	IAEA Nuclear Security Series No. 13 Recommendations	Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities	Revision 5
IAEA	IAEA Nuclear Security Series No. 17 Technical Guidance	Computer Security at Nuclear Facilities	2011

13 SCA – SAFEGUARDS AND NON-PROLIFERATION

13.1 Safeguards Program

Licence Condition 13.1:

The licensee shall implement and maintain a safeguards program.

Preamble:

Safeguards is a system of inspection and other verification activities undertaken by the IAEA in order to evaluate a Member State's compliance with its obligations pursuant to its safeguards agreements with the IAEA.

Canada has entered into a Safeguards Agreement and an Additional Protocol (hereafter referred to as "safeguards agreements") with the IAEA pursuant to its obligations under the *Treaty on the Non-Proliferation of Nuclear Weapons* (INFCIRC/140). The objective of the Canada-IAEA safeguards agreements is for the IAEA to provide assurance on an annual basis to Canada and to the international community that all declared nuclear materials are in peaceful, non-explosive uses and that there is no indication of undeclared nuclear materials or activities. This conclusion confirms that Canada is in compliance with its obligations under the following Canada-IAEA safeguards agreements:

- *Agreement Between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*
- *Protocol Additional to the Agreement Between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*

These are reproduced in information circulars INFCIRC/164, and INFCIRC/164/Add. 1.

The scope of non-proliferation activities carried out under this licence is limited to tracking and reporting of foreign obligations and origins of nuclear material, which includes the enriched uranium for Shutdown System Enhancement fission chambers. Additionally, the import and export of controlled nuclear substances, equipment and information identified in the *Nuclear Non-proliferation Import and Export Control Regulations* require separate authorization from the CNSC, consistent with section 3.(2) of the *General Nuclear Safety and Control Regulations*. The guidance to seek such an authorization is provided in REGDOC-2.13.2 – *Import and Export*.

The safeguards and non-proliferation SCA includes the following SpAs:

- Nuclear material accountancy and control;
- Access and assistance to the IAEA;
- Operational and design information;
- Safeguards equipment, containment and surveillance; and

- Import and Export (see above regarding separate authorization).

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
N-PROG-RA-0015	Nuclear Safeguards	Yes
N-STD-RA-0024	Nuclear Safeguards Implementation	Yes

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	RD-336	Accounting and Reporting of Nuclear Material	2010	2013-09-01

<u>Safeguards Program</u>

To ensure the safeguards program enables Canada to meet its international safeguards obligations, the licensee shall:

- Make and submit reports to the Commission on the inventory and transfer of fissionable and fertile substances in accordance with the regulatory document RD-336, *Accounting and Reporting of Nuclear Material*, or as otherwise stipulated in any regulatory document that replaces RD-336.
- Disclose to the Commission, to the IAEA, or to an IAEA inspector, any records that are required to be kept or any reports that are required to be made under a safeguards agreement.
- Make such reports and provide such information to the Commission as are required to facilitate Canada's compliance with any applicable safeguards agreement.
- Provide the IAEA, an IAEA inspector, or a person acting on behalf of the IAEA, with such reasonable services and assistance as are required to enable the IAEA to carry out its duties and functions pursuant to a safeguards agreement.
- Grant prompt access at all reasonable times to all locations at the nuclear facility to an IAEA inspector, or to a person acting on behalf of the IAEA, where such access is required for the purposes of carrying on an activity pursuant to a safeguards agreement. In granting access, the licensee will provide health and safety services and escorts as required in order to facilitate activities pursuant to a safeguards agreement.
- Provide such reasonable assistance to an IAEA inspector, or to a person acting on behalf of the IAEA, as is required to enable sampling and removal or shipment of samples required pursuant to a safeguards agreement.
- Provide such reasonable assistance to an IAEA inspector, or to a person acting on behalf of the IAEA, as is required to enable measurements, tests and removal or shipment of equipment required pursuant to a safeguards agreement.

- At the request of the Commission, or of a person authorized by the Commission, install safeguards equipment at the nuclear facility.
- Permit an IAEA inspector, or a person acting on behalf of the IAEA, to service safeguards equipment at the nuclear facility.
- Operate safeguards equipment at the nuclear facility in accordance with the methods and procedures specified by the IAEA.
- Provide the services required for the operation of the safeguards equipment at the nuclear facility, in accordance with the specifications of the IAEA.
- Not interfere with or interrupt the operation of safeguards equipment at the nuclear facility, or alter, deface or break a safeguards seal, except pursuant to a safeguards agreement.
- Implement measures to prevent damage to, or the theft, loss or sabotage of safeguards equipment or samples collected pursuant to a safeguards agreement or the illegal use, possession, operation or removal of such equipment or samples.

Some additional reporting requirements in RD-336 are relaxed effective February 17, 2016 (see CNSC letter e-Doc 4918737):

- Pickering NGS is no longer required to submit monthly General Ledgers for months in which no inventory changes occur. Note that this does not remove the requirement to create and retain General Ledgers, and to provide them at CNSC or IAEA request.
- Pickering NGS is no longer required to create or submit Summary of Inventory Change reports.
- Pickering NGS is no longer required to create or submit Obligated Materials Information Summary (OMIS) reports for years in which there was no inventory of foreign-obligated materials in their possession. An OMIS must still be submitted for any year in which the foreign obligated material inventory is not zero for the entirety of the year.

Safeguards measures are included in operation, equipment or procedures are considered to be part of the licensing basis. With respect to the implementation of safeguards measures, changes made by the licensee to operation, equipment or procedures as of the result of agreement between the licensee, the CNSC and the IAEA are considered routine.

If a requested change would adversely impact Canada’s compliance with its safeguards agreements, CNSC staff do not have the authority to give approval, as this would violate the obligations arising from the Canada-IAEA safeguards agreement.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	GD-336	Guidance for Accounting and Reporting of Nuclear Material	2010
CNSC	REGDOC-2.13.1	Safeguards and Nuclear Material Accountancy	2018

CNSC	REGDOC-2.13.2	Import and Export	2016

OPG is expected to provide an implementation plan and gap analysis for REGDOC-2.13.1 by July 31, 2018. See e-Doc 5510468 for more information.

14 SCA – PACKAGING AND TRANSPORT

14.1 Packaging and Transport Program

Licence Condition 14.1:

The licensee shall implement and maintain a packaging and transport program.

Preamble:

Every person who transports radioactive material, or requires it to be transported, shall act in accordance with the requirements of the *Transportation of Dangerous Goods Regulations* (*TDGR*) and the *Packaging and Transport of Nuclear Substances Regulations, 2015* (*PTNSR* 2015).

The *PTNSR* 2015 and the *TDGR* provide specific requirements for the design of transport packages, the packaging, marking and labeling of packages and the handling and transport of nuclear substances.

The packaging and transport SCA includes the following SpAs:

- Package design and maintenance;
- Packaging and transport; and
- Registration for use.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
W-PROG-WM-0002	Radioactive Material Transportation	No
N-STD-RA-0036	Radioactive Materials Transportation Emergency Response Plan	No

Package Design and Maintenance

PTNSR 2015 apply to the packaging and transport of nuclear substances, including the design, production, use, inspection, maintenance and repair of packages, and the preparation, consigning, handling, loading, carriage and unloading of packages.

Where necessary, OPG package designs are certified by the CNSC.

Packaging and Transport (Program)

The licensee shall implement and maintain a packaging and transport program that will ensure compliance with the requirements of the TDGR and the PTNSR 2015 for all shipments of nuclear substances to and from the Pickering NGS site. Shipments of nuclear substances within the nuclear facility where access to the property is controlled are exempted from the application of TDGR and PTNSR 2015.

Registration and Use

OPG's packaging and transport program also covers the registration for use of certified packages as required by the regulations.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	REGDOC 2.14.1	Information Incorporated by Reference in Canada's Packaging and Transport of Nuclear Substance Regulations, 2015	2016

15 NUCLEAR FACILITY-SPECIFIC

15.1 Periodic Safety Review Integrated Implementation Plan

Licence Condition 15.1:

The licensee shall implement the Integrated Implementation Plan.

Preamble:

In support of the application (see LC G.1 for more information) for renewal of Pickering NGS Power Reactor Operating Licence (PROL), Ontario Power Generation (OPG) conducted a Periodic Safety Review (PSR) in accordance with the requirements of REGDOC-2.3.3, Periodic Safety Reviews. In conducting the PSR, OPG built on the results of several earlier safety reviews such as the work performed in support of Units 1 and 4 return to service, the 2009 Integrated Safety Review (ISR) conducted for Pickering NGS B, and the Darlington ISR completed in 2015 (because of these previous reviews, the current PSR is sometimes referred to as PSR2). LC 15.1 requires the licensee to implement the results of the PSR to ensure the continued safe and reliable commercial operation of Pickering NGS to the end of 2024. The results of Pickering NGS PSR are documented in an Integrated Implementation Plan (IIP), developed in accordance with REGDOC-2.3.3. Should OPG request to extend the operation of any Pickering reactor unit beyond December 31, 2024, OPG shall be required to reassess the impact of such extended operation on the licensing basis and continued plant safety, and submit the results of such reassessment for CNSC staff acceptance in accordance with REGDOC-2.3.3.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
P-REP-03680-0031	Pickering NGS Periodic Safety Review 2 (PSR2) Integrated Implementation Plan	Yes
P-INS-03680-00001	Pickering IIP Administration	Yes

Licensing Basis Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
CNSC	REGDOC-2.3.3	Periodic Safety Reviews	2008	2018-09-01

The PSR IIP contains commitments with target completion dates for safety enhancement actions; the last of which is to be completed by December 31, 2020. OPG instruction P-INS-03680-00001, *Pickering IIP Administration* was developed by OPG and reviewed by CNSC staff for matters such as IIP management, change control, completion and closure of actions, reporting, roles and responsibilities, and communication with CNSC

Among the high-ranked IIP committed actions are the following:

- Upgrading, as well as annually updating and submitting to CNSC the Life Cycle Management Plans (LCMP) for fuel channels demonstrating their fitness for service for operation to the end of commercial operation.
- Assessing the impact of aging on safety analyses.
- Upgrading Pickering NGS Units 1 and 4 water makeup provisions to the steam generators, heat transport system and calandria.
- Providing additional means for restoring emergency cooling water and electric power to the Air Conditioning Units (ACUs) in reactor units and the Pressure Relief Duct (PRD), as well as emergency electric powers to Hydrogen Igniters, Filtered Air Discharge System (FADS) and Main Volume Vacuum Pumps.
- Interconnecting the Fire Protection System water supplies of Pickering Units 1, 4 and Units 5-8.
- Updating the LCMP for the steam generators, feeders, and calandria internal components.
- Completing the Pickering Units 5-8 Irradiated Fuel Bay Leak Mitigation Project.
- Developing and implementing Condition Assessment action tracking and reporting process including a database.

Detailed criteria for implementing the results of the PSR are as follows:

- The licensee shall progress to completion the actions identified during the PSR and documented in the P-REP-03680-0031, *Pickering NGS Periodic Safety Review 2 (PSR2) Integrated Implementation Plan*.
- In each calendar year, and as per P-INS-03680-00001, *Pickering IIP Administration*, the licensee shall submit a quarterly progress report on the IIP implementation, no later than fifteen calendar days from the end of the quarter.
- The licensee quarterly progress reports on the IIP implementation should contain, as a minimum, the following:
    - Summary of changes in the IIP Administration, IIP Change Control, Action completion and closure targets;
    - A list of actions completed since the last quarter, emphasizing physical improvements;
    - A list of actions to be completed in the subsequent four quarters, emphasizing physical improvements;
    - Intent and non-intent changes effected; and
    - Requests for closure of completed actions.

- For each calendar year, and as per P-INS-03680-00001, *Pickering IIP Administration*, the licensee shall submit an annual report on the state of the IIP execution, no later than February 28 of the following year.
- The licensee annual status report on the IIP implementation shall contain, as a minimum, the following:
  - Summary of changes in the IIP Administration, IIP Change Control, Action completion and closure targets;
  - Update of the information included in Appendix B of REP-03680-00031, *Pickering NGS Periodic Safety Review 2 (PSR2) Integrated Implementation Plan*, reflecting most current information;
  - Actions completed since the last annual report, emphasizing physical improvements;
  - Actions to be completed in the subsequent year, emphasizing physical improvements;
  - Intent and non-intent changes effected during the reporting year;
  - Requests for closure of completed IIP actions during the year;
  - Request for closure of completed Resolution Statements during the year; and
  - Changes to the IIP pending CNSC acceptance/concurrence.
- For any of the Pickering units to operate beyond December 31, 2024, the licensee shall perform and complete by or before December 31, 2022 a reassessment of the continued validity of the PSR results and, as a minimum, shall:
  - Reassess the results of the global assessment included in the PSR *Global Assessment Report* (GAR);
  - Include new or revised requirements, expectations and practices that became available since the freeze-date of the PSR stated in P-REP-03680-0001, *Pickering NGS Periodic Safety Review 2 (PSR2) Basis Document*;
  - For any newly identified findings, utilize the consolidation, prioritization and ranking methods employed in performing the PSR global assessment to formulate new global issues and resolutions plans;
  - Evaluate the continued validity of conclusions reached in PSR; and
  - Revise the IIP by incorporation the results of the reassessment as new or modified IIP actions, and submit the revised IIP for CNSC acceptance.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CSA	N290.18	Periodic safety review for nuclear power plants	2017
IAEA	Specific Safety Guide No. SSG-25	Periodic Safety Review for Nuclear Power Plants	2013

15.2 Safe Storage of Units 2 and 3

Licence Condition 15.2:

The licensee shall maintain Units 2 and 3 in the safe storage phase.

Preamble:

Units 2 and 3 were shutdown at the end of December 1997. Units 2 and 3 were not returned to service and placed in safe storage. Both Units 2 and 3 have been de-fuelled and D_2O in both the moderator and the Heat Transport System (HTS) drained completely.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
NA44-SR-01320-00001	Pickering A Safety Report (Part 1)	No

The licensing basis for all units of the Pickering Nuclear Generating Station including units 2 and 3 is described throughout the LCH.

Guidance:

The graded approach may be applied commensurate with risk, in accordance with Section 4.1.3 of CSA N286, *Management System Requirements for Nuclear Facilities*, when considering implementation of safety provisions specific to units 2 and 3

15.3 Pressure Tube Assessment for Safe Operation

Licence Condition 15.3:

Before Hydrogen equivalent concentration exceeds 120 ppm, the licensee shall demonstrate that pressure tube fracture toughness will be sufficient for safe operation beyond 120 ppm.

Preamble:

OPG submits assessments for fuel channel components to support safe operation and satisfy compliance verification criteria in CSA N285.4 and CSA N285.8 as outlined in LC 6.1. These assessments rely on models intended to predict the current and future conditions of fuel channel components. Fracture toughness models are used to assess likelihood of pressure tube failure from postulated flaws in the reactor core, through CSA N285.8-15 Clause 7 evaluations. The current model for fracture toughness in CSA N285.8 has an upper bound for hydrogen equivalent (Heq) concentration in pressure tubes of 120 parts per million (ppm).

If OPG predicts that Pickering NGS will operate any pressure tube with Heq concentration in excess of 120 ppm, before the end of an evaluation period, OPG must demonstrate that this has no impact on safe operation.

Current OPG Heq concentration predictions are not expected to reach 120 ppm before the end of commercial operation of the Pickering NGS units.

Compliance Verification Criteria:

The following compliance verification criteria apply to Pickering NGS Unit with a pressure tube predicted to exceed 120 ppm in Heq concentration.

OPG shall provide prior written notification and seek CNSC staff concurrence before operating any pressure tube with a predicted Heq concentration greater than 120 ppm between the inlet and outlet burnish marks.

At least one year prior to any pressure tube reaching an Heq concentration of 120 ppm, OPG shall submit a technical basis document for the Fracture Toughness Model that is intended to support operation of pressure tubes with Heq predictions in excess of 120 ppm. OPG shall concurrently submit a schedule for the activities to support model development and validation.

Until the Fracture Toughness Model is accepted for use, OPG shall report, on a semi-annual basis, the following:

- Status updates on the validation of the Fracture Toughness Model;
- Quantitative assessment of uncertainties for the revised Model as new test data are added;
- Updates to the test plan, which includes:
  - status of findings and outcomes from previous fracture toughness tests;
  - additions and changes to the test plan;

- o changes to the test strategy; and
- o results of fracture toughness tests including, as a minimum, material tested, test conditions, the results, whether the test objective has been met, and
- o the tests planned for the next six months.

Guidance:

Guidance Publications				
Org	**Document #**	**Title**	**Version**	**Effective Date**
COG	JP-4491-V197	Fuel Channel Life Management – Third Party Review of Probabilistic Fracture Protection Evaluation Methodology Acceptance Criteria	March 2017	2018-09-01
COG	JP-4452-V119	Theory Manual for the Evaluation Module of Probabilistic Core Assessment Computer Code SCEPTR V1.2e	2015	2018-09-01

Attributes for an Acceptable Fracture Toughness Model

To support the licensing application of the updated Model(s), OPG should demonstrate that the model can:

- Explicitly account for actual hydride orientation;
- Account for the variation in hydride morphology from pressure tube inlet to outlet;
- Predict hydride fracture, as a function of hydride length and temperature;
- Predict the transition-to-upper shelf temperature;
- Account for hydride length and orientation (using improved fracture path and ligament rupture models);
- Explicitly model the fissures initiating at zirconium-chlorine-carbon precipitates; and
- Make use of the conventional traction-separation rule applied to finite-element cohesive-zone analyses.

Uncertainty Analysis

To support the licensing application of the revised Model(s), a quantitative assessment of uncertainties should be conducted. The assessment should utilize the approach in sections A.1, A.2 and A.5 of Appendix A to COG-JP-4491-V197, "*Fuel Channel Life Management: Third Party Review of Probabilistic Fracture Protection Evaluation Methodology and Acceptance Criteria*", e-Doc 5230291.

Predicted Maximum Heq Concentration

The predicted Heq concentration at the inlet and outlet burnish marks at the end of the evaluation period should be determined through a station or unit-specific model. The initial Hydrogen concentration should be from off-cut measurements and be channel-specific, the unit-specific bounding value, or the station-specific bounding value. Operating conditions such as temperature and fast flux, where applicable to the model or its components, should be channel-specific, the unit-specific bounding combination, or the station-specific bounding combination. If any inputs are sampled from a distribution, the inputs as well as their percentiles should be justified. For a parametric or probabilistic approach, the input for and choice of the upper-bound percentile for the Heq prediction at the end of the evaluation period should be justified. In accordance with Clauses 12.3.4.6 and 12.4.4.6 of CSA N285.4, OPG should report all of the parametric data and inputs used in the determination and prediction of the Heq concentration values.

The maximum limit of 120 ppm for Heq concentration identified in this LC is the validity limit for the currently used fracture toughness model (see also LC 6.1) in accordance with CSA N285.8-15 Clause D.13.2. This limit should be distinguished from the maximum Heq concentration limit(s) identified in CSA N285.8-15 Clause 8.2(a), which provides the material surveillance measurement requirements for the inspected pressure tubes. LC 6.1 provides additional CVC for Pickering pressure tubes predicted to exceed the maximum Heq concentration limit identified in CSA Standard N285.8-15 Clause 8.2(a).

15.4 End of Commercial Operations

Licence Condition 15.4:

The licensee shall implement and maintain plans for end of commercial operations of all Pickering units.

Preamble:

On June 28, 2017, OPG informed the CNSC that all Pickering units would cease commercial operation on December 31, 2024 (P-CORR-00531-04930, e-doc 5290277).

As a result of this announcement, CNSC staff revised regulatory expectations specific to the end of commercial operation to reflect evolving elements of the regulatory framework. Previous regulatory expectations had been developed in 2011, in the anticipation that Pickering NGS would cease commercial operation in 2020. The revised regulatory expectations are detailed in CNSC letter, e-doc 5307950, dated August 2, 2017.

This licence condition states the regulatory requirement for the licensee to implement and maintain plans for the end of commercial operation for Pickering NGS. According to the CNSC letter of August 2, 2017, these plans are to include:

- A sustainable operations plan (SOP) for the safe operation until the final permanent shutdown of each reactor, and
- A stabilization activity plan (SAP) for transitioning every shutdown reactor unit to the safe storage state.

This licence condition also ensures that operation beyond December 31, 2024 would constitute a change in the licensing basis requiring approval by the Commission.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
P-PLAN-09314-00003	Pickering Site Strategic Plan	No

CNSC regulatory requirements and expectations for the systematic preparation for the end of commercial operation of Pickering NGS are detailed in CNSC letter, e-doc 5307950, dated August 2, 2017.

End of Commercial Operation - General Requirements

- The licensee shall notify the CNSC, in writing and no later than December 31, 2022, of its intent to operate any reactor unit of Pickering NGS beyond December 31, 2024 and provide as a minimum the following:

- Changes to OPG P-PLAN-09314-00003, *Pickering Site Strategic Plan*;
- Revised dates for end of commercial operation of each Pickering operating reactor units;
- Timeline for the reassessment of the impact of operations beyond 2024, based on the global assessment included in P-REP-03680-00032, *Pickering NGS PSR2 Global Assessment Report*, and the consequential impact on identifying new findings that could result in new IIP actions (See also LC 15.1 and 15.3 and LC 15.1 for WN of the GAR); and
- Request for CNSC acceptance, by a specific date, of potential new or revised actions in P-REP-03680-0031, *Pickering NGS Periodic Safety Review 2 (PSR2) Integrated Implementation Plan* (See LC 15.1 for WN of the IIP).

- The licensee shall establish and implement an end of commercial operation (ECO) strategy that includes:

  - A sustainable operations plan (SOP) to manage anticipated challenges while approaching the ECO of any reactor unit to be shut down; and

  - A stabilization activity plan (SAP) to manage the transition period until all the units of Pickering NGS are placed in a Safe Storage Stage (SSS).

SOP – Specific Requirements

- The sustainable operations plan (SOP) shall be developed and implemented at least five years preceding the permanent shutdown of the first unit of Pickering NGS.
- For any subsequent Pickering NGS unit to be shut down, the SOP shall be updated using lessons learned from previous application.

SAP – Specific Requirements

- The stabilization activity plan (SAP) shall be developed at least 3 years prior to, and be implemented immediately after the permanent shutdown of the first unit of Pickering NGS.
- For any subsequent Pickering unit to be shut down, the SAP shall to be updated using lessons learned from previous application.

Annual updates to the SOP and SAP shall be submitted by December 15 of each year, and include a report on the progress and effectiveness of measures committed to in these two plans.

Guidance:

Additional guidance is provided in the CNSC letter, e-doc 5307950, dated August 2, 2017.

15.5 Cobalt-60 Program

Licence Condition 15.5:

The licensee shall implement and maintain a Cobalt-60 program for activities described under Part IV) of this licence.

Preamble:

This LC provides basis for regulatory oversight related to the licensed activity associated with Cobalt-60. Pickering NGS Units 1 and 4 currently do not produce Cobalt-60, but OPG is authorized to produce Cobalt-60 as a commercial by-product at Pickering NGS Units 5 to 8. Cobalt-60 rods are packaged and shipped off-site. OPG is under contractual obligation to take back the spent Cobalt-60 that has reached the end of its service life (the spent Cobalt-60 arrives to the site in form of sealed sources).

The CNSC has strengthened its regulatory controls on sealed sources, principally through establishment of a sealed source tracking system within an upgraded national sealed source registry and enhanced export and import controls for high-risk sealed sources. These measures provide for safe and secure management and protection of such sources in Canada and are consistent with strengthened international norms in these areas, particularly with respect to the IAEA *Code of Conduct on the Safety and Security of Radioactive Sources*.

OPG is exempted from the requirement for leak testing in accordance with Section 18(2)(d) of the *Nuclear Substances and Radiation Devices Regulations*, based on the Summary Record of Proceedings and Decision (e-Doc 3609970), which detailed that the sealed sources are stored underwater and that OPG's equipment is capable of detecting waterborne contamination of 200 Bq or less of a nuclear substance.

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
P-OM-018-31985-01	Cobalt Processing - Table of Contents/Revision History	No
P-OP-31985-0001	Cobalt Processing Procedure	No
P-OM-018-31985-04.04.12	Cobalt Processing – Cobalt Handling	No

When managing Cobalt-60 produced at Pickering NGS Units 5 to 8 OPG shall follow the Operating Manual "Cobalt Processing" and the relevant associated procedures.

Applicable requirements set out in the Transport Canada *Transportation of Dangerous Goods Regulations* and in the CNSC *Packaging and Transport of Nuclear Substances Regulations* shall be met before transferring Cobalt-60 and shipping it off-site.

When managing and storing Cobalt-60 sealed sources, OPG shall follow the Operating Manual section 4.4.12 “Cobalt Handling” and the relevant associated procedures.

Cobalt-60 sealed sources are recorded in the CNSC database (the Sealed Source Tracking System) that tracks the location of each significantly hazardous radioactive source (IAEA Category 1 and 2 sources) in Canada.

The licensee shall submit a report in writing within 48 hours of any receipt of a Cobalt-60 sealed source with an activity equal to, or greater than, 0.3 TBq in accordance with the requirements of REGDOC-3.1.1 (LC 3.3). The report shall be submitted to the CNSC in accordance with standard communication protocols. The report shall include:

(i) The date of receipt of a transfer,

(ii) The name of the shipper and licence number,

(iii) The address of the shipper's authorized location,

(iv) The nuclear substance,

(v) Activity (radioactivity) (Bq) per source on the reference date,

(vi) The reference date,

(vii) The number of sealed source(s), and

(viii) The aggregate activity (Bq).

<u>Guidance:</u>

This section has no contents.

15.6 Import and Export of Nuclear Substances

Licence Condition 15.6:

The licensee shall limit the import and export of nuclear substances to those occurring as contaminants in laundry, packaging, shielding or equipment.

Preamble:

OPG is authorized to import and export nuclear substances occurring as contaminants in laundry originating from the Pickering NGS site and the Western Waste Management Facility (WWMF). Under this licence condition, Pickering NGS is allowed to accept contaminated laundry from WWMF to combine with the Pickering laundry prior to export to the United States for laundering. In addition to contaminated laundry, the licence condition allows for import and export of packaging, shielding or equipment with low levels of contamination similar to laundry. This licence condition does not authorize OPG to import and export controlled nuclear substances as defined under the Nuclear Non-Proliferation Import and Export Control Regulations.

This licensed activity was previously authorized under NSRD licence 12861-15-19.1. The original licensing basis for this activity is described in OPG's November 25, 2011, licence application for the renewal of the NSRD licence 12861-15-12.0 (N-CORR-00531-05496, e doc 3846889).

Compliance Verification Criteria:

Licensee Documents that Require Notification of Change		
Document #	**Title**	**Prior Notification**
W-PROG-WM-0002	Radioactive Material Transportation	No

The licensee shall limit the import and export of nuclear substances to the nuclear substances and quantities listed in Table 1 as follows:

Table 1: Nuclear Substances and Quantity Limits for Import and Export

Nuclear Substance	Maximum Total Quantity
Americium 241	10 MBq
Antimony 122	10 GBq
Antimony 124	50 GBq
Antimony 125	20 GBq
Carbon 14	10 GBq
Cerium 141	1 GBq

Nuclear Substance	Maximum Total Quantity
Cerium 144	1 GBq
Cesium 134	1 GBq
Cesium 137	5 GBq
Chromium 51	50 GBq
Cobalt 57	10 MBq
Cobalt 58	100 MBq
Cobalt 60	50 GBq
Curium 242	1 MBq
Curium 244	100 kBq
Deuterium	350 mg
Europium 154	50 MBq
Europium 155	50 MBq
Gadolinium 153	100 MBq
Gadolinium 159	500 MBq
Hafnium 181	10 MBq
Hydrogen 3 (Tritium)	10 GBq
Iodine 129	200 kBq
Iodine 131	2 MBq
Iodine 133	2 MBq
Iron 55	10 GBq
Iron 59	50 GBq
Lanthanum 140	1 MBq
Manganese 54	5 GBq
Manganese 56	5 GBq
Molybdenum 99	1 MBq
Neptunium 237	1 kBq
Neptunium 239	500 kBq
Nickel 59	200 MBq
Nickel 63	500 MBq
Niobium 94	10 MBq
Niobium 95	5 GBq

Nuclear Substance	Maximum Total Quantity
Plutonium 238	1 MBq
Plutonium 239	50 MBq
Plutonium 240	1 MBq
Plutonium 241	58 MBq
Promethium 147	50 MBq
Ruthenium 103	1 GBq
Ruthenium 106	1 GBq
Scandium 46	50 MBq
Silver 108m	100 kBq
Silver 110m	10 MBq
Strontium 89	5 MBq
Strontium 90	10 MBq
Tantalum 182	50 kBq
Tin 113	50 MBq
Tungsten 187	1 MBq
Uranium 234	1 kBq
Uranium 235	1 kBq
Uranium 238	10 kBq
Zinc 65	5 MBq
Zirconium 93	100 GBq
Zirconium 95	100 GBq

The licensee is not authorized, subject to any restrictions or exemptions under the regulation, to import or export the items described in Parts A and B of the Schedule to the *Nuclear Non-Proliferation Import and Export Control Regulations,* such as:

(1) Special fissionable material, as described in paragraph A.1.1:

(i) Plutonium;

(ii) Uranium 233;

(iii) Uranium enriched in Uranium 233 or Uranium 235.

(2) Source material, as described in paragraph A.1.2:

(i) Uranium, containing the mixture of isotopes that occurs in nature;

(ii) Uranium, depleted in the isotope Uranium 235; and

(iii) Thorium.

(3) Deuterium and heavy water, as described in paragraph A.1.3.

(4) Tritium, as described in paragraph A.1.5.

(5) Alpha-emitting nuclear substances, as described in paragraph B.1.1.1, including but not limited to:

(i) Actinium 225, 227;

(ii) Californium 248, 250, 252, 253, 254;

(iii) Curium 240, 241, 242, 243, 244;

(iv) Einsteinium 252, 253, 254, 255;

(v) Fermium 257;

(vi) Gadolinium 148;

(vii) Mendelevium 258, 260;

(viii) Neptunium 235;

(ix) Polonium 208, 209, 210;

(x) Radium 223; and

(6) Radium-226, as described in paragraph B.1.1.16.

Guidance:

Guidance Publications			
Org	**Document #**	**Title**	**Version**
CNSC	REGDOC-2.13.2	Import and Export	2016

APPENDIX A – ACRONYMS

The following is the list of acronyms used in the LCH:

ACU	Air Conditioning Units
Act (the)	*Nuclear Safety and Control Act*
ADL	Administrative Dose limits
AECB	Atomic Energy Control Board
AIA	Authorized Inspection Agency
AIM	Abnormal Incident Manual
AL	Action Levels
ALARA	As Low As Reasonably Achievable
ASME	American Society of Mechanical Engineers
BDBA	Beyond Design Based Accident
CANDU	CANadian Deuterium Uranium
CEA	Cyber Essential Assets
CMD	Commission Member Document
CME	Common Mode Events
CNEP	Consolidated Nuclear Emergency Plan
CNSC	Canadian Nuclear Safety Commission
COG	CANDU Owners Group
CRSS	Control Room Shift Supervisor
CSA	Canadian Standards Association
CT	Calandria Tube
cUL/ULC	Underwriters Laboratory of Canada
CVC	Compliance Verification Criteria
DBA	Design Basis Accident
DRL	Derived Release Limits
EAL	Environmental Action Levels
ECO	End of Commercial Operations
EFPH	Effective Full Power Hour
EMEG	Emergency Mitigating Equipment Guidelines
EMS	Environmental Management System
E-NOP	Enhanced Neutron Overpower Protection
EOP	Emergency Operating Procedures
EQ	Environmental Qualification
FADS	Filtered Air Discharge System
FC	Fuel Channel
FPP	Fire Protection Program
GAR	Global Assessment Report
Gd	Gadolinium
GSS	Guaranteed Shutdown State
Heq	Hydrogen Equivalent Concentration
HTS	Heat Transport System
IAEA	International Atomic Energy Agency
IFB	Industrial Fire Brigade
IIP	Integrated Implementation Plan
INFO	CNSC INFOrmation documents
ISI	In-service Inspection
IUC	Instrument Uncertainty Calculations

LBB	Leak Before Break
LBLOCA	Large Break LOCA
LC	Licence Condition
LCH	Licence Conditions Handbook
LCMP	Life Cycle Management Plans
LOCA	Loss of Coolant Accident
LORPR	Loss of Reactor Power Regulation
MCCP	Minimum Complement Coordination Program
MSC	Minimum Shift Complement
NDE	Non-destructive Examination
NEW	Nuclear Energy Worker
NFPA	National Fire Protection Association
NGS	Nuclear Generating Station
NOP	Neutron Overpower Protection
NoRU	Notification of Regulatory Undertakings
NPP	Nuclear Power Plant
NSCA	*Nuclear Safety and Control Act*
OMIS	Obligated Materials Information Summary
OPG	Ontario Power Generation Inc.
OP&P	Operating Policies and Principles
OPEX	Operating Experience
OSR	Operational Safety Requirements
OCAS	Outage Completion Assurance Statement
PARs	Passive Autocatalytic Combiners
PDP	Preliminary Decommissioning Plan
PIDP	Public Information Disclosure Program
PIP	Periodic Inspection Program
PLBB	Probabilistic Leak Before Break
PNERP	Provincial Nuclear Emergency Response Plan
PPE	Personal Protective Equipment
ppm	Parts Per Million
PR	Power Reactor
PRA	Probabilistic Risk Assessment
PRD	Pressurized Relief Duct
PROL	Power Reactor Operating Licence
PRPD	Pickering Regulatory Program Division
PSA	Probabilistic Safety Assessment
PSR	Periodic Safety Review
PT	Pressure Tube
PT-CT	Pressure Tube-Calandria Tube
R	Revision
RD	Regulatory Document
R&D	Research and Development
RBGSS	Rod Based Guaranteed Shutdown State
RBGSS-DM	Rod Based Guaranteed Shutdown State with a Drained Moderator
REGDOC	Regulatory Document
RP	Radiation Protection
SAMG	Severe Accident Management Guidelines
SAP	Stabilization Activity Plan
SCA	Safety and Control Area

SM	Shift Manager
SOE	Safe Operating Envelope
SOP	Sustainable Operations Plan
SpA	Specific Area
SRS	Systems Related Safety
SSCs	Structures, systems and components
SSS	Special Safety Systems
SQ	Seismic Qualification
TDGR	*Transportation of Dangerous Goods Regulations*
ULC/cUL	Underwriters Laboratory of Canada
VB	Vacuum Building
wk	Week
WN	Written Notification
WSIA	*Workplace Safety and Insurance Act*
WWMF	Western Waste Management Facility

APPENDIX B – GLOSSARY OF TERMS - DEFINITIONS

For definitions of terms used in this document, see REGDOC-3.6, *Glossary of CNSC Terminology*, which includes terms and definitions used in the *NSCA* and the regulations made under it, and in CNSC regulatory documents and other publications.

The following definitions, which have not been formally defined in REGDOC-3.6, are also applicable to this document.

Accept/ed/able/ance
Meet regulatory requirements, which mean it is in compliance with regulatory documents or technical standards referenced in the licence.

Approval
Commission's permission to proceed, for situations or changes where the licensee would be:

- Not compliant with a regulatory requirements set out in applicable laws and regulations, or
- Not compliant with a licence condition, or
- Not in the **safe direction** but the objective of the licensing basis is met.

Consent
Written permission to proceed, given by CNSC delegated authority, for situations or changes where the licensee would:

- Comply with a regulatory requirements set out in applicable laws and regulations;
- Comply with a licence condition; and
- Not adversely impact the licensing basis.

Effective Date
The date that a given document becomes effective within the licensing period. The effective date is either set to the licence issue date or to a future date when the given document becomes effective.

Extent of condition
Means an evaluation to determine if an issue has potential or actual applicability to other activities, processes, equipment, programs, facilities, operations or organizations.

Important to safety
Items important to safety include, but are not limited to:

- Structures, Systems or Components (SSC) whose malfunction or failure could lead to undue radiation exposure of the facility/site personnel, or members of the public.
- SSCs that prevent anticipated operational occurrences from leading to accident conditions.
- Those features that are provided to mitigate the consequences of malfunctions or failures of SSCs.
- Tasks, duties, activities, aging mechanisms, findings, or any work that improperly performed could lead to radiation exposure of the facility/site personnel, or members of the public.

Program(s)

A documented group of planned activities, procedures, processes, standards and instructions coordinated to meet a specific purpose.

Published Document(s)

A document issued or published for public knowledge, which are typically CNSC regulatory documents and CSA standards.

Qualified Staff

Trained licensee staff, deemed competent and qualified to carry out tasks associated to their respective positions.

Recommendations and Guidance

Non-mandatory suggestions on how to comply with the licence condition. Recommendations and guidance may include regulatory advice and/or recommended industry best practices to guide the licensee towards a higher level of safety and/or fully satisfactory performance/implementation of its programs.

Regulatory undertakings

Refers to high level commitments that ensure safety, not component work orders or regulatory predefined maintenance tasks. The licensee's deferral and Station Condition Record process focus on these lower level commitments.

Restart of the reactor

Means removal of the Guaranteed Shutdown State (GSS).

Safe direction

Means changes in plant safety levels which would not result in:

- A reduction in safety margins,
- A breakdown of barrier,
- An increase (in certain parameters) above accepted limits,
- An increase in risk,
- Impairment(s) of special safety systems,
- An increase in the risk of radioactive releases or spills of hazardous substances,
- Injuries to workers or members of the public,
- Introduction of a new hazard,
- Reduction of the defense-in-depth provisions,
- Reducing the capability to control, cool and contain the reactor while retaining the adequacy thereof, and
- Causing hazards or risks different in nature or greater in probability or magnitude than those stated in the safety analysis of the nuclear facility.

Safety and control measures

Measures or provisions that demonstrate that the applicant:

(i) is qualified to carry on the licensed activities, and

(ii) has made adequate provision for the protection of the environment, the health and safety of persons, the maintenance of national security and any measures required to implement international obligations to which Canada has agreed.

Written notification

A physical or electronic communication between a CNSC delegated authority and a person authorized to act on behalf of the licensee.

Written notification prior to implementation

CNSC must receive the written notification for the proposed changes within a reasonable time (based on the extent of the proposed changes and the potential impact on safe operation of the facility) prior to the implementation. This will allow sufficient time for CNSC staff to review the submission and determine the acceptability.

APPENDIX C – LIST OF LICENSEE DOCUMENTS THAT REQUIRE NOTIFICATION OF CHANGE

Document #	Document Title	Notification Requirements	L.C.
GENERAL			
NK30-D0A-10200-0001	Building Development Site Plan	When implemented	G.3
NA44-SR-01320-00001	Pickering A Safety Report (Part 1)	When implemented	G.3 15.2
NK30-SR-01320-00001	Pickering B Safety Report (Part 1)	When implemented	G.3
N/A	CNSC Financial Security and ONFA Access Agreement between OPG, the Province of Ontario and the CNSC effective January 1, 2018 (Commission Decision e-Doc 5400969 and CMD 17-H11 e-Doc 5306917.	PRIOR to implementation	G.5
W-STD-WM-0003	Nuclear Liability Management – Update of Cost Estimates for the Ontario Nuclear Funds Agreement and Financial Guarantee Processes	When implemented	G.5
N-STD-AS-0013	Nuclear Public Information Disclosure	When implemented	G.6
MANAGEMENT SYSTEM			
N-POL-0001	Nuclear Safety Policy	When implemented	1.1
N-CHAR-AS-0002	Nuclear Management System	PRIOR to implementation	1.1
N-PROG-AS-0001	Managed Systems	When implemented	1.1
N-STD-AS-0020	Nuclear Management Systems Organizations	When implemented	1.1
OPG-PROC-0166	Organization Design Change	When implemented	1.1
N-PROG-RA-0010	Independent Assessment	When implemented	1.1
N-PROC-RA-0097	Self-Assessment and Benchmarking	When implemented	1.1
N-PROC-RA-0023	Fleetview Program Health and Performance Rating	When implemented	1.1

Document #	Document Title	Notification Requirements	L.C.
N-PROG-RA-0003	Corrective Action	When implemented	1.1
N-PROC-RA-0035	Operating Experience Process	When implemented	1.1
N-PROC-RA-0022	Processing Station Conditions Records	When implemented	1.1
N-PROG-MP-0001	Engineering Change Control	When implemented	1.1
OPG-PROC-0178	Controlled Document Management	When implemented	1.1
N-STD-AS-0023	Nuclear Safety Oversight	When implemented	1.1
OPG-PROG-0010	Health and Safety Management System Program	When implemented	1.1 8.1
N-PROC-AS-0077	Nuclear Safety Culture Assessment	When implemented	1.1
N-STD-MP-0027	Configuration Management	When implemented	1.1
N-STD-OP-0024	Nuclear Safety Configuration Management	When implemented	1.1
OPG-PROG-0001	Information Management	When implemented	1.1
OPG-PROG-0009	Items and Services Management	When implemented	1.1
N-PROC-MM-0021	Supply Inspection	When implemented	1.1
N-PROG-AS-0005	Business Planning	When implemented	1.1
N-PROC-AS-0080	Nuclear Business Planning	When implemented	1.1
OPG-PROG-0033	Business Continuity Program	When implemented	1.1
OPG-PROG-0039	Project Management	When implemented	1.1
OPG-PROG-0010	Safety Management System Program	When implemented	1.1
HUMAN PERFORMANCE MANAGEMENT			
N-PROG-AS-0002	Human Performance	When implemented	2.1
P-PLAN-01900-00005	Pickering Human Performance Strategic Plan	When implemented	2.1

Document #	Document Title	Notification Requirements	L.C.
N-STD-OP-0002	Communications	When implemented	2.1
N-STD-OP-0012	Conservative Decision Making	When implemented	2.1
N-PROC-OP-0047	Limits of Hours of Work	PRIOR to implementation	2.1
P-INS-09100-00003	Pickering Minimum Shift Complement	PRIOR to implementation	2.2
P-INS-09260-00008	Duty Crew Minimum Complement Assurance	PRIOR to implementation	2.2
N-INS-03490-10003	Minimum Shift Complement Resources, Qualifications and Procedures Required for Responding to Resource Limiting Events	When implemented	2.2
N-PROG-TR-0005	Training	When implemented	2.3 2.4
N-PROC-TR-0008	Systematic Approach to Training	When implemented	2.3 2.4
N-MAN-08131-10000-CNSC-031	Responsible Health Physicist	PRIOR to implementation	2.4
N-MAN-08131-10000-CNSC-007	Shift Manager, Pickering Nuclear	PRIOR to implementation	2.4
N-MAN-08131-10000-CNSC-010	Authorized Nuclear Operators	PRIOR to implementation	2.4
N-MAN-08131-10000-CNSC-028	Control Room Shift Supervisor, Pickering Nuclear	PRIOR to implementation	2.4
N-INS-08920-10004	Written and Oral Initial Certification Examination for Shift Personnel	When implemented	2.4
N-INS-08920-10002	Simulator-Based Initial Certification Examinations for Shift Personnel	When implemented	2.4
N-INS-08920-10001	Requalification Testing of Certified Shift Personnel	When implemented	2.4
OPERATING PERFORMANCE			
N-PROG-OP-0001	Nuclear Operations	PRIOR to implementation	3.1
N-STD-OP-0036	Operational Decision Making	When implemented	3.1
N-PROG-AS-0008	Heavy Water Management	When implemented	3.1
N-PROG-MA-0019	Production Work Management	When implemented	3.1

APPENDIX C – LIST OF LICENSEE DOCUMENTS THAT REQUIRE WRITTEN NOTIFICATION

Document #	Document Title	Notification Requirements	L.C.
N-STD-OP-0011	Operations Performance Monitoring	PRIOR to implementation	3.1
N-STD-AS-0002	Procedure Use and Adherence	When implemented	3.1
N-STD-AS-0014	Requirements for Technical Procedures	When implemented	3.1
N-PROC-MA-0013	Planned Outage Management	When implemented	3.1
N-PROC-MA-0049	Forced Outage Management	When implemented	3.1
N-STD-OP-0025	Heat Sink Management	When implemented	3.1
N-STD-OP-0009	Reactivity Management	When implemented	3.1
N-STD-OP-0021	Control of Fuelling Operations	When implemented	3.1
N-STD-MP-0016	Safe Operating Envelope	PRIOR to implementation	3.1
NA44-OPP-03600	Pickering NGS-A Operating Policies and Principles	PRIOR to implementation	3.1
NA44-OSR-08131.02-00001	Pickering A Operational Safety Requirements: Shutdown Systems	PRIOR to implementation	3.1
NA44-OSR-08131.02-00002	Pickering A Operational Safety Requirements: Negative Pressure Containment	PRIOR to implementation	3.1
NA44-OSR-08131.02-00003	Pickering A Operational Safety Requirements: Fuel and Reactor Physics	PRIOR to implementation	3.1
NA44-OSR-08131.02-00004	Pickering A Operational Safety Requirements: Emergency Coolant Injection System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00005	Pickering A Operational Safety Requirements: Boiler Emergency Cooling System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00006	Pickering A Operational Safety Requirements: Emergency Boiler Water Supply System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00007	Pickering A Operational Safety Requirements: Feedwater System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00008	Pickering A Operational Safety Requirements: Service Water Systems	PRIOR to implementation	3.1

Document #	Document Title	Notification Requirements	L.C.
NA44-OSR-08131.02-00009	Pickering A Operational Safety Requirements: Powerhouse Emergency Venting System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00010	Pickering A Operational Safety Requirements: Main Steam Supply System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00011	Pickering A Operational Safety Requirements: Shutdown Cooling System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00012	Pickering A Operational Safety Requirements: Moderator System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00013	Pickering A Operational Safety Requirements: Heat Transport System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00014	Pickering A Operational Safety Requirements: Reactor Regulating System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00015	Pickering A Operational Safety Requirements: Electrical Power System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00016	Pickering NGS-A Annulus Gas System	PRIOR to implementation	3.1
NA44-OSR-08131.02-00017	Pickering NGS-A Operational Safety Requirements: Fuel Handling System & Irradiated Fuel Bays	PRIOR to implementation	3.1
NA44-OSR-08131.02-00018	Pickering NGS-A Critical Safety Parameter Monitoring Instrumentation	PRIOR to implementation	3.1
NA44-OSR-08131.02-00019	Pickering NGS-A Operational Safety Requirements: Shield Cooling Systems	PRIOR to implementation	3.1
NA44-OSR-08131.02-00021	Pickering NGS-A Operational Safety Requirements: Interstation Transfer Bus (ISTB)	PRIOR to implementation	3.1
NA44-OSR-08131.02-00022	Pickering Nuclear 1-4 Operational Safety Requirements: Powerhouse Environmental Protection System	PRIOR to implementation	3.1
NK30-OPP-03600	Pickering NGS-B Operating Policies and Principles	PRIOR to implementation	3.1

Document #	Document Title	Notification Requirements	L.C.
NK30-OSR-08131.02-00001	Pickering B Operational Safety Requirements: Emergency Coolant Injection System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00002	Pickering B Operational Safety Requirements: Fuel and Reactor Physics	PRIOR to implementation	3.1
NK30-OSR-08131.02-00003	Pickering B Operational Safety Requirements: Negative Pressure Containment	PRIOR to implementation	3.1
NK30-OSR-08131.02-00004	Pickering B Operational Safety Requirements: Shutdown Systems	PRIOR to implementation	3.1
NK30-OSR-08131.02-00005	Pickering B Operational Safety Requirements: Boiler Emergency Cooling System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00006	Pickering B Operational Safety Requirements: Feedwater System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00007	Pickering B Operational Safety Requirements: Emergency Water Supply System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00008	Pickering B Operational Safety Requirements: Service Water Systems	PRIOR to implementation	3.1
NK30-OSR-08131.02-00009	Pickering B Operational Safety Requirements: Main Steam Supply System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00010	Pickering B Operational Safety Requirements: Moderator System	PRIOR to implementation	3.1
NK30-OSR-08131.02-000011	Pickering B Operational Safety Requirements: Powerhouse Emergency Venting System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00012	Pickering B Operational Safety Requirements: Shutdown Cooling System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00013	Pickering B Operational Safety Requirements: Heat Transport System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00014	Pickering B Operational Safety Requirements: Emergency Power Supply	PRIOR to implementation	3.1
NK30-OSR-08131.02-00015	Pickering B Operational Safety Requirements: Reactor Regulating System	PRIOR to implementation	3.1

Document #	Document Title	Notification Requirements	L.C.
NK30-OSR-08131.02-00017	Pickering B Operational Safety Requirements: Group 1 Electrical Power System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00018	Pickering B Operational Safety Requirements: Fuel Handling & Irradiated Fuel Bays	PRIOR to implementation	3.1
NK30-OSR-08131.02-00019	Pickering NGS Operational Safety Requirements: HPECI Power Supplies	PRIOR to implementation	3.1
NK30-OSR-08131.02-00020	Pickering B Operational Safety Requirements: Annulus Gas System	PRIOR to implementation	3.1
NK30-OSR-08131.02-00021	Pickering B Operational Safety Requirements: Critical Safety Parameter monitoring Instrumentation	PRIOR to implementation	3.1
NK30-OSR-08131.02-00022	Pickering B Operational Safety Requirements: Shield Cooling System	PRIOR to implementation	3.1
N-STD-OP-0017	Response to Transients	When implemented	3.1 3.2
N-STD-MP-0019	Beyond Design Basis Accident Management	Prior to implementation	3.1 4.1
N-PROG-MP-0014	Reactor Safety Program	When implemented	3.2 4.1
N-PROC-RA-0005	Written Reporting to Regulatory Agencies	When implemented	3.3
SAFETY ANALYSIS			
N-PROG-MP-0014	Reactor Safety Program	When implemented	3.2 4.1
N-PROC-MP-0086	Safety Analysis Basis and Safety Report	When implemented	4.1
N-PROG-MP-0006	Software	When implemented	4.1 5.1
N-PROC-MP-0096	Use of Scientific, Engineering and Safety Analysis Software	When implemented	4.1 5.1
N-PROG-RA-0016	Risk and Reliability Program	When implemented	4.1
N-STD-RA-0034	Preparation, Maintenance and Application of Probabilistic Risk Assessment	When implemented	4.1
N-STD-MP-0019	Beyond Design Basis Accident Management	PRIOR to implementation	3.1 4.1

Document #	Document Title	Notification Requirements	L.C.
N-REP-03491-0650826	Updated Emergency Planning Technical Basis for Provincial Nuclear Emergency Response Plan	PRIOR to implementation	4.1 10.1
N-STD-MP-0023	Technology and Research	When implemented	4.1
N-PROC-MP-0092	Technology and Research Program Management	When implemented	4.1
PHYSICAL DESIGN			
N-STD-MP-0028	Conduct of Engineering	When implemented	5.1
N-PROG-MP-0009	Design Management	When implemented	5.1
N-PROG-MP-0006	Software	When implemented	4.1 5.1
N-LIST-00590-00001	List of Significant Technical Changes from Code-Over-Code Review	PRIOR to implementation	5.1
P-REP-07701-00002	Predictive Effects Assessment For Pickering Nuclear Safe Storage	When implemented	5.1
W-PROC-WM-0093	Planning for Decommissioning	When implemented	5.1 11.2
N-PROG-MA-0016	Fuel	When implemented	5.1
N-PROG-MP-0004	Pressure Boundary Program	PRIOR to implementation	5.2
N-PROC-MP-0040	System and Item Classification	PRIOR to implementation	5.2
N-PROC-MP-0082	Design Registration	PRIOR to implementation	5.2
N-MAN-01913.11-10000	Pressure Boundary Program Manual	When implemented	5.2
N/A	Authorized Inspection Agency Service Agreement	PRIOR to implementation	5.2
N-LIST-00531-10003	Index to OPG Pressure Boundary Program Elements	When implemented	5.2
N-PROG-RA-0006	Environmental Qualification	When implemented	5.3
N-STD-MP-0016	General Requirements for Seismic Qualification of OPG Nuclear Facilities	When implemented	5.3
N-PROC-RA-0051	Environmental Qualification Lists	When implemented	5.3

APPENDIX C – LIST OF LICENSEE DOCUMENTS THAT REQUIRE WRITTEN NOTIFICATION

Document #	Document Title	Notification Requirements	L.C.
N-PROC-RA-0044	Environmental Qualification Assessment	When implemented	5.3
	FITNESS FOR SERVICE		
N-PROG-MA-0026	Equipment Reliability	When implemented	6.1
N-PROG-RA-0016	Risk and Reliability Program	When implemented	6.1
N-STD-RA-0033	Reliability and Monitoring of Systems Important to Safety	When implemented	6.1
P-REP-03611-00012	PNGS Systems and Components Important to Safety	PRIOR to implementation	6.1
P-LIST-06937-00001	Pickering A and B List of Safety Related Systems	PRIOR to implementation	6.1
I-PROG-AS-0001	Conduct of Inspection and Maintenance Services	When implemented	6.1
N-PROG-MA-0004	Conduct of Maintenance	When implemented	6.1
N-PROG-MA-0017	Component and Equipment Surveillance	PRIOR to implementation	6.1
N-PROG-MA-0025	Major Components	When implemented	6.1
N-PROC-MA-0024	System Performance Monitoring	When implemented	6.1
N-PROG-MP-0008	Integrated Aging Management	When implemented	6.1
N-PROC-MP-0060	Aging Management Process	When implemented	6.1
N-STD-MA-0024	Obsolescence Management	When implemented	6.1
N-PLAN-01060-10003	Reactor Components and Structures Life Cycle Management Plan	PRIOR to implementation	6.1
N-PLAN-01060-10008	Reactor Components and Structures Life Cycle Management Plan: Technical Basis Document	When implemented	6.1
N-PROC-MA-0044	Fuel Channel Life Cycle Management	When implemented	6.1
N-PLAN-01060-10002	Fuel Channels Life Cycle Management Plan	PRIOR to implementation	6.1
N-PLAN-01060-10001	Feeders Life Cycle Management Plan	PRIOR to implementation	6.1

Document #	Document Title	Notification Requirements	L.C.
N-PLAN-01060-10007	Feeders Life Cycle Management Plan: Technical Basis Document	When implemented	6.1
N-PLAN-33110-10009	Steam Generators Life Cycle Management Plan	PRIOR to implementation	6.1
NA44-PLAN-33110-10003	Pickering Units 1 and 4 Steam Generator Life Cycle Management Plan (Except Appendix B)	When implemented	6.1
NK30-PLAN-33110-10008	Pickering Units 5-8 Steam Generator Life Cycle Management Plan (excluding Sheet Sections 001 to 007)	When implemented	6.1
N-PLAN-01060-10004	Aging Management Plan for Containment Structures	PRIOR to implementation	6.1
NA44-PLAN-34220-00002	Life Cycle and Aging Management Program Plan for Fiberglass-Reinforced Plastic Components in the Pickering NGS Vacuum Building	PRIOR to implementation	6.1
N-PROG-OP-0004	Chemistry	When implemented	6.1
I-STD-AS-0003	Non-Destructive Examination	When implemented	6.1
I-PROG-AS-0001	Conduct of Inspection and Maintenance Services	When implemented	6.1
N-PROC-MA-0052	Flaw Dispositioning	When implemented	6.1
NA44-PIP-03641.2-00001	Pickering Nuclear Generating Station A Periodic Inspection Plan For Unit 1	PRIOR to implementation	6.1
NA44-PIP-03641.2-00007	Pickering Nuclear Generating Station A Periodic Inspection Plan For Unit 4	PRIOR to implementation	6.1
NK30-PIP-03641.2-00001	Pickering B Periodic Inspection Program Unit 5	PRIOR to implementation	6.1
NK30-PIP-03641.2-00002	Pickering B Periodic Inspection Program Unit 6	PRIOR to implementation	6.1
NK30-PIP-03641.2-00003	Pickering B Periodic Inspection Program Unit 7	PRIOR to implementation	6.1
NK30-PIP-03641.2-00004	Pickering B Periodic Inspection Program Unit 8	PRIOR to implementation	6.1

Document #	Document Title	Notification Requirements	L.C.
N-REP-31100-10041	Acceptance Criteria and Evaluation Procedures for Material Surveillance Pressure Tube	PRIOR to implementation	6.1
NA44-PIP-31100-00001	Pickering Nuclear 1-4, Unit 1 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	PRIOR to implementation	6.1
NA44-PIP-31100-00004	Pickering Nuclear 1-4, Unit 4 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	PRIOR to implementation	6.1
NK30-PIP-31100-00001	Pickering Nuclear 5-8, Unit 5 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	PRIOR to implementation	6.1
NK30-PIP-31100-00002	Pickering Nuclear 5-8, Unit 6 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	PRIOR to implementation	6.1
NK30-PIP-31100-00003	Pickering Nuclear 5-8, Unit 7 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	PRIOR to implementation	6.1
NK30-PIP-31100-00004	Pickering Nuclear 5-8, Unit 8 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	PRIOR to implementation	6.1
N-REP-31100-10061	Compliance Plan for Long-Term Use of CSA N285.8 For In-Service Evaluation of Zirconium Alloy Pressure Tubes	PRIOR to implementation	6.1
NA44-PIP-33126-00002	Pickering Nuclear Unit 1 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	PRIOR to implementation	6.1
NA44-PIP-33126-00001	Pickering Nuclear Unit 4 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	PRIOR to implementation	6.1
NK30-PIP-33126-00001	Pickering Nuclear Unit 5 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	PRIOR to implementation	6.1
NK30-PIP-33126-00002	Pickering Nuclear Unit 6 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	PRIOR to implementation	6.1

Document #	Document Title	Notification Requirements	L.C.
NK30-PIP-33126-00003	Pickering Nuclear Unit 7 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	PRIOR to implementation	6.1
NK30-PIP-33126-00004	Pickering Nuclear Unit 8 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	PRIOR to implementation	6.1
COG-JP-4107-V06	Fitness-for-Service Guidelines for Feeders in CANDU Reactors	PRIOR to implementation	6.1
Appendix B in NA44-PLAN-33110-10003	Pickering Units 1 and 4 Steam Generator Life Cycle Management Plan - Appendix B: Pickering Units 1 and 4 Steam Generators In-Service Inspection Plan	PRIOR to implementation	6.1
NK30-PLAN-33110-10008 Sheet Section 006	Pickering Units 5-8 In-Service Inspection Plan	PRIOR to implementation	6.1
COG Report 07-4089	Fitness-For-Service Guidelines for Steam Generator and Preheater Tubes	PRIOR to implementation	6.1
NA44-PIP-03642.2-00001	Pickering Nuclear Generating Station A Periodic Inspection Program For Containment Components	PRIOR to implementation	6.1
NK30-PIP-03642.2-00001	Pickering Nuclear Generating Station “B” Periodic Inspection Program For Containment Components	PRIOR to implementation	6.1
P-PIP-03642.2-00001	Pickering Nuclear Generating Station A Periodic Inspection Program For Unit 0 Containment Components	PRIOR to implementation	6.1
N-PROC-MA-0066	Administrative Requirements for In-Service Examination and Testing for Concrete Containment Structures	PRIOR to implementation	6.1
NA44-PIP-03643.2-00001	Pickering Nuclear GSA – Reactor Building Periodic Inspection Program	PRIOR to implementation	6.1
NK30-PIP-03643.2-00001	Pickering Nuclear GSB – Reactor Building Periodic Inspection Program	PRIOR to implementation	6.1
NA44-PIP-03643.2-00002	Pickering Nuclear GS – PRD & VB Periodic Inspection Program	PRIOR to implementation	6.1

Document #	Document Title	Notification Requirements	L.C.
NA44-PIP-03643.2-00003	Pickering Nuclear GS – Vacuum Building Post Tensioning Rods Periodic Inspection Program	PRIOR to implementation	6.1
NA44-REP-34200-00017	Pickering NGS "A" Reactor Building and Pressure Relief Duct In-service Leakage Rate Test Requirements in accordance with CSA N287.7-08	PRIOR to implementation	6.1
NA44-REP-25100-00009	Pickering NGS Vacuum Building In-service Leakage Rate Test Requirements in Accordance with CSA N287.7-08	PRIOR to implementation	6.1
N-PROC-MP-0060	Aging Management Process	When implemented	6.1
RADIATION PROTECTION			
N-PROG-RA-0013	Radiation Protection	PRIOR to implementation	7.1
N-STD-RA-0018	Controlling Exposure As Low As Reasonably Achievable	When implemented	7.1
N-REP-03420-10001	Occupational Radiation Protection Action Levels for Power Reactor Operating Licenses	PRIOR to implementation	7.1
N-PROC-RA-0019	Dose Limits and Exposure Control	PRIOR to implementation	7.1
N-MAN-03416-10000	Radiation Dosimetry Program – General Requirements	When implemented	7.1
OPG-PROC-0132	Respiratory Protection	When implemented	7.1
CONVENTIONAL HEALTH AND SAFETY			
OPG-POL-0001	Employee Health and Safety Policy	When implemented	8.1
OPG-PROG-0010	Health and Safety Management System Program	When implemented	1.1 8.1
N-PROG-MA-0015	Work Protection	When implemented	8.1
OPG-PROC-0132	Respiratory Protection	When implemented	8.1
ENVIRONMENTAL PROTECTION			

Document #	Document Title	Notification Requirements	L.C.
N-STD-OP-0031	Monitoring of Nuclear and Hazardous Substances in Effluents	When implemented	9.1
N-INS-03480-10002	Performance Testing of Airborne Effluent Monitoring Systems	When implemented	9.1
NA44-REP-03482-00001	Derived Release Limits and Environmental Action Levels for Pickering Nuclear Generating Station A	PRIOR to implementation	9.1
NK30-REP-03482-00001	Derived Release Limits and Environmental Action Levels for Pickering Nuclear Generating Station B	PRIOR to implementation	9.1
P-REP-03482-00001	Derived Release Limits and Environmental Action Levels for Pickering Nuclear Sewage Effluent	PRIOR to implementation	9.1
OPG-POL-0021	Environmental Policy	When implemented	9.1
N-PROG-OP-0006	Environmental Management	When implemented	9.1 11.1
N-PROC-OP-0044	Contaminated Lands and Groundwater Management	When implemented	9.1
N-INS-07080-10000	Hazardous Material Control	When implemented	9.1
N-PROC-OP-0038	Abnormal Waterborne Tritium Emission Response	When implemented	9.1
N-PROC-OP-0025	Management of the Environmental Monitoring Programs	When implemented	9.1
P-MAN-03443-00002	Pickering Environmental Monitoring Program	When implemented	9.1
N-PROC-OP-0037	Environmental Approvals	When implemented	9.1
P-REP-07701-0001	Environmental Risk Assessment Report for Pickering Nuclear	When implemented	9.1
EMERGENCY MANAGEMENT AND FIRE PROTECTION			
N-PROG-RA-0001	Consolidated Nuclear Emergency Plan	PRIOR to implementation	10.1

Document #	Document Title	Notification Requirements	L.C.
N-REP-03491-0650826	Updated Emergency Planning Technical Basis for Provincial Nuclear Emergency Response Plan	PRIOR to implementation	4.1 10.1
N-STD-AS-0010	Nuclear Crisis Communications Standard	When implemented	10.1
N-PROC-RA-0045	Emergency Preparedness Drills and Exercises	When implemented	10.1
N-PROC-RA-0133	Management of Equipment Important to Emergency Response	When implemented	10.1
N-PROG-RA-0012	Fire Protection	PRIOR to implementation	10.2
WASTE MANAGEMENT			
W-PROG-WM-0001	Nuclear Waste Management	PRIOR to implementation	11.1
N-PROC-OP-0043	Waste Management	When implemented	11.1
N-PROC-RA-0017	Segregation and Handling of Radioactive Wastes	When implemented	11.1
N-PROC-WM-0001	Disposal of Oil and Chemical Waste	When implemented	11.1
N-PROG-OP-0006	Environmental Management	When implemented	9.1 11.1
W-PROG-WM-0003	Decommissioning Program	PRIOR to implementation	11.2
W-PROC-WM-0093	Planning for Decommissioning	When implemented	5.1 11.2
W-STD-WM-0005	Conduct of Decommissioning	When implemented	11.2
P-PLAN-00960-00001	Preliminary Decommissioning Plan – Pickering Nuclear Generating Stations A and B	PRIOR to implementation	11.2
SECURITY			
N-PROG-RA-0011	Nuclear Security	PRIOR to implementation	12.1
TRAN-PLAN-03450-10000	Transport Security Plan	PRIOR to implementation	12.1
N-PROC-MP-0103	Security for Real-Time Process Computing System	When implemented	12.1
OPG-POL-0035	Cyber Security Policy	When implemented	12.1
P-LIST-69000-00001	Significant Cyber Assets	When implemented	12.1
SAFEGUARDS			

Document #	Document Title	Notification Requirements	L.C.
N-PROG-RA-0015	Nuclear Safeguards	PRIOR to implementation	13.1
N-STD-RA-0024	Nuclear Safeguards Implementation	PRIOR to implementation	13.1
PACKAGING AND TRANSPORT			
W-PROG-WM-0002	Radioactive Material Transportation	When implemented	14.1 15.6
N-STD-RA-0036	Radioactive Materials Transportation Emergency Response Plan	When implemented	14.1
NUCLEAR FACILITY-SPECIFIC			
P-REP-03680-0031	Pickering NGS Periodic Safety Review 2 (PSR2) Integrated Implementation Plan	PRIOR to implementation	15.1
P-INS-03680-00001	Pickering IIP Administration	PRIOR to implementation	15.1
NA44-SR-01320-00001	Pickering A Safety Report (Part 1)	When implemented	G.3 15.2
P-PLAN-09314-00003	Pickering Site Strategic Plan	When implemented	15.4
P-OM-018-31985-01	Cobalt Processing - Table of Contents/Revision History	When implemented	15.5
P-OP-31985-0001	Cobalt Processing Procedure	When implemented	15.5
P-OM-018-31985-04.04.12	Cobalt Processing – Cobalt Handling	When implemented	15.5
W-PROG-WM-0002	Radioactive Material Transportation	When implemented	14.1 15.6

APPENDIX D – LIST OF LICENSING PUBLICATIONS

Document #	Document Title	Version	L.C.
INFO-0795	Licensing Basis Objectives and Definitions	2010	G.1
AECB 1059	Reactor Licensing and Safety Requirements, Hurst and Boyd	1972	G.3 4.1
N294	Decommissioning of facilities containing nuclear substances	2009	G.5 11.2
RD/GD-99.3	Public Information and Disclosure	2012	G.6
N286	Management System Requirements for Nuclear Facilities	2012	1.1
P-119	Policy on Human Factors	2000	2.1
REGDOC-2.2.4	Fitness for Duty: Managing Worker Fatigue	2017	2.1
REGDOC-2.2.4	Fitness for Duty, Volume II: Managing Alcohol and Drug Use	2017	2.1
RD-363	Nuclear Security Officer Medical, Physical, Psychological Fitness	2008	2.1
REGDOC-2.2.2	Personnel Training	2014	2.3
RD-204	Certification of Persons Working at Nuclear Power Plants	2008	2.4
REGDOC-2.3.2	Accident Management: Severe Accident Management Programs for Nuclear Reactors	2013	3.1
N290.15	Requirements for the safe operating envelope for nuclear power plants	2010 (Reaffirmed 2015)	3.1
REGDOC-3.1.1	Reporting Requirements for Nuclear Power Plants	2016 version 2	3.3
REGDOC-2.4.1	Deterministic Safety Analysis	2014	4.1
S-294	Probabilistic Safety Assessment (PSA) for Nuclear Power Plants	2005	4.1
REGDOC-2.4.2	Probabilistic Safety Assessment (PSA) for Nuclear Power Plants	2014	4.1
N286.7	Quality assurance of analytical, scientific and design computer programs for nuclear power plants	2016	4.1 5.1
N290.12	Human factors in design for nuclear power plants	2014	5.1
N291	Requirements for safety-related structures for CANDU nuclear power plants	2008	5.1 6.1
N285.0/N285.6	General requirements for pressure-retaining systems and components in CANDU nuclear power plants/Materials Standards for reactor components for CANDU nuclear power plants, issued June 2008 - Annex K and Annex M are accepted to be used as “Normative” Annexes.	2008 and Update No. 2 (August 2010)	5.2
N285.0/N285.6	General requirements for pressure-retaining systems and components in CANDU nuclear power plants/ Materials Standards for reactor components for CANDU nuclear power plants, issued August 2012 – Annex N (only)	2012 and Update No. 1 (September 2013)	5.2

Document #	Document Title	Version	L.C.
B51	Boiler, pressure vessel, and pressure piping code	2009 and Update No. 1 (March 2009)	5.2
BPVC	ASME Boiler and Pressure Vessel Code with Addenda	2010 Edition with 2011 Addendum	5.2
B31.1	Power Piping	2010	5.2
B31.3	Process Piping	2010	5.2
B31.5	Refrigeration Piping and Heat Transfer Components	2010	5.2
N289.1	General requirements for seismic design and qualification of CANDU nuclear power plants	2008	5.3
N290.13	Environmental qualification of equipment for CANDU nuclear power plants	2005 & Update 1 (2009) Reaffirmed in 2015	5.3
RD/GD-98	Reliability Programs for Nuclear Power Plants	2012	6.1
RD/GD-210	Maintenance Programs for Nuclear Power Plants	2012	6.1
REGDOC 2.6.3	Aging Management	2014	6.1
N285.4	Periodic Inspection of CANDU Nuclear Power Plant Components	2005	6.1
N285.8	Technical Requirements for In-Service Inspection Evaluation of Zirconium Alloy in Pressure Tubes in CANDU Reactors	2015	6.1
N285.5	Periodic Inspection of CANDU Nuclear Power Plant Containment Components	2008	6.1
N287.1	General requirements for concrete containment structures for nuclear power plants	2014	6.1
N287.2	Material requirements for concrete containment structures for CANDU nuclear power plants	2008	6.1
N287.7	In-service Examination and Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants	2008	6.1
P-223	Protection of the Environment	2001	9.1
N288.5	Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills	2011	9.1
N288.1	Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities	2008	9.1
N288.1	Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities	2014 and Update No. 1 & 2 (May & November 2017)	9.1
N288.3.4	Performance Testing of Nuclear Air-Cleaning Systems at Nuclear Facilities	2013	9.1
REGDOC-2.9.1	Environmental Protection Policies, Programs and Procedures	2013	9.1

Document #	Document Title	Version	L.C.
N288.7	Groundwater protection programs at Class I nuclear facilities and uranium mines and mills	2015	9.1
N288.4	Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills	2010	9.1
N288.6	Environmental risk assessments at Class I nuclear facilities and uranium mines and mills	2012	9.1
REGDOC-2.10.1	Nuclear Emergency Preparedness and Response	2014	10.1
N293	Fire protection for CANDU nuclear power plants	2012	10.2
P-290	Managing Radioactive Waste	2004	11.1
N292.2	Interim Dry Storage of Irradiated Fuel	2013	11.1
N292.3	Management of Low and Intermediate-Level Radioactive Waste	2008	11.1
REGDOC-2.12.1	High-Security Sites: Nuclear Response Force	2013	12.1
REGDOC-2.12.2	Site Access Security Clearance	2013	12.1
REGDOC-2.12.3	Security of Nuclear Substances: Sealed Sources	2013	12.1
RD-321	Criteria for Physical Protection Systems and Devices at High-Security Sites	2010	12.1
RD-361	Criteria for Explosive Substance Detection, X-ray Imaging, and Metal Detection Devices at High-Security Sites	2010	12.1
N290.7	Cyber security for nuclear power plants and small reactor facilities	2014	12.1
RD-336	Accounting and Reporting of Nuclear Material	2010	13.1
REGDOC-2.3.3	Periodic Safety Reviews	2008	15.1

APPENDIX E – LIST OF GUIDANCE PUBLICATIONS

Document #	Document Title	Version	L.C.
G-206	Financial Guarantees for the Decommissioning of Licensed Activities	2000	G.5 11.2
G-219	Decommissioning Planning for Licensed Activities	2000	G.5 11.2
REGDOC-3.2.2	Aboriginal Engagement	2016	G.6
N286.0.1	Commentary on N286-12	2014	1.1
N286.10	Configuration Management for High Energy Reactor Facilities	2016	1.1
G-323	Ensuring the Presence of Sufficiently Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement	2007	2.1 2.2
G-278	Human Factors Verification and Validation Plans	2003	2.2 3.1 5.1
REGDOC-2.2.2	Human Performance Management Personnel Training, Version 2	2016	2.3
N290.11	Requirements for reactor heat removal capability during outage of nuclear power plants	2013	3.1
REGDOC-2.3.2	Accident Management, Version 2	2015	3.1 10.1
N290.16	Requirements for Beyond Design Basis Accidents	2016	3.1
COG 09-9030	Principles & Guidelines For Deterministic Safety Analysis	R2	4.1
COG 11-9023	Guidelines for Application of the LOE/ROE Methodology to Deterministic Safety Analysis	R01	4.1
COG 06-9012	Guidelines for Application of the Best Estimate Analysis and Uncertainty (BEAU) Methodology to Licensing Analysis	R01	4.1
COG 08-2078	Principles and Guidelines for NOP/ROP Trip Setpoint Analysis for CANDU Reactors	R00	4.1
CSA N290.17	Probabilistic Safety Assessment for Nuclear Power Plants	2017	4.1
ASME/ANS RA-Sa-2009	Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications, Addenda ASME/ANS RA-Sb-2013	2013	4.1
IAEA SSG-3	Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants	2010	4.1
IAEA SSG-4	Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants	2010	4.1
RD-327	Nuclear Criticality Safety	2010	4.1
GD-327	Guidance for Nuclear Criticality Safety	2010	4.1
REGDOC-1.1.3	Licence Application Guide: Licence to Operate a Nuclear Power Plant	2017	5.1 6.1

Document #	Document Title	Version	L.C.
REGDOC 2.5.2	Design of Reactor Facilities: Nuclear Power Plants	2014	5.1
G-276	Human Factors Engineering Program Plans	2003	5.1
N290.0	General Requirements for Safety Systems of Nuclear Power Plants	2011	5.1
N290.1	Requirements for the shutdown systems of nuclear power plants	2013	5.1
N290.2	Requirements for emergency core cooling systems for nuclear plants	2011	5.1
N290.3	Requirements for containment system of nuclear power plants	2016	5.1
N290.4	Requirements for reactor control systems of nuclear power plants	2011	5.1
N290.5	Requirements for electrical power and instrument air systems of CANDU nuclear power plants	2006	5.1
N290.6	Requirements for monitoring and display of nuclear power plant safety functions in the event of an accident	2009	5.1
N290.14	Qualification of Digital Hardware and Software for Use in Instrumentation and Control Applications for Nuclear Power Plants	2015	5.1
N291	Requirements for safety-related structures for CANDU nuclear power plants	2015	5.1 6.1
N289.2	Ground motion determination for seismic qualification of nuclear power plants	2010	5.3
N289.3	Design procedures for seismic qualification of nuclear power plants	2010	5.3
N289.4	Testing procedures for seismic qualification of nuclear power plant structures, systems, and components	2012	5.3
N289.5	Seismic instrumentation requirements for nuclear power plants and nuclear facilities	2012	5.3
REGDOC-2.6.1	Reliability Programs for Nuclear Power Plants	2017	6.1
REGDOC-2.6.2	Maintenance Programs for Nuclear Power Plants	2017	6.1
N285.4	Periodic Inspection of CANDU Nuclear Power Plant Components	2014	6.1
N285.5	Periodic Inspection of CANDU Nuclear Power Plant Containment Components	2013	6.1
N287.1	General requirements for concrete containment structures for nuclear power plants	2014	6.1
N287.2	Material requirements for concrete containment structures for CANDU nuclear power plants	2008	6.1
N287.3	Design requirements for concrete containment structures for nuclear power plants	2014	6.1
N287.4	Construction, fabrication, and installation requirements for concrete containment structures for CANDU nuclear power plants	2008	6.1

Document #	Document Title	Version	L.C.
N287.5	Examination and testing requirements for concrete containment structures for nuclear power plants	2011	6.1
N287.8	Aging Management for Concrete Containment Structures for Nuclear Power Plants	2015	6.1
N285.7	Periodic Inspection of CANDU Nuclear Power Plants Balance of Plant Systems and Components	2015	6.1
G-129	Keeping Radiation Exposures and Doses “As Low As Reasonably Achievable (ALARA)”	2004	7.1 9.1
G-228	Developing and Using Action Levels	2001	7.1
REGDOC-2.9.1	Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.1	2017	9.1
N288.2	Guidelines for Calculating the Radiological Consequences to the Public of a Release of Airborne Radioactive Material for Nuclear Reactor Accidents	2014	9.1
N288.7	Groundwater protection programs at Class I nuclear facilities and uranium mines and mills	2015	9.1
P-223	Protection of the Environment	2001	9.1
G-228	Developing and Using Action Levels	2001	9.1
REGDOC-2.10.1	Nuclear Emergency Preparedness and Response, Version 2	2016	10.1
N1600	General requirements for nuclear emergency management programs	2016	10.1
NEI 00-01	Guidance for Post Fire Safe Shutdown Circuit Analysis	Revision 2	10.2
G-320	Assessing the Long term Safety of Radioactive Waste Management	2006	11.1
N292.0	General principles for the management of radioactive waste and irradiated fuel	2014	11.1
N292.1	Wet storage of irradiated fuel and other radioactive materials	2016	11.1
N292.3	Management of low- and intermediate-level radioactive waste	2014	11.1
N292.5	Guideline for the exemption of clearance from regulatory control of materials that contain, or potentially contain, nuclear substances	2011	11.1
G-274	Security Programs for Category I or II Nuclear Material or Certain Nuclear Facilities	2003	12.1
G-208	Transportation Security Plans for Category I, II or III Nuclear Material	2003	12.1
IAEA Nuclear Security Series No. 4 Technical Guidance	Engineering Safety Aspects of the Protection of Nuclear Power Plants Against Sabotage	2007	12.1
IAEA Nuclear Security Series No. 13 Recommendations	Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities	Revision 5	12.1

Document #	Document Title	Version	L.C.
IAEA Nuclear Security Series No. 17 Technical Guidance	Computer Security at Nuclear Facilities	2011	12.1
GD-336	Guidance for Accounting and Reporting of Nuclear Material	2010	13.1
REGDOC-2.13.1	Safeguards and Nuclear Material Accountancy	2018	13.1
REGDOC-2.13.2	Import and Export	2016	13.1 15.6
REGDOC-2.14.1	Information Incorporated by Reference in Canada's Packaging and Transport of Nuclear Substance Regulations, 2015	2016	14.1
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COG JP-4452-V119	Theory Manual for the Evaluation Module of Probabilistic Core Assessment Computer Code SCEPTR V1.2e	2015	15.3