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Annual Program Report

Rapport annuel sur les programmes

**Regulatory Oversight  
Report for Canadian  
Nuclear Power  
Generating Sites for 2021**

**Rapport de surveillance  
réglementaire des sites  
de centrales nucléaires  
au Canada pour 2021**

Public Meeting

Réunion publique

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Submitted by:

Soumise par :

CNSC Staff

Le personnel de la CCSN

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## Summary

This CMD presents the *Regulatory Oversight Report for Canadian Nuclear Power Generating Sites for 2021*.

The following summarizes the regulatory oversight report:

- Through compliance verification activities, CNSC staff concluded that nuclear power plants (NPPs) and the waste management facilities (WMFs) on their sites in Canada operated safely during 2021. The evaluations of all findings for the safety and control areas show that, overall, NPP and WMF licensees made adequate provision for the protection of the health, safety and security of persons and the environment from the use of nuclear energy and took the measures required to implement Canada's international obligations.
- The following observations support the conclusions:
  - Radiation doses to members of the public were well below the regulatory limit.
  - Radiation doses to workers were below the regulatory limits.
  - The frequency and severity of non-radiological injuries to workers were low.
  - Radiological releases to the environment from the NPPs and WMFs were below regulatory limits.
- Licensees met applicable requirements related to Canada's international obligations.

## Résumé

Ce CMD présente le Rapport de surveillance réglementaire des sites de centrales nucléaires au Canada pour 2021.

Ce qui suit résume le rapport de surveillance réglementaire :

- En se basant sur des activités de vérification de la conformité, le personnel de la CCSN a conclu que les centrales nucléaires et les installations de gestion des déchets sur leurs sites ont été exploitées de manière sûre en 2021. Les évaluations de toutes les constatations relatives aux domaines de sûreté et de réglementation montrent que, dans l'ensemble, les titulaires de permis de centrale nucléaire et d'installation de gestion des déchets ont pris les mesures voulues pour préserver la santé, la sûreté et la sécurité des personnes, protéger l'environnement contre l'utilisation de l'énergie nucléaire et respecter les obligations internationales que le Canada a doit assumer.
- Les observations suivantes appuient les conclusions:
  - Les doses de rayonnement reçues par le public étaient bien en deçà de la limite réglementaire.
  - Les doses de rayonnement reçues par les travailleurs étaient en deçà des limites réglementaires.
  - La fréquence et la gravité des blessures non radiologiques subies par les travailleurs étaient faibles.

- Les rejets radiologiques dans l'environnement par les titulaires de permis de centrale nucléaire et d'installation de gestion des déchets étaient sous les limites réglementaires
- Les titulaires de permis se sont conformés aux exigences applicables en rapport avec les obligations internationale du Canada.

There are no actions requested of the Commission. This CMD is for information only

Aucune mesure n'est requise de la Commission. Ce CMD est fourni à titre d'information seulement.

**Signed/signé le**

18 July 2022

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## EXECUTIVE SUMMARY

The Canadian Nuclear Safety Commission acknowledges that nuclear power generating stations are located on the traditional territories and homelands of many Indigenous peoples and are covered by several treaties.

The regulatory oversight report describes the regulatory oversight and safety performance of nuclear power generating sites, consisting of nuclear power plants (NPPs) and their associated waste management facilities (WMFs) in Canada in 2021. For certain topics, updates on developments in 2022 are also described.

The following list identifies the facilities for each site covered by this report. Each line in the list identifies facilities that are governed by a single CNSC licence; for this reason, they are assessed together in this report:

- [Darlington Nuclear Generating Station](#) (DNCS), which includes the Tritium Removal Facility and Retube Waste Processing Building
- [Darlington Waste Management Facility](#) (DWMF), which includes the Retube Waste Storage Building
- [Pickering Nuclear Generating Station](#) (PNGS)
- [Pickering Waste Management Facility](#) (PWMF)
- [Bruce A Nuclear Generating Station and Bruce B Nuclear Generating Station](#)
- [Western Waste Management Facility](#) (WWMF)
- [Radioactive Waste Operations Site-1](#) (RWOS-1)
- [Point Lepreau Nuclear Generating Station](#) (PLNGS), which includes Solid Radioactive Waste Management Facility (SRWMF)
- [Gentilly-2](#) Facilities

CNSC staff concluded that the NPPs and WMFs operated safely in 2021. This conclusion was based on detailed CNSC staff assessments of findings from compliance verification activities for each facility in the context of the 14 CNSC safety and control areas (SCAs).

The conclusion was supported by other observations including the following:

- No serious process failures occurred at the NPPs. The number of unplanned power reductions, transients and trips in the reactors was low and acceptable to CNSC staff. All unplanned power reductions and transients in the reactors were properly controlled and adequately managed
- Radiation doses to the public, and workers at the NPPs and WMFs were well below the regulatory limits
- The frequency and severity of non-radiological injuries to workers were low
- Radiological releases to the environment from the NPPs and WMFs were below regulatory limits

- Licensees met the applicable requirements related to Canada’s international obligations; safeguards inspection results were acceptable to the IAEA

All SCAs were rated as Satisfactory at all NPPs, with the exception of the SCA of Security at both the Darlington and Pickering NPPs, which were both assessed as being “Below Expectations”.

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

# 1 INTRODUCTION

## 1.1 About the regulatory oversight report

The *Regulatory Oversight Report for Canadian Nuclear Power Generating Sites: 2021* provides Canadian Nuclear Safety Commission (CNSC) staff assessment of the overall performance of Canadian nuclear power plants (NPPs) and their associated waste management facilities (WMFs) for 2021.

Section 1 provides introductory material that explains this report, the licensed facilities that are covered, and the CNSC regulatory framework and practices. In particular, the CNSC approach to the safety assessments of the NPPs and WMFs is described in section 1.4.5.

Section 2 provides background information that serves as context for the assessments. Although the assessments for each site are provided in section 3, section 2 contains some assessments of groups of licensees, where appropriate. For example, section 2 compares safety performance data for multiple licensees.

Section 3 contains highlights from the individual assessments for each facility.

Sections 2 and 3 are organized according to the CNSC safety and control area (SCA) framework, as it existed at the end of 2021.

Section 4 contains CNSC overall staff conclusions.

Some of the terms used in this document are defined in CNSC [REGDOC-3.6, Glossary of CNSC Terminology](#).

This report includes information requested by the Commission from previous Regulatory Oversight Reports (RORs) and licensing hearings. These requests are tracked through the CNSC Regulatory Information Bank (RIB) system. Table 1 provides the RIB tracking number, a description of the request, and where the request is addressed by CNSC staff in this report.

**Table 1: Details on RIB Requests from the Commission**

RIB #	Request	Report section
23134	Provide an update on asbestos phase-out	2.15
22116	Provide updates on matters related to emergency management and emergency preparedness at PNGS (iii) Results from the PNERP technical study (v) OPGs review and revision of the PNGS PIDP in regard to emergency preparedness and the provision of information to populations beyond the DPZ	(iii) 2.10 (v) Supplemental CMD

RIB #	Request	Report section
20544	Present how many IIP commitments in each NGS were planned, completed, reviewed, and closed	3.1.0 3.3.0 3.5.0 3.7.0
17557	Follow up to the licence renewal for Pickering Nuclear Generating Station (PNGS) (i) provide update on the status of the integrated implementation plan (IIP) (iii) provide update on the joint fuel machine reliability project	(i) 3.3.0 (iii) 2.6
16516	Provide update on PNGS fish diversion system (i) improvements and resulting fish impingement rate (ii) results of Ontario Power Generation's (OPG's) thermal plume monitoring (iii) a) OPG's compliance with its <i>Fisheries Act</i> authorization and b) involvement of Indigenous groups in activities related to the authorization	(i) 3.3.0 (ii) 3.3.0 (iii) a) 3.3.0 (iii) b) 2.15
14761	Describe enhancements at Bruce A to bring internal fire risk below the safety goal target	3.5.4
14757	Describe developments related to pressure tube fracture toughness for Bruce A and B, including: (i) fracture toughness modelling (ii) estimates of the maximum amount of equivalent hydrogen	(i) 3.5.6 (ii) Appendix C
14753	Provide update on status of major component replacement for Bruce A and B	3.5.0

## 1.2 Scope of the regulatory oversight report

The *Regulatory Oversight Report for Canadian Nuclear Power Generating Sites: 2021* covers the NPPs in Canada, including Gentilly-2. General statements in the report that refer to “NPPs” are intended to apply to Gentilly-2, while the phrase “operating NPPs” is used for statements that do not apply to Gentilly-2. The report also covers the WMFs located at the same sites, whether they are regulated under the same licence as the NPP or licensed separately.

Generally speaking, the information provided in this regulatory oversight report is pertinent to 2021, and the status that is described is valid as of December 2021. The word “UPDATE” is used to identify topics where more recent information (up to June 1, 2022) is included (for example, progress on corrective actions, descriptions of significant events and updates that the Commission specifically requested).

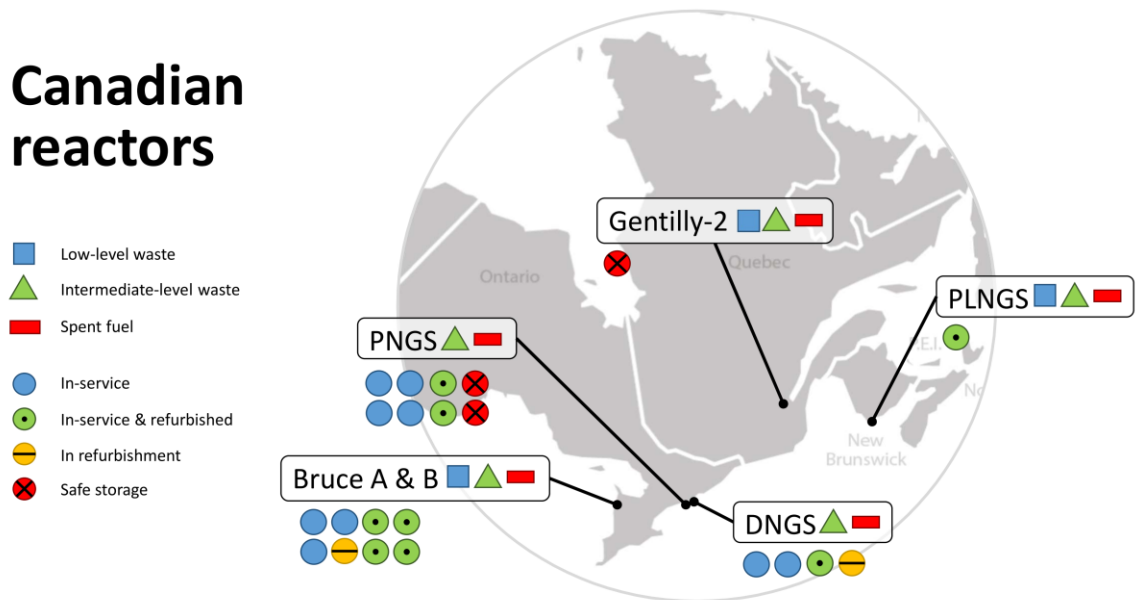
The detailed scope of the safety assessments in this regulatory oversight report is covered by the set of specific areas (SpA) that constitute each SCA.

They are described in more detail in [General Description of Regulatory Framework for Nuclear Power Generating Sites](#) [2]. The detailed information contained in reference 2 should be read in tandem with this regulatory oversight report.

### 1.3 Nuclear facilities covered by this regulatory oversight report

Figure 1 shows the geographic location in Canada of the NPPs and WMFs which includes the type of waste stored at the WMF and the status of each reactor on-site, covered by this report. All sites are located on traditional territories of Indigenous peoples in Canada.

## Canadian reactors



**Figure 1: Locations and facilities of nuclear power generating sites in Canada**

#### 1.3.1 Nuclear power generating sites and associated waste management facilities in Canada

The [Darlington site](#) is located in Clarington, Ontario, and consists of the Darlington Nuclear Generating Station (DNGS) and the Darlington Waste Management Facility (DWMF). The operation of DNGS and DWMF are authorized under separate licences. See sections 3.1 and 3.2 for details. The site also includes the Darlington New Nuclear Project (DNNP), which is at the Licence to Prepare Site (LTPS) stage of licensing.

The [Pickering site](#) is located in Pickering, Ontario, and consists of the Pickering Nuclear Generating Station (PNGS) and the Pickering Waste Management Facility (PWMF). The operation of PNGS and PWMF are authorized under separate licences. See sections 3.3 and 3.4 for details.

The [Bruce site](#) is located in Tiverton, Ontario, and consists of the Bruce A and B Nuclear Generating Stations; OPG's Western Waste Management Facility (WWMF) and Radioactive Waste Operations Site-1 (RWOS-1); and Canadian Nuclear Laboratory's (CNL's) Douglas Point Waste Facility. The operation of Bruce A and B are authorized under a single licence. The operation of WWMF, RWOS-1 and Douglas Point Waste Facility are authorized under separate licences. See sections 3.5 and 3.6 for details. Note that the Douglas Point Waste Facility is not covered in this report, but in the *Regulatory Oversight Report for Canadian Nuclear Laboratories Sites: 2021*.

The [Point Lepreau site](#) is located on the Lepreau Peninsula in New Brunswick and consists of the Point Lepreau Nuclear Generating Station (PLNGS) and the Solid Radioactive Waste Management Facility (SRWMF). The operation of the PLNGS and SRWMF are authorized under a single licence. See section 3.7 for details.

The [Gentilly nuclear site](#) is located in Bécancour, Quebec, and consists of CNL's Gentilly-1 Waste Facility and Hydro-Québec's Gentilly-2 Facilities. The operation of Gentilly-1 and Gentilly-2 facilities are authorized under separate licences. See section 3.8 for details. Note that the Gentilly-1 Waste Facility is not covered in this report, but in the *Regulatory Oversight Report for Canadian Nuclear Laboratories Sites: 2021*.

### 1.3.2 Nuclear power plants

#### Operating NPPs

There were 17 reactors which continued to operate in Canada throughout 2021. They are located in 2 provinces (Ontario and New Brunswick – see figure 1) and are operated by 3 distinct licensees (OPG, Bruce Power and NB Power). These NPPs range in size from 1 to 8 power reactors, all of which are of the Canada Deuterium Uranium (CANDU) design.

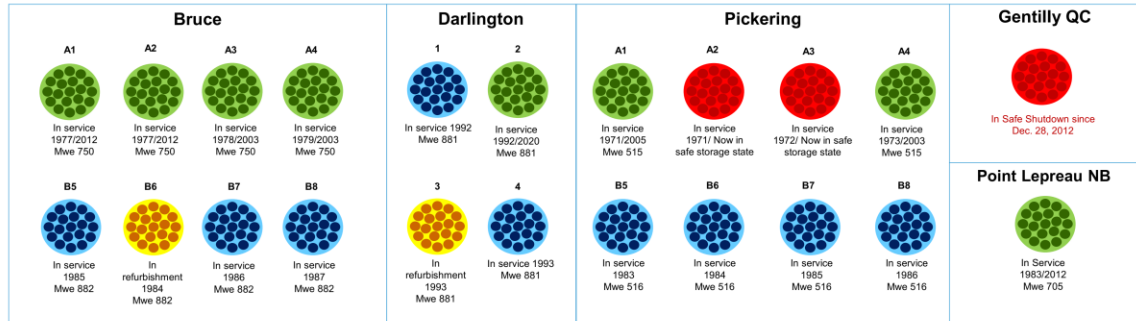
Figure 2 provides data for each NPP, including the generating capacity of the reactor units, their initial start-up dates, and reactor status in 2021. Additional information on the NPPs and licences is provided in section 3.



## Operating Performance of the Canadian Nuclear Fleet

### Operable status (Average age – 25 Years)

- In service within design life
- In service / Returned to service
- Safe storage state
- In refurbishment



**Figure 2: Basic information for all NPPs**

### Non-operating reactors

As indicated in figure 2, BNGS Unit 6 and DNGS Unit 3 were offline for refurbishment in 2021. The PNGS also includes Units 2 and 3, which remained defueled and in safe storage. They are also CANDU designs and are governed by the same PROL as the operating units.

UPDATE: DNGS Unit 1 was shut down to facilitate refurbishment in March 2022.

In addition, the NPP at Gentilly-2 is shut down and is proceeding to decommissioning through preparation for the “storage with surveillance” phase. It is also a CANDU design and is governed by a power reactor decommissioning licence.

### New NPPs

In 2012, the Commission issued a nuclear power reactor site preparation licence (PRSL) to OPG for the DNNP at the Darlington site for a period of 10 years. The PRSL requires OPG to continue follow-up work on the environmental assessment (EA) conducted in conjunction with the licence application.

In June 2021, a Commission Hearing was held to consider an application by OPG to renew its licence (PRSL 18.00/2022), for a 10-year term. On October 12, 2021, the [Commission renewed](#) the licence for a period of 10 years. On December 2, 2021, [OPG announced](#) the selection of the [GE Hitachi BWRX-300](#) as the new reactor technology for the DNNP and plan to submit an application for a licence to construct in 2022.

CNSC staff noted that OPG did not conduct any licence to prepare site (LTPS) activities during the current licence period. However, OPG has carried out some baseline site characterization and other long lead-time work to address selected commitments.

### 1.3.3 Waste management facilities

The WMFs that are included in this regulatory oversight report are licensed independently from the associated NPP. They include the DWMF, PWMF and WWMF, each of which is owned and operated by OPG under a waste facility operating licence (WFOL). The RWOS-1 facility is licensed under a Waste Nuclear Substance Licence (WNSL).

Table 2 provides data for each WMF, including the initial start-up date, the name of the licensee, the expiry date of the licence, and the type of waste managed at each facility (for example, low- and intermediate-level waste (L&ILW), intermediate-level waste (ILW) and high-level waste (HLW)). Additional information on the facilities and licences is provided in section 3. As discussed in section 1.3.1, both the Point Lepreau and Gentilly-2 sites also have WMFs that are further discussed in sections 3.7 and 3.8, respectively.

**Table 2: Basic information for WMFs**

Facility	Licensee	Location	Operation start	WFOL expiry	Manages
DWMF	OPG	Clarington, ON	2008	Apr. 30, 2023	HLW from DNGS. ILW from DNGS refurbishment
PWMF	OPG	Pickering, ON	1996	Aug. 31, 2028	HLW from PNGS. ILW from PNGS Units 1–4 refurbishment
WWMF	OPG	Tiverton, ON	1974	May 31, 2027	HLW from Bruce A and B NPPs. ILW from Bruce Units 1 and 2 refurbishment  L&ILW from DNGS, PNGS, and Bruce A and B NPPs operations
RWOS-1*	OPG	Tiverton, ON	Mid-1960	Oct. 31, 2029	L&ILW from Douglas Point and PNGS

\*The RWOS-1 site is no longer receiving waste and is in a state of storage with surveillance by OPG

## 1.4 Regulatory framework and oversight

The CNSC regulates the nuclear sector in Canada, including NPPs and WMFs, through licensing, reporting, compliance verification, and enforcement. The CNSC uses a risk-informed regulatory approach, applying resources and regulatory oversight commensurate with the risk associated with the regulated facility and activity.

Additional information on the CNSC regulatory framework and oversight is provided in this section and in [General Description of Regulatory Framework for Nuclear Power Generating Sites](#) [2].

### 1.4.1 CNSC requirements

All licensees are required to operate in accordance with the applicable requirements. When a licence is issued, CNSC staff develop a licence conditions handbook (LCH) to identify the specific requirements that apply to that licence. All NPPs and WMFs covered by this report have LCHs.

Appendix B lists all CNSC regulatory documents and CSA Group standards that are identified in the LCHs for NPPs and WMFs. The appendix illustrates the large number of CNSC regulatory documents and CSA Group standards that provide requirements relevant to all SCAs.

Appendix B also indicates the CNSC regulatory documents and CSA Group standards that the licensees are implementing. Details about the implementation of these publications are provided under the relevant SCAs throughout this regulatory oversight report.

Each licensee implements new CNSC regulatory documents and CSA Group standards in a staged, risk-informed manner that takes into consideration the timing of licence renewals, operational needs, and other concurrent changes. Although differences exist in applicable requirements between similar facilities at any given time, the requirements nevertheless are comprehensive, and updated requirements are implemented in a systematic way.

### 1.4.2 Licensing

Each of the operating NPPs and WMFs described in this report has been granted a licence by the Commission. In 2015, the [Commission granted](#) OPG a 10-year licence for DNGS, and in 2018, the [Commission granted](#) Bruce Power a 10-year licence for BNGS and OPG a 10-year licence for [PNGS](#). In 2021, PLNGS submitted a request for a license renewal of 25-years. Commission hearings for this license request are taking place in 2022. For operating NPPs, licenses are issued in conjunction with the implementation of a periodic safety review (PSR) process in preparation for the licence renewal.

UPDATE: [Part 1](#) of the PLNGS relicensing hearing took place January 26, 2022 and [Part 2](#) took place May 10-12, 2022.

The PSR is a comprehensive evaluation of the design, condition, and operation of an NPP. As outlined in CNSC [REGDOC-2.3.3, Periodic Safety Reviews](#), a PSR involves an assessment of the current state of the NPP and plant performance to determine the extent to which the NPP conforms to modern codes, standards and practices, and to identify any factors that would limit safe, long-term operation. It provides the licensee a framework to systematically identify practicable safety enhancements, which are documented in an integrated implementation plan (IIP). A PSR is not a requirement for Gentilly-2 and the WMFs because, relative to operating NPPs, there are fewer associated hazards and the requirements change

on a less frequent basis, such that the regular licensing process and implementation of CNSC regulatory documents and CSA Group standards are sufficient to assure safe, long-term operation.

The status of the PSR for each operating NPP is described in section 3.

### ***Fisheries Act Authorization***

In addition to CNSC licences, this regulatory oversight report describes developments related to *Fisheries Act* authorizations (FAAs). The *Fisheries Act* requires the establishment of offsets to compensate for any residual harm caused to fish and fish habitats after mitigation measures have been put in place. The CNSC has a [memorandum of understanding](#) (MOU) with Fisheries and Oceans Canada whereby CNSC staff are responsible for monitoring activities and verifying compliance for FAA. The [Minister of Fisheries and Oceans Canada](#) is responsible for enforcing the authorizations in the event of non-compliance.

The status of the *Fisheries Act* Authorization for each operating NPP is described in section 3.

### **1.4.3 Reporting**

Licensees are required to provide various reports and notices to the CNSC in accordance with regulations made under the [NSCA](#). LCHs clarify CNSC expectations for these requirements, if needed.

In addition to, and in conjunction with, the reporting requirements in the regulations, a licence condition requires NPP licensees to report to the CNSC in accordance with CNSC [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants](#). REGDOC-3.1.1 requires licensees to submit quarterly and annual reports on various subjects; for example, quarterly reports on the safety performance indicators that are discussed in this report.

For Gentilly-2, the requirements in REGDOC-3.1.1 have been adjusted in accordance with its current state and the associated risks [3].

For WMFs, OPG is required to submit annual compliance reports as described in [REGDOC-3.1.2, Reporting Requirements, Volume I: Non-Power Reactor Class I Facilities and Uranium Mines and Mills](#). In addition, OPG is required to provide quarterly operations reports for all 3 WMFs as part of the conditions listed in the LCH.

During 2021, NPP licensees reported to CNSC staff on 232 events, and submitted 90 scheduled reports. In accordance with the [General Nuclear Safety and Control Regulations](#), the WMF licensee, OPG, also submitted 9 reportable events to CNSC staff that occurred at the DWMF, PWMF and WWMF.

### **1.4.4 Compliance verification program**

The CNSC staff conclusions presented in this report were based on the results of activities planned through the CNSC compliance verification program (CVP). In 2021, these activities included Type I inspections that evaluate the licensee

programs, Type II inspections that evaluate the outputs and outcomes of licensee programs, field inspections that collect data on the outputs and outcomes of licensee programs, desktop inspections, technical assessments, and surveillance.

Additional reactive compliance verification activities for NPPs and WMFs were added as needed. These reactive activities focus on site-specific matters and known or potential licensee challenges. As necessary during the year in response to new or emerging licensee challenges. The goal is to ensure that the CVPs for NPPs and WMFs are always timely, risk-informed, performance-based, and responsive to developments.

The CVPs for NPPs also include technical assessments of safety performance indicators submitted quarterly to the CNSC in accordance with [REGDOC-3.1.1](#). Some of these indicators are reproduced in this report. No regulatory limits or thresholds are associated with this data, but CNSC staff monitor these indicators, observing for trends over time and deviations from the data typically provided by other licensees with similar operations or facilities.

Any unfavourable trend or comparison is followed by increased regulatory scrutiny, which can range from increased surveillance, to increased focus during field inspections, adjustment of the timing or scope of a baseline inspection, focused technical assessment, or a reactive inspection, depending on the safety significance of the trend or deviation.

#### **1.4.5 Safety assessment ratings**

This report presents safety performance ratings for each SCA at each NPP and WMF based on findings generated during CVP activities. All findings are allocated into appropriate specific areas within SCAs and assessed against a set of high-level performance objectives, as well as the detailed regulatory requirements. Since the CVP consists of a rolling (typically 5-year) cycle of regulatory activities, not all specific areas are directly evaluated every year.

The SCAs and their associated specific areas are described in more detail in [General Description of Regulatory Framework for Nuclear Power Generating Sites](#) [2]. See Appendix A.2 for a description of the rating methodology used for this regulatory oversight report.

In generating the ratings, CNSC staff considered over 1,300 findings for NPPs and WMFs.

All of these findings were assessed as being either compliant or negligible and of low, medium, or high safety significance.

For the Bruce A and B, Darlington, and Pickering sites, the NPP and WMF are assessed separately because they are regulated under separate licences and have facility-specific licensing bases. The WMFs at Point Lepreau and Gentilly-2 are governed by the NPP licences and are subject to the same regulatory requirements, so they are assessed together with their respective NPPs (as was done in previous regulatory oversight reports).

## 2 GENERAL AND SUPPORTING INFORMATION

This section provides information, organized by [Safety and Control Area](#) (SCA), which serves as background for the assessments in section 3. In some cases, it describes data and issues that are applicable to more than 1 facility. General information about the SCAs and the applicability of the specific areas is provided in the [General Description of Regulatory Framework for Nuclear Power Generating Sites](#) [2].

### 2.1 Management System

The CNSC published [REGDOC-2.1.2, Safety Culture](#), in April 2018. This document sets out requirements and guidance for fostering a healthy safety culture and for conducting periodic safety culture assessments. Operating Nuclear Power Plant (NPP) and WMF licensees have indicated full compliance with the [REGDOC-2.1.2, Safety Culture](#) and associated NPP documentation is listed as compliance verification criteria in the Licence Conditions Handbooks.

Point Lepreau conducted a safety culture self-assessment (SCSA) in late 2021. CNSC staff will follow-up on the implementation of the actions resulting from this assessment. Bruce Power has committed to conduct a SCSA during 2022, one year later than the original schedule which was changed due to the COVID-19 pandemic. OPG plans to conduct a SCSA in 2023. CNSC confirmed that Hydro-Québec complied with Section 2 of the REGDOC, which states that the licensees shall document their commitment to fostering a safety culture in their governing documentation. The requirement to conduct a safety culture self assessment, described in Section 3 is no longer applicable to Gentilly-2, given that the reactor is permanently shutdown and defueled.

CNSC staff are developing an oversight strategy to assess compliance with [REGDOC 2.1.2, Safety Culture](#) and to monitor safety culture on an ongoing basis.

The Licence Conditions Handbooks (LCHs) for the NPPs include a requirement for licensees to maintain a Business Continuity Plan (BCP). The licensees must maintain contingency plans to provide for essential services through a sustained period with significant employee absenteeism. In response to the COVID-19 pandemic, all NPP licensees implemented their BCPs.

As noted in the 2020 report, the licensees took measures to ensure that minimum shift complement was not compromised by the COVID-19 pandemic and those measures continued into 2021.

Overall, licensees are adequately prepared with their plans for events involving pandemic and labour actions.

### 2.2 Human Performance

All NPPs and WMFs have implemented human performance programs that meet CNSC requirements. CNSC inspection activities in 2021 indicated that licensees have developed human performance programs using a systematic approach

including consideration for the interplay between humans, technology, and the organization to support worker performance.

The CNSC requires NPP licensees to employ certified Shift Supervisors, Shift Managers, Reactor Operators and Senior Health Physicists. Due to the design of Bruce Nuclear Generating Station (BNGS A, BNGS B) and Darlington Nuclear Generating Station (DNBS), the CNSC requires these licensees to also employ certified Unit 0 Control Room Operators (U0 CRO). It should be noted that Gentilly-2 no longer employs certified shift workers, and therefore responsible health physicists (“responsables techniques de radioprotection”) are the only remaining certified workers at the Gentilly-2 NPP.

Table 3 below shows the number of certified personnel who are available in the certified positions at each NPP, as of December 31, 2021. The table also shows the minimum required number of personnel for each position, which is the minimum number of certified personnel that must be on-site at all times multiplied by the total number of crews.

**Table 3: Number of available certifications per NPP and certified positions for 2021**

Station	Reactor Operator	Unit 0 Control Room Operators <sup>a</sup>	Shift Supervisor <sup>b</sup>	Senior Health Physicist	Total
<b>Darlington Nuclear Generating Station</b>					
Actual	62	17	30 (21 SM+9CRSS)	4	113
Minimum	30	10	10	1	51
<b>Pickering Nuclear Generating Station 1, 4 <sup>c</sup></b>					
Actual	37		19	2	58
Minimum	20		10	1	31
<b>Pickering Nuclear Generating Station 5–8</b>					
Actual	63		26	2	91
Minimum	30		10	1	41
<b>Bruce Nuclear Generating Station A<sup>d</sup></b>					
Actual	49	25	28	3	105
Minimum	30	10	10	1	51
<b>Bruce Nuclear Generating Station B</b>					
Actual	63	24	31	3	121
Minimum	30	10	10	1	51
<b>Point Lepreau Nuclear Generating Station</b>					
Actual	10		9	2	21
Minimum	6		6	1	13

<b>Gentilly-2<sup>e</sup></b>					
Actual				2	2
Minimum				1	1

- There are no Unit 0 positions at PNGS Units 1 and 4 and Units 5–8, or Point Lepreau
- At multi-unit NPPs, the shift supervisor number is the total of certified shift managers plus certified control room shift supervisors
- There are 2 certified health physicists in all at Pickering, who cover both PNGS Units 1 and 4 and Units 5–8
- There are 3 certified health physicists in all at Bruce, who cover both BNGS A and BNGS B.
- There are no reactor operators, UOOs or shift supervisors at Gentilly-2

All NPP licensees have a documented minimum shift complement (MSC), which forms part of its licensing basis. MSC is monitored each shift and is managed through face-to-face turnover, the use of electronic minimum complement monitoring systems, or the use of manual tracking mechanisms to record the availability of staff as they enter and exit the facility.

In 2021, licensees reported 1 MSC violation at the DNGS, 2 violations at the Pickering Nuclear Generating Station (PNGS), 3 violations at BNGS A and B and 2 violations at Point Lepreau Nuclear Generating Station (PLNGS). All violations were of a short duration and the licensees took appropriate actions, e.g., calling in relief staff, holding over staff already present and operating in quiet mode.

All NPP and WMF licensees, as well as Gentilly-2 have procedures to manage worker fatigue that include limits on hours of work. [CNSC REGDOC-2.2.4, \*Fitness for Duty: Managing Worker Fatigue\*](#) specifies requirements and guidance for managing worker fatigue at all high-security sites (HSS), a term which includes NPPs and WMFs, with the aim of minimizing the potential for errors that could affect nuclear safety and security. OPG, Bruce Power and Hydro-Québec implemented this regulatory document in 2019.

NB Power planned to implement REGDOC-2.2.4 by 2020 for normal operations and 2022 for outages. However, as a result of challenges related to the COVID-19 pandemic, NB Power requested an extension to their implementation for normal operations to March 2021 which was accepted by CNSC staff. NB Power's commitment to implement the regulatory document for outages in 2022 was unaffected. NB Power's plan involved expanding its security and emergency response team staff (from a 5 to a 6 crew format working on a 42-day shift cycle, which would match its operations staff). NB Power submitted updates to their hours of work procedures in March 2021 as part of the implementation of [REGDOC-2.2.4, \*Fitness for Duty: Managing Worker Fatigue\*](#). CNSC staff met with NB Power to seek clarification of the changes and requested a gap analysis. The gap analysis was provided by NB Power and additional updates to the procedures were submitted. A review of the updated procedures was conducted by CNSC staff, and a few gaps were identified.

UPDATE: NB Power submitted updates to their procedures to address the CNSC-identified gaps in February 2022. A review by CNSC staff is in progress. A Type



I inspection to assess compliance of NB Power's fatigue management program is planned for 2022.

A Type I Inspection to assess compliance of Bruce Power's fatigue management program was completed in early 2022, and two notices of non-compliances, one of negligible and one of low safety significance were issued to Bruce Power. CNSC staff are monitoring the corrective actions to address these non-compliances.

[REGDOC-2.2.4, \*Fitness for Duty, Volume II: Managing Alcohol and Drug Use\*](#), Version 3 sets out requirements and guidance for managing fitness for duty of workers occupying safety-sensitive and safety-critical positions in relation to alcohol and drug use at all High Security Sites (HSS). All licensees of HSS provided implementation plans early in 2018, which were accepted by CNSC staff. In late 2018, OPG, Bruce Power and NB Power requested an amendment to include oral fluid testing to supplement the urinalysis testing required by the regulatory document. CNSC staff reviewed, and the Commission accepted the request and began work in 2019 to revise REGDOC-2.2.4 Volume II. The amendment was presented to the Commission on November 5, 2020 and approved for publication and use. The new version (version 3) was published on January 22, 2021. OPG, Bruce Power and NB Power confirmed that they had implemented version 3 as planned by July 2021, with the exception of random testing, which they committed to implement by January 22, 2022. Hydro-Québec implemented version 2 of REGDOC-2.2.4 Volume II in July 2019, and in June 2021 provided a gap analysis indicating that their current program was compliant with version 3.

UPDATE: On January 21, 2022, the Federal Court granted an injunction putting on hold the implementation of pre-placement and random alcohol and drug testing pending the results of the Federal Court's judicial review scheduled for late 2022.

Licensees are required to ensure that all nuclear security officers have medical, physical, and psychological certificates that meet CNSC's requirements. CNSC [REGDOC-2.2.4, \*Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical and Psychological Fitness\*](#) sets out the expectations and minimum requirements for medical, physical and psychological certificates for nuclear security officers. All licensees implemented the document by December 31, 2020.

A Type II inspection was conducted at PLNGS in 2021, which verified compliance. Compliance verification for all other licensees is being planned subject to pandemic restrictions.

## 2.3 Operating Performance

All operating NPPs licensees are required to report serious process failures to the CNSC, in accordance with CNSC [REGDOC-3.1.1, \*Reporting Requirements for Nuclear Power Plants\*](#). REGDOC-3.1.1 also requires quarterly reports from operating NPP licensees on the performance indicator "Number of unplanned transients", which tracks unplanned transients (unexpected reactor power changes) for each reactor that is not in a guaranteed shutdown state.

Unplanned transients indicate problems within a plant and place unnecessary strain on its systems.

Table 4 summarizes the number of unplanned transients for the operating NPPs caused by stepbacks, setbacks and reactor trips, where the trip resulted in a reactor shutdown. Stepbacks and setbacks are power changes intended to eliminate potential challenges to plant operations. Reactor trips are power reductions initiated by any of a reactor's safety systems to rapidly shutdown the reactor. "Industry total" provides the data for the operating NPPs as a whole. In 2021, all unplanned transients were properly controlled by the reactor control systems. There were no serious process failures at any NPP.

**Table 4: Number of unplanned transients**

NPPs	Number of operating reactors <sup>3</sup>	Number of hours of operation	Un-planned reactor trips <sup>1</sup>	Step backs	Set backs	Total unplanned transients	Number of trips per 7,000 operating hours
DNGS	3	22,548	0	1	0	1	0.00
PNGS 1, 4	2	17,181	0	n/a <sup>2</sup>	2	2	0.00
PNGS 5–8	4	26,774	0	0	3	3	0.00
BNGS A	4	28,680	0	1	2	3	0.00
BNGS B	3	24,513	0	0	2	2	0.00
PLNGS	1	7,038	0	0	2	2	0.00
Industry total	17	126,737	0	2	11	13	0.00

**Notes:**

- 1 This includes automatic reactor trips only; it does not include manual reactor trips or trips during commissioning testing
- 2 Stepbacks are not a design feature at PNGS Units 1 and 4
- 3 DNGS Units 2 and 3 were down for refurbishment at different times, but never overlapping

Figure 3 shows the total number of unplanned transients from 2017 to 2021 for the operating NPPs.

**Figure 3: Trend of unplanned transients for stations and industry**

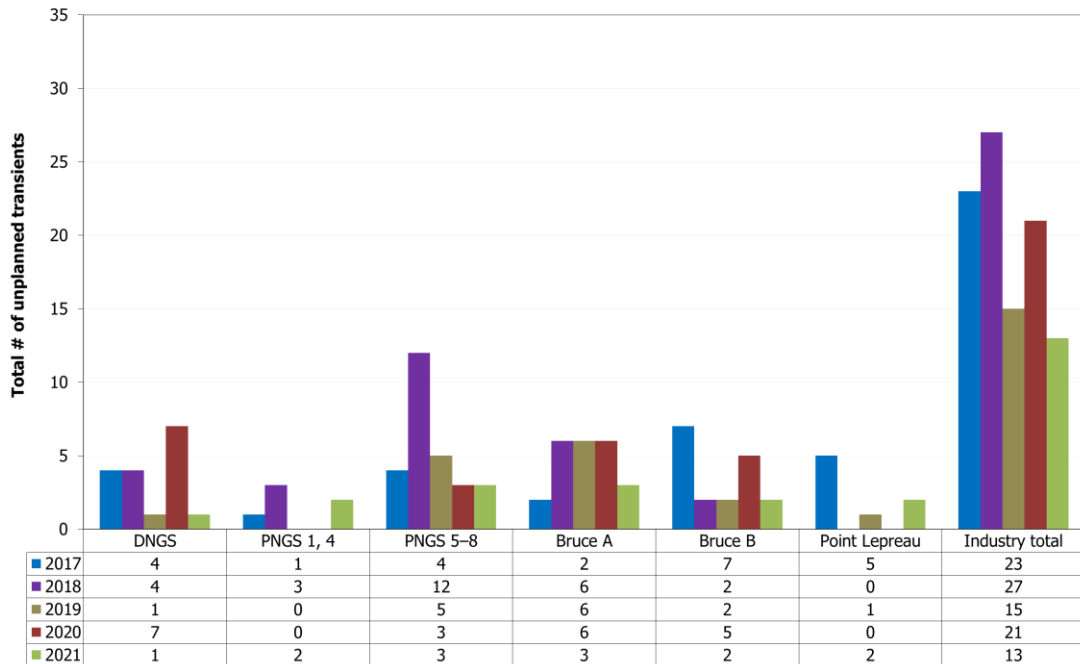
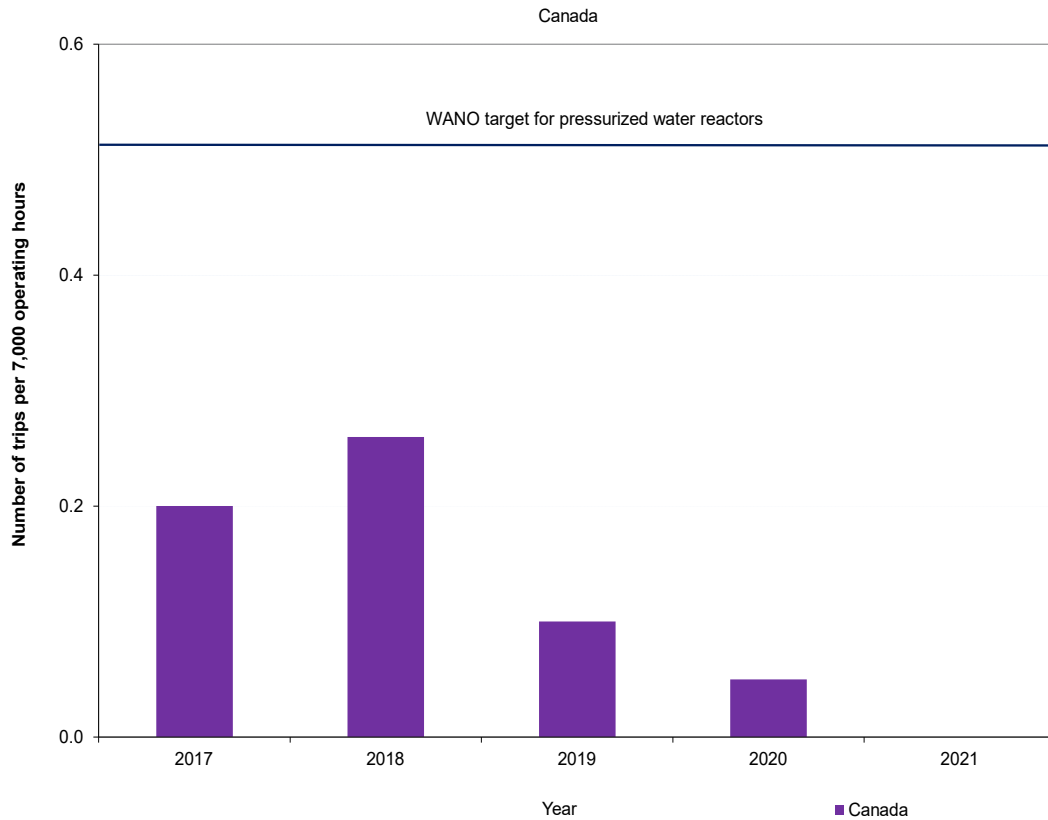


Figure 4 compares the number of unplanned reactor trips for Canada's operating NPPs per 7,000 hours of operation, which is a measure used by the [World Association of Nuclear Operators](#) (WANO). This WANO indicator is defined as the number of unplanned automatic scrams (reactor protection system logic actuations) that occur per 7,000 hours of critical operation (which is approximately 1 year of operation). WANO targets include the following:

- The pressurized heavy water reactors (PHWR) individual target (which is the target for each of the 17 individual operational units) is 1.5 trips per 7,000 hours critical. All units in Canada met this target in 2021
- The PHWR industry target (which is the equivalent industry total trips per 7,000 hours critical) is 1.0. Although the WANO target for PHWR is the appropriate benchmark for the CANDU reactors at Canadian NPPs, figure 4 superimposes a line at the more challenging target (0.5) for pressurized water reactors, which Canadian NPPs continue to use as the more conservative target

**Figure 4: Trend of unplanned reactor trips per 7,000 operating hours**

CNSC staff confirmed that forced outages and outage extensions were managed safely and in accordance with the applicable regulatory requirements. CNSC staff inform the Commission of unplanned outages resulting from reactor trips and their outcomes via status reports on NPPs, however none occurred in 2021.

At each planned outage of a unit in 2021, CNSC staff conducted compliance inspections to confirm regulatory requirements were met and outages were executed safely. All planned and unplanned (forced) outages were managed appropriately by licensees' staff.

CNSC staff concluded that all licensees had adequate safe operating envelope (SOE) programs in 2021 that were based on the requirements of CSA N290.15-10 *Requirements for the safe operating envelope of nuclear power plants (2019)*. All licensees have in place a hierarchy of governance, standards, processes, and procedures to support producing, updating and maintaining SOE-related documentation. All licensees operated within the SOE limits in 2021.

## 2.4 Safety Analysis

In 2021, the NPP licensees continued their safety analysis improvement programs, which are linked to the ongoing staged implementation of [REGDOC-2.4.1, \*Deterministic Safety Analysis\*](#). Several safety analyses were updated throughout 2021 to reflect the anticipated state of reactors being returned to service after refurbishment and demonstrated improved safety margins due to the reduction of aging effects and safety enhancements. CNSC staff were satisfied with the progress in 2021 and provided recommendations to the licensees on their ongoing safety analyses activities.

Aging of a reactor affects certain characteristics of the heat transport system, which can result in a gradual reduction of safety margins. Therefore, compensatory measures are implemented to mitigate the impact of aging when needed. The structures, systems, and components (SSCs) of a reactor are affected by aging simultaneously, continuously and to different degrees. As such, the overall safety case of an NPP needs to be periodically assessed and the safety margins quantified.

Important safety parameters affected by reactor aging are systematically monitored by an aging management program. Details for each facility are provided further in section 3.

The regulatory document REGDOC-2.4.2, [Probabilistic Safety Assessment \(PSA\) for Nuclear Power Plants](#), version 1 was introduced in the Licensees' LCH with an implementation plan for compliance.

- PLNGS has been compliant with REGDOC-2.4.2 since 2016. In November 2021, NB Power completed the submission of the PLNGS PSA update
- BNGS A and B completed PSA submissions in compliance with REGDOC-2.4.2, in June 2019. CNSC staff concluded that BNGS A and B was compliant with REGDOC-2.4.2 in 2021
- PNGS completed its transition to REGDOC-2.4.2 compliance in 2020. CNSC staff concluded that the PNGS was compliant with REGDOC-2.4.2 in 2021
- DNGS completed the submission of the PSA for compliance with REGDOC-2.4.2 in 2020. CNSC staff concluded that DNGS was compliant with REGDOC-2.4.2 in 2021

The compliance dates are in accordance with the implementation plan included in the Licensees' LCHs.

Table 5 summarizes the status of PSAs at the operating NPPs in 2021.

**Table 5: Status of PSAs and reviews**

PSA submission	DNGS	PNGS 1, 4	PNGS 5-8	BNGS A	BNGS B	PLNGS
REGDOC-2.4.2 Compliance	2020	2020	2020	2019	2019	2016
Last PSA report received	2020	2020	2020	2019	2019	2021
Review status	Completed	Completed	Completed	Completed	Completed	Ongoing
Next PSA report expected	2025	2023	2022	2024	2024	2026

CNSC staff reviewed Bruce Power's request to approve the use of MAAP5-CANDU version 5.00a for severe accident analyses to support the upcoming 2024 update of Level-2 PSA for BNGS A and B. Bruce Power's request was accepted by CNSC staff with some recommendations. The recommendations aim to ensure that any gaps in the code validation are closed and the impact of the new core collapse model on severe accident progression at BNGS A and B is well understood through performing sensitivity analysis.

OPG developed a software package to estimate the source term and doses to members of the public following a reactor accident. CNSC staff assessed the adequacy of calculation assumptions, appropriateness of the input data, and verified that the software package met the required Quality Assurance documentation based on CSA N286.7, Quality Assurance of Analytical, Scientific, and Design Computer Programs. In 2021, CNSC staff reviewed OPGs request to close the Action Item raised during CNSC staff review of the documents prepared in support of the deployment of this software. The Action Item requests were satisfactorily addressed by OPG and CNSC staff closed this Action Item and issued two recommendations to OPG to improve the software accuracy.

CNSC staff continue to monitor the management of CANDU Safety Issues (CSIs) by licensees of operating NPPs to ensure timely and effective implementation of plant-specific safety improvement initiatives and risk control measures.

CNSC staff have assessed the status update for the CSI AA3 Computer Code and Plant Model Validation program for all licensees and determined that the CNSC staff comments on the code validation and accuracy estimation guidelines are properly addressed and implemented in the revised versions of both guidelines.

CNSC staff have noted that some progress on the code applicability assessment has been made; however, more validation work is needed to continue to evaluate modeling uncertainties and the code accuracy.

The industry has developed a composite analytical approach (CAA) to addressing the large break LOCA (LBLOCA) safety margin issues (CSI AA9, PF9 and PF10). A key aspect of the CAA is to reclassify a portion of LBLOCA scenarios from Design Basis Accident (DBA) category to Beyond Design Basis Accident (BDBA) category and, subsequently, to use a realistic analysis approach, in lieu of the traditional conservative approach, in estimation of the consequences for the BDBA-LBLOCA portion. The scope of the realistic analysis is currently under discussions between CNSC staff and the industry.

Bruce Power has taken a lead role in implementing the CAA in its application for BNGS B reactors. The first major activity was to determine the threshold break size (TBS) – a delineation between the DBA- and BDBA-breaks, based on a pipe break frequency assessment. Given Bruce Power’s assessment of low likelihood of breaks above the TBS, CNSC staff accepted Bruce Power’s request for re-categorization of the three LBLOCA safety margin issues from Category 3 to Category 2 for BNGS B reactors (CNSC letter of November 14, 2019). On the same basis, CNSC staff accepted Bruce Power’s request for reclassification of the breaks above the TBS from DBA to BDBA for BNGS B reactors.

In September 2020, CNSC staff communicated to the industry a regulatory position and expectations on the LBLOCA reclassification and on the CAA-LBLOCA analysis methodology. Consistent with the regulatory position and expectations, CNSC staff reviewed Bruce Power’s submission of its LBLOCA safety analysis using the CAA for BNGS B reactors. CNSC staff noted that the LBLOCA analysis used a realistic methodology for the limited purpose of showing large analytical margins is a first-of-a-kind approach to analysis of a BDBA. As such, CNSC staff requested additional information for clarification.

UPDATE: In February 2022, Bruce Power provided additional information, and requested CNSC staff acceptance of DBA analysis at or below the TBS, while continuing discussions and workshops with CNSC staff on the BDBA-LBLOCA realistic analysis. CNSC staff are currently reviewing this additional information.

In February 2022, Bruce Power submitted assessments of TBS for BNGS A reactors, requesting for CNSC staff concurrence of the determined TBS. CNSC staff are currently reviewing this request.

OPG and NB Power have expressed their intent to apply the CAA, or a similar approach, to address their LBLOCA safety margin issues. As industry members, they continue to participate in discussions and workshops with CNSC staff on the novel analytical approach.

## 2.5 Physical Design

NPP and WMF licensees including Gentilly-2 maintain a Fire Hazard Assessment and update the assessment periodically to reflect changes and modifications in the

plant. In addition, licensees implement various fire protection measures that identify, minimize, monitor, and control fire hazards within the plant on an ongoing basis.

In 2021, there were no major issues with regards to the Electrical Power Systems (EPSs) across all stations. All the EPSs performed as per the design intent. CNSC staff confirmed that the licensees' EPSs and instrumentation and control (I&C) functioned as required.

Licensees of operating NPPs have mature fuel design and inspection programs, however, over the past several years, operating NPPs have experienced challenges related to fuel performance (such as fuel defects or fuel bundle vibrations). Licensees have adequately managed these challenges and have mitigation strategies in place. CNSC staff continued to monitor the status of the mitigation strategies and were satisfied with the industry's management of these issues in 2021. Regulatory limits for fuel bundle and fuel channel power were met by all licensees throughout this period. Additional details are provided in Section 3 for each NPP.

## 2.6 Fitness for Service

Overall, the special safety systems (SSSs) performed well in 2021 and met their unavailability targets, with some exceptions as outlined in Section 3.

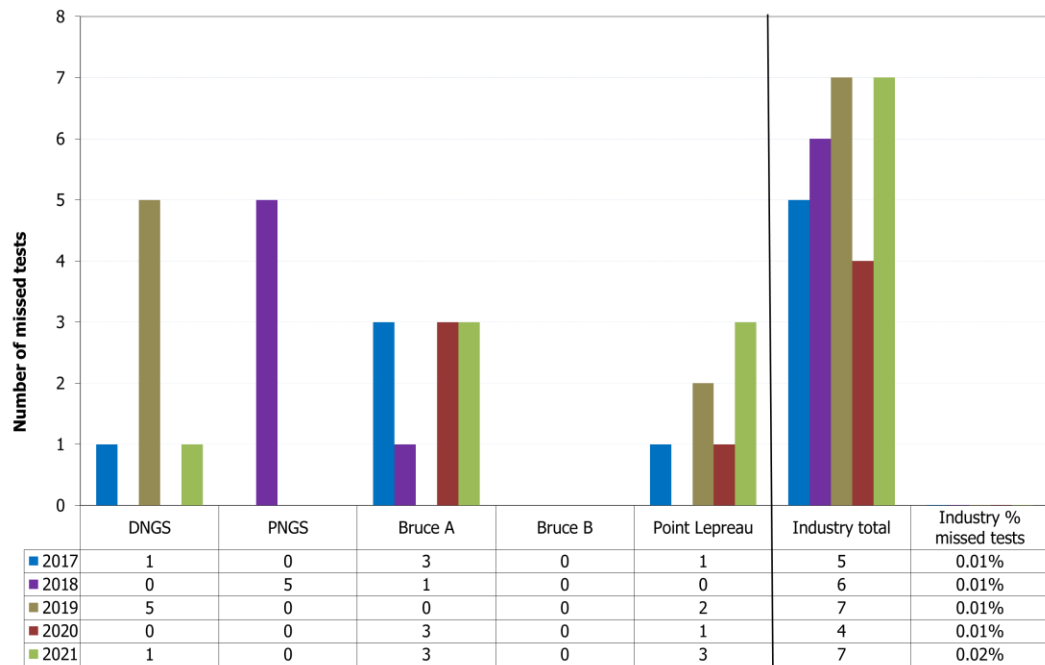
The number of total missed safety system tests remained very low in 2021. In all, 40,222 tests were performed, and the percentage of missed tests was 0.02%. The impact of missing a single test is negligible because the NPP designs have sufficiently high redundancy to ensure continuous availability of the safety systems.

Table 6 provides the number of planned tests versus the number of tests not completed.

**Table 6: Safety system test performance for 2021**

Nuclear power plant	Number of annual planned tests	Safety system tests not completed				Percent not completed
		Special safety systems	Standby safety systems	Safety-related process systems	Total	
DNGS	7,125	1	0	0	1	0.01
PNGS	14,012	0	0	0	0	0.00
BNGS A	7,914	1	2	0	3	0.04
BNGS B	6,945	0	0	0	0	0.00
PLNGS	4,226	0	1	2	3	0.07
Industry total	40,222	2	3	2	7	0.02



**Figure 5: Trend of safety system test performance for NPPs and industry**

In 2016, OPG initiated a joint fuelling machine reliability project with NB Power through COG with the aim to prevent premature failures of fuelling machine ram seals. The fuel handling organization is continuing to progress on a number of equipment reliability improvement projects to support reliable and safe operation and defueling. In addition, fuel handling is improving access to equipment operational and performance data to further advance the capability of the OPG to identify and respond to equipment degradation issues before they develop into failures. While this is an operational issue rather than a safety issue, the Commission previously requested updates on improved fuelling machine reliability [RIB 17557 (item iii)].

The preventative maintenance completion ratio (PMCR) quantifies the effectiveness of the preventive maintenance program. The average PMCR value for operating NPPs was 95% in 2021.

The corrective and deficient maintenance backlogs and deferrals for the industry are provided in table 7. The industry average of these 3 performance indicators were continuously kept low in 2021.

The current levels of the maintenance backlogs and deferrals for critical components for the NPPs represent a negligible risk to the safe operation of the NPPs.

**Table 7: Trend of industry maintenance backlogs and deferrals for critical components of NPPs**

Performance indicator	Average quarterly work orders per unit in 2019	Average quarterly work orders per unit in 2020	Average quarterly work orders per unit in 2021	Three-year trending
Corrective maintenance backlog	1	1	1	steady
Deficient maintenance backlog	9	4	4	down
Deferrals of preventive maintenance	2	2	2	steady

*Pressure tubes and fuel channels – Overall performance*

With respect to the pressure tubes in operating NPPs, overall, the life cycle management plans (LCMPs) reflected sound aging management practices. Aging management activities were successful at identifying regions of elevated hydrogen equivalent concentration (Heq) near the outlet rolled joint burnish marks of pressure tubes in extended operation before fitness for service was challenged. However current Heq modelling approaches did not predict the findings of elevated Heq. In the subsequent evaluations of the finding impact on the fitness for service, it was demonstrated that the likelihood of flaws that would lead to crack initiation in the region of elevated Heq was low in operating NPPs, thus, the intent of existing compliance verification criteria was not challenged.

Therefore, the elevated Heq finding did not challenge continued operation of pressure tubes for the short to medium term. Late in 2021, an additional finding of elevated Heq was observed near the inlet rolled joint of a pressure tube. While the full impact of this finding is still subject to CNSC staff review, it was concluded that the finding did not present an unacceptable risk. Industry is implementing research and development activities to improve the understanding of hydrogen isotope diffusion near the rolled joint burnish marks, which is expected to lead to enhancements to the LCMPs to support longer term operation. A detailed update

on these Heq findings and subsequent industry actions are the subject of separate, focused Commission proceedings in 2022.

CNSC staff also continued to review the results from fuel channel inspections that occurred routinely during planned outages in 2021. Where concerns were identified, CNSC staff requested additional supporting information, or in some cases imposed restrictions on operation to ensure that appropriate margins were maintained. CNSC staff are satisfied that operational safety has been demonstrated. CNSC staff confirmed that no new flaw-initiation mechanisms were identified.

CNSC staff were satisfied with the licensees' work to ensure that fuel channel spacers continued to perform their design function.

CNSC staff have enhanced regulatory oversight for licensees' activities to assess and manage the aging of fuel channels for units in extended operation. The equivalent full power hour operating targets for the extended operation of pressure tubes in the existing licences are based on the current knowledge concerning the rates of change of dimensions and material properties. Licensees are required to monitor the rates of change to confirm that they can safely meet those targets. Licensees are not permitted to operate tubes that do not satisfy safety margins.

#### *Recent developments and research in aging management*

The licensees demonstrate the ability to maintain safe operations through assessments of the current and expected conditions of the pressure tubes, basing the assessments on an understanding of relevant degradation mechanisms. Research activities as well as inspection and maintenance programs provide data to periodically validate the input parameters for these assessments.

The current revision of the cohesive zone model being used by licensees is only valid for hydrogen equivalent (Heq) concentrations below 120 ppm because of the limitations of the data available at the time it was developed. An additional limitation of 80 ppm Heq concentration was placed on use of the model for front end pressure tube material to account for burst test results performed on pressure tube material from this region. Industry submitted the technical basis for a revised fracture toughness model in 2021, which extended the Heq limits to 100 ppm within 1.5 m of the front end of a pressure tube and 140 ppm for the remainder of the tube. The CNSC staff review of the new model extended into 2022.

The licensees must seek CNSC staff concurrence for PNGS or Commission approval for BNGS A and BNGS B to operate any pressure tube beyond 120 ppm Heq. Details on the current and anticipated future fuel channel conditions and validity of the fracture toughness model for the NPPs in Ontario are provided in appendix C. These predictions only apply to regions of the pressure tubes that are not impacted by the recent elevated Heq findings near the burnish marks. Additional regulatory actions have been taken to address the regions where elevated Heq has been observed.

In 2021, CNSC staff actively monitored the industry's progress in research activities to ensure that licensees have sufficient understanding of degradation issues to safely operate pressure tubes, especially those planned for extended operation. Specifically, CNSC staff monitored the fuel channel life confirmation project, which included the following activities in 2021:

- Research focusing on the fracture toughness of front end pressure tube material and changes in toughness occurring as Heq levels exceed 120 ppm
- Collection of additional pressure tube burst-test data, supporting development of a revised version of the fracture toughness model
- Continued development of assessment methodologies for pressure tubes in extended operation
- Continued development of an industry-standard set of fitness for service guidelines for Inconel X-750 (a.k.a. "tight-fitting") annulus spacers

Overall, CNSC staff were satisfied with the licensees' work to demonstrate and support the safe operation of pressure tubes in the near- and medium-terms. Plans are under development to enhance Heq modelling near the rolled joint burnish marks and further evaluate the potential impacts of higher Heq of pressure tubes in extended operation.

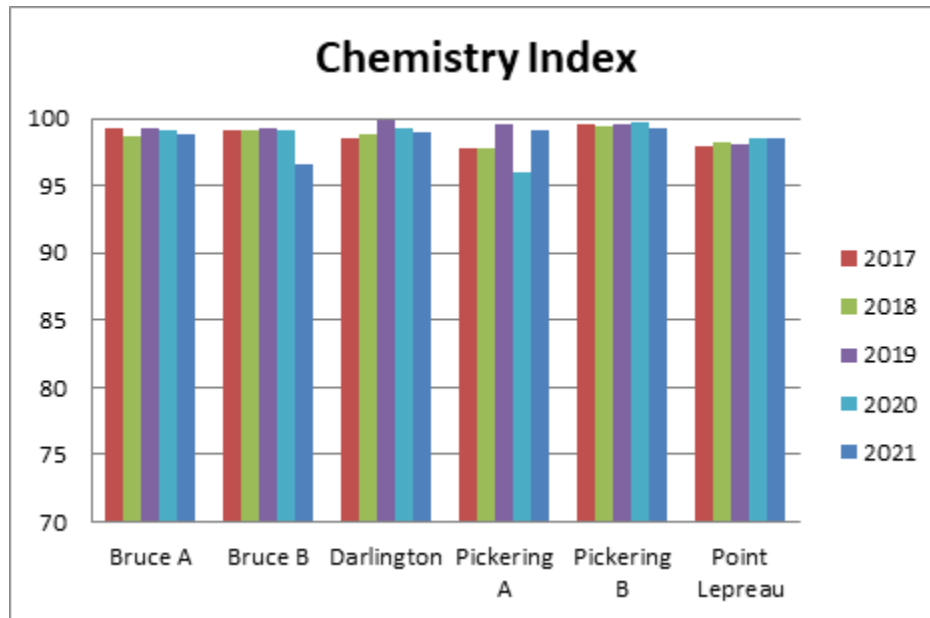
The licensees are updating their periodic inspection programs to comply with CSA N285.7, *Periodic inspection and CANDU nuclear power plant balance of plant systems and components*. N285.7 will be adopted as compliance verification criteria in the future for all operating NPPs except PNGS. Implementation of a program for N285.7 is not practical for PNGS, given the planned shutdown in 2024. If operation of PNGS beyond 2024 is considered, then the need for implementation of N285.7 will be re-evaluated. Furthermore, CNSC staff will apply experience gained from its implementation at other NPPs to PNGS, in order to address potential safety implications should the need arise.

Figures 6 and 7 show the values of both chemistry control indices for operating NPPs from 2017 to 2021. The Chemistry Index (CI) is the percentage of time that the selected chemical parameters are within specification. It quantifies the long-term control of important chemical parameters. The CI is used to determine long-term impacts on safety-related systems, including corrosion. The Chemistry Compliance Index (CCI) is the percentage of time that the selected chemical parameters are within the licensees' specifications for guaranteed shutdown state (GSS) and non- GSS conditions. The CCI parameters are selected based on potential immediate risks if these parameters are out of specification.

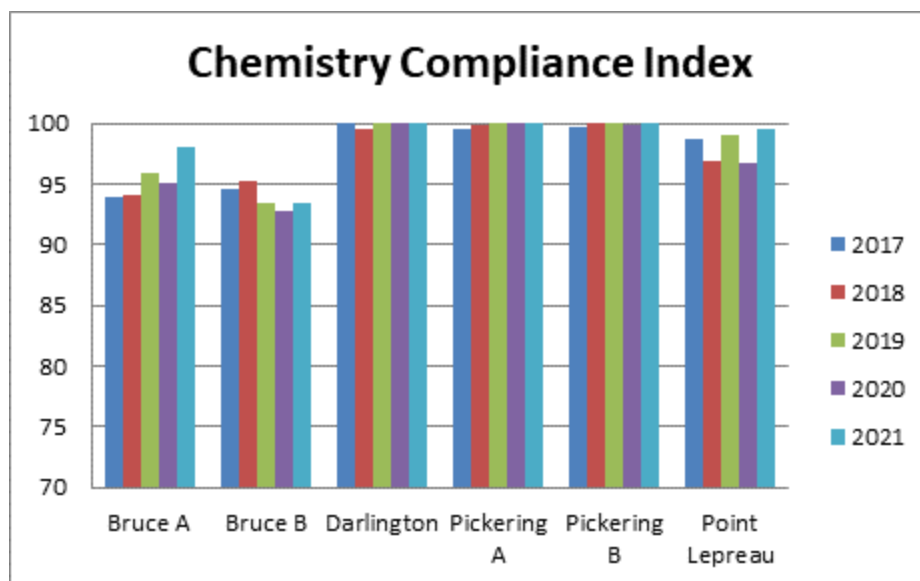
Based on these values, CNSC staff concluded that chemistry control was acceptable for all licensees. A steadily increasing trend of the CCI from BNGS A is due to upgrading efforts to bring moderator D2O Isotopic within specification. Bruce Power will continue to apply remedial action to bring moderator isotopic within specification at both stations. CNSC staff note that although the value of

moderator isotopic is outside of the range specified by Bruce Power, the value is well within the range required for safe operation.

**Figure 6: Trend of chemistry index for industry (in percentage)**



**Figure 7: Trend of chemistry compliance index for industry (in percentage)**



## 2.7 Radiation Protection

Each licensee has a comprehensive radiation protection program, including an ALARA program, which takes into account the design, age, maintenance activities, and work scope of each facility. The safety performance indicator for the Application of ALARA is the “collective radiation exposure” also known as collective dose. Most collective radiation exposure for the NPGS sites occur at the NPPs. In 2021, the total collective dose for monitored individuals at all Canadian

NPPs and WMFs was 35.5 person-sieverts (p-Sv), approximately 30.5% higher than the industry-wide collective dose reported for the previous year (27.2 p-Sv). The number of non-zero doses reported in 2021 (10,855) was slightly higher than 2020 values (9,624). The increase in total collective dose was mainly due to increased outage activities at BNGS A and DNGS. The routine operations dose remained relatively constant between 2021 and 2020.

The collective doses for the individual NPPs are shown in table 8. Table 8 shows that outages (including refurbishment activities) account for a much greater fraction of the collective dose than routine operations (with the exception of PLNGS) and that external dose is, collectively, much greater than internal dose. Resulting from differences between the facilities, the ratio of internal dose to external dose varies by NPP.

As indicated above, the collective dose is a safety performance indicator for the Application of ALARA. The collective doses shown in table 12 for 2021 are expected based on the activities performed at the individual NPPs during 2021, including outages and refurbishments. Each facility performed well within their individual ALARA program and continued ALARA initiatives to ensure doses to monitored persons are appropriately controlled.

**Table 8: Breakdown of collective dose for operating NPPs in 2021 (person-mSv)**

NPP	Number of Operating Units	Routine Operations	Outages **	Internal	External	Total
Pickering	6	987	2,915	862	3,040	3,902
Darlington	4*	273	13,135	448	12,960	13,408
Point Lepreau	1	170	117	66	221	287
Bruce A	4	384	8,038	297	8,125	8,422
Bruce B	4*	477	9,497	264	9,710	9,974

\* During 2021, DNGS and Bruce B each had one (1) unit undergoing refurbishment activities

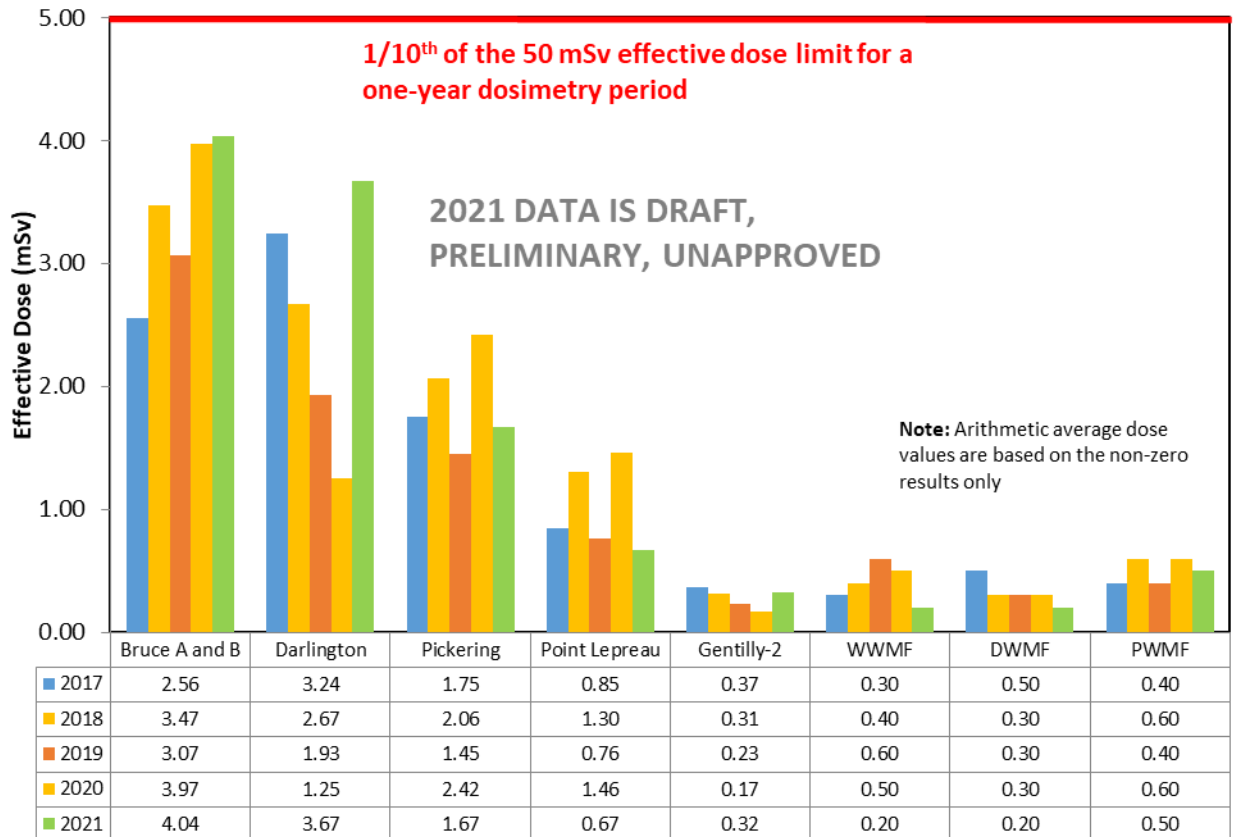
\*\* For 2021, DNGS and Bruce B had dose attributed to refurbishment activities

On a per person basis, the annual average effective dose in 2021 for all operating Canadian NPPs was 3.27 millisieverts (mSv), an approximate increase of 15.5% from the 2020 value of 2.83 mSv. Similar to the collective dose, this increase is also mainly due to outage activities. Figure 8 shows the average effective doses to monitored persons with non-zero dose at each NPP and WMF for the period 2017 to 2021. In general, the fluctuations in average dose observed from year to year reflect the type and scope of work being performed at each facility.

In particular, the large increase in average effective dose at DNGS in 2021 is a result of the completion of outage activities deferred from 2020 to 2021 due to

COVID-19 precautions and the conduct of Unit 3 reactor refurbishment work that involved core disassembly. No negative trends were identified in 2021.

**Figure 8: Trend of average effective doses of monitored persons**



The maximum annual individual effective doses, as reported by each NPP and WMF for 2017 to 2021, are presented in figure 9. In 2021, the maximum individual effective dose received at a single site was 19.95 mSv, received by a worker who performed feeder removal duties at DNGS during refurbishment activities. In 2021, no radiation exposures received by persons at any NPP or WMF exceeded the regulatory dose limit of 50 mSv/year for nuclear energy workers, as established in the [Radiation Protection Regulations](#).

**Figure 9: Trend of maximum individual effective doses**

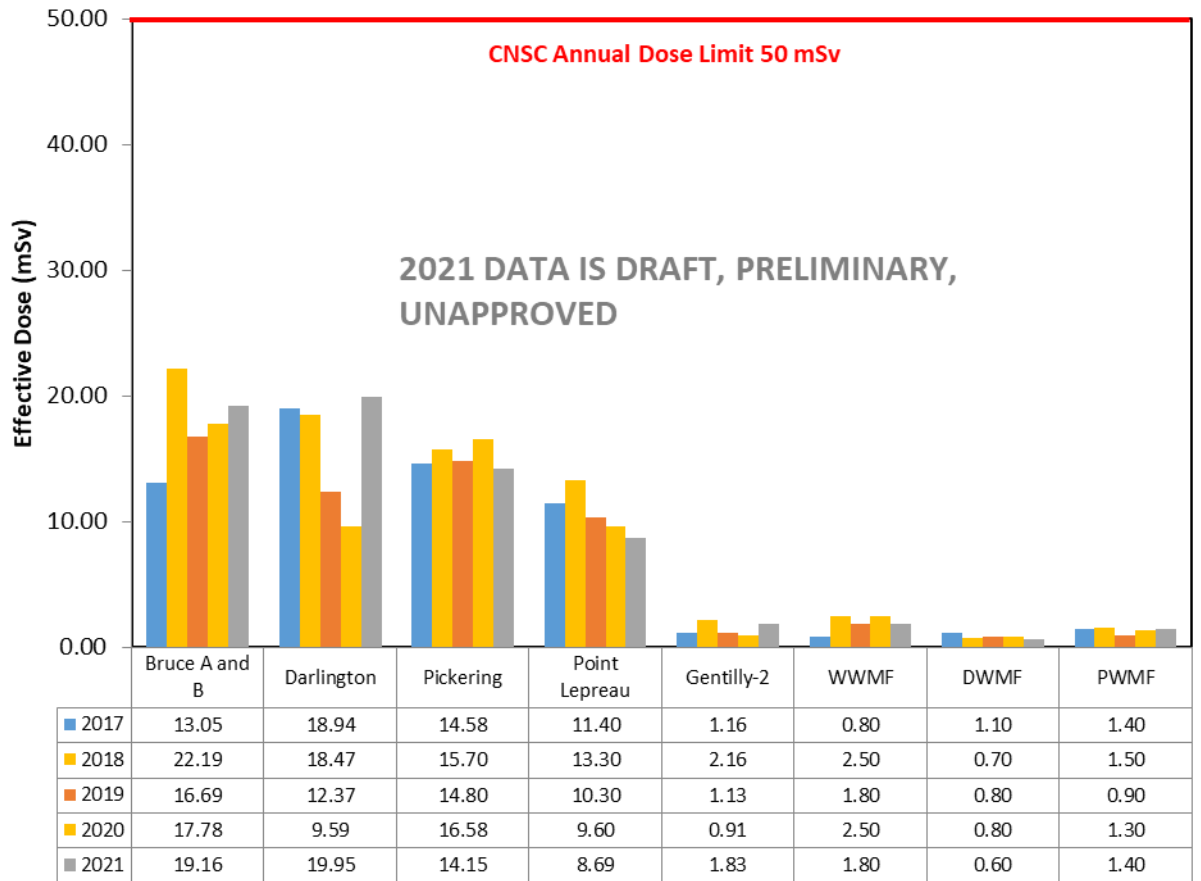
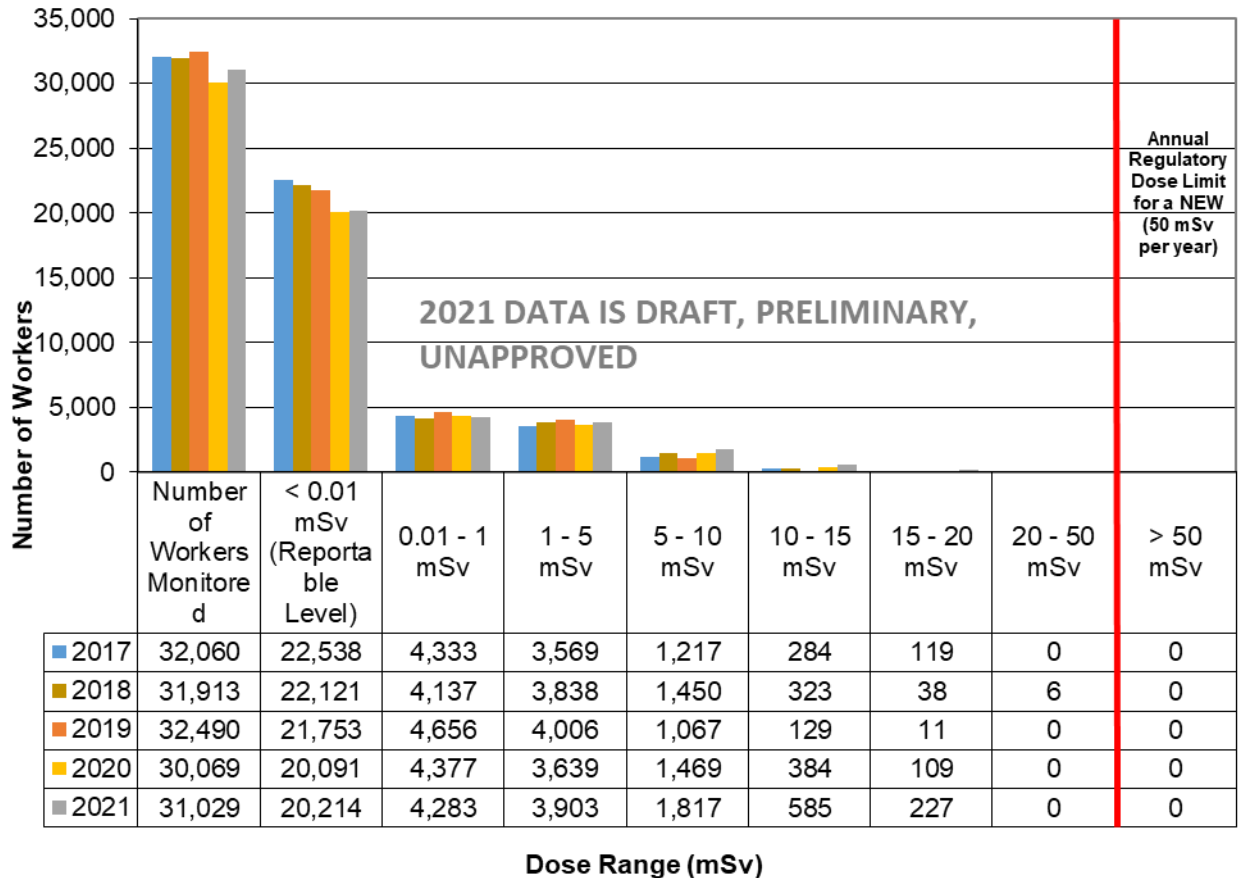




Figure 10 provides the distribution of annual effective doses to all monitored persons at all Canadian NPPs from 2017 to 2021. All doses reported over those years were below the annual regulatory dose limit of 50 mSv for nuclear energy workers. In fact, approximately 79% of the doses reported were at or below the much lower annual regulatory dose limit of 1 mSv for members of the public.

**Figure 10: Trend of distribution of annual effective doses received by all monitored persons at Canadian NPPs**



NPPs continued to employ performance metrics and perform self-assessments to monitor and control performance in all aspects of the RP program. Operating experience and benchmarking with industry was used to improve performance.

CNSC staff did not observe any failures of RP programs in 2021 and are satisfied with the industry's performance.

## 2.8 Conventional Health and Safety

The performance indicators for this SCA include Accident Severity Rate (ASR), Accident Frequency (AF), and Industrial Safety Accident Rate (ISAR). The ASR measures the total number of days lost due to work-related injuries for every 200,000 person-hours (approximately 100 person-years) worked at an NPP. The AF is a measure of the number of fatalities and injuries (lost-time and medically treated) due to accidents for every 200,000 person-hours worked at NPPs.

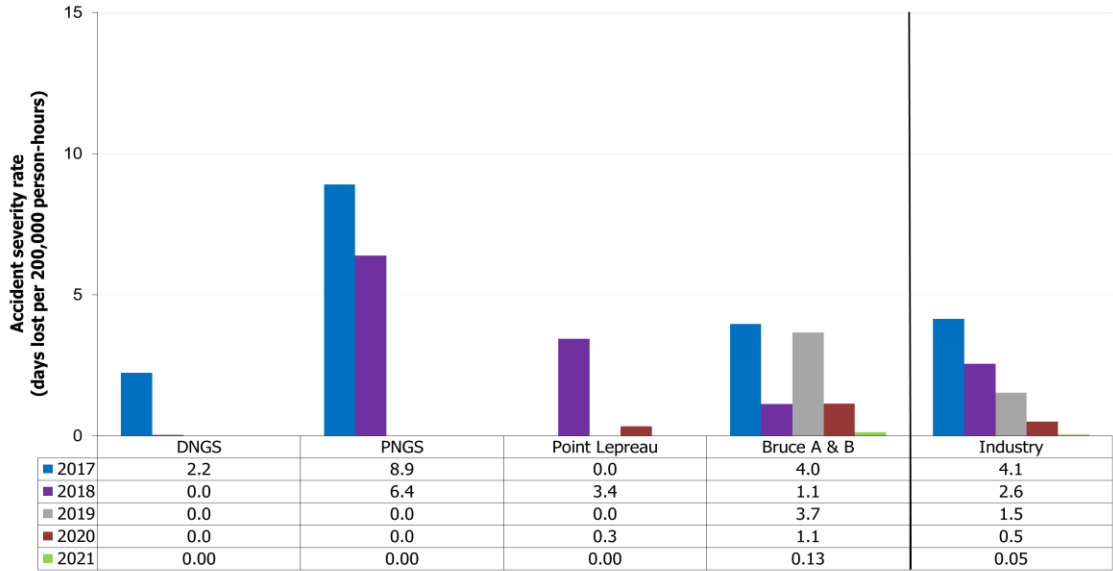
The ISAR is a measure of the number of lost-time injuries for every 200,000 hours worked by NPP personnel.

The ASR, AF and ISAR values for the NPPs and industry average are presented in figures 11, 12 and 13, respectively. The data in these figures indicate continuing low rates of accidents and lost time due to accidents.

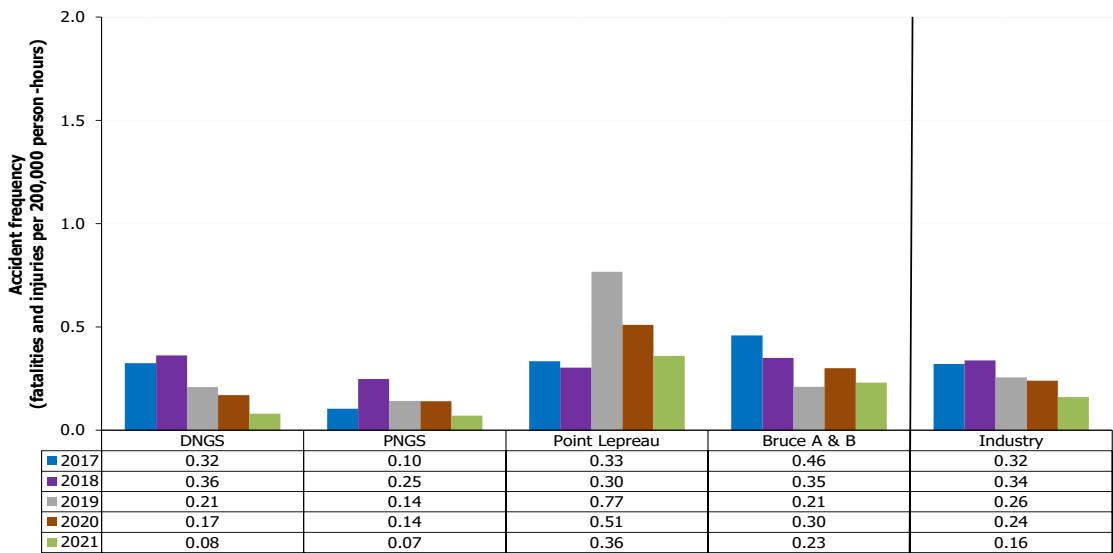
In addition, the values for ASR, AF and ISAR for WMFs were all zero in 2021. CNSC staff observed that no work-related fatalities occurred at Canadian NPPs and WMFs in 2021.

All licensees continue to implement and maintain a conventional health and safety program in accordance with provincial and federal regulatory requirements. Regulatory requirements for conventional health and safety are found in the relevant provisions of provincial and/or federal laws ([Occupational Health and Safety Act](#) (Ontario), the [Ontario Labour Relations Act](#), [Occupational Health and Safety Act](#) (New Brunswick), Quebec's [Loi sur la Santé et la Sécurité au Travail](#) (Québec), and the [Canada Labour Code, Part II: Occupational Health and Safety](#)). CSA N286-12, *Management system requirements for nuclear facilities* also contains regulatory requirements that are directly applicable to conventional health and safety. The CNSC has a [memorandum of understanding](#) with the Ontario Ministry of Labour, Training and Skills Development, which establishes a formal mechanism for cooperation and exchange of information between the Ministry and the CNSC.

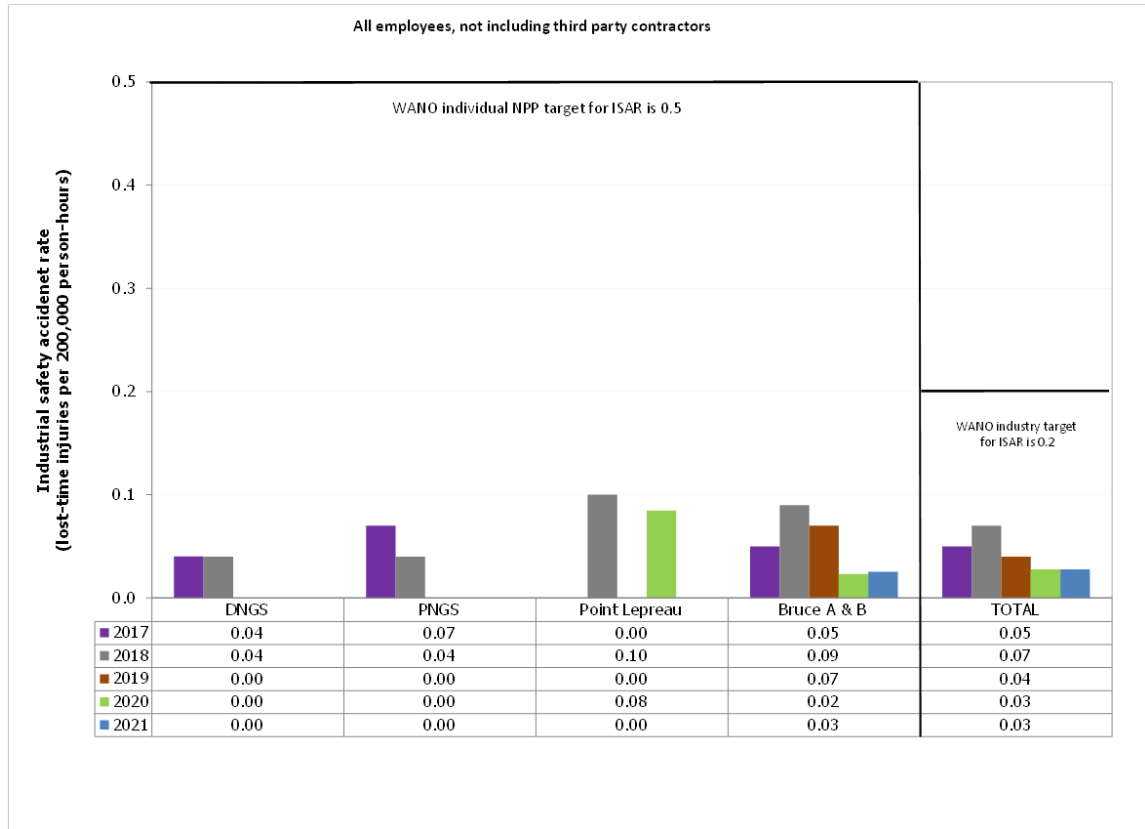
**Figure 11: Trend of accident severity rate for NPPs and Canadian industry**  
(covers all employees, not including third party contractors)



**Figure 12: Trend of accident frequency for NPPs and Canadian industry**  
(covers all employees, not including third party contractors)



**Figure 13: Trend of industrial safety accident rate for NPPs and Canadian industry** (covers all employees, not including third party contractors)



## 2.9 Environmental Protection

The CNSC publishes annual radionuclide loadings to the environment from nuclear facilities on the [CNSC Open Government Portal](#) [4], where the data is available for the facilities covered in this report. In previous years reports, this information was replicated in an Appendix, but is only provided via the above reference in the 2021 report.

In addition to licensees carrying out required monitoring of their operations, the CNSC carries out its Independent Environmental Monitoring Program (IEMP).

The objective of the Independent Environmental Monitoring Program (IEMP) is to build Indigenous and public trust in the CNSC's regulation of the nuclear industry, via an independent, technical environmental sampling program in publicly accessible areas around nuclear facilities, while using CNSC resources effectively and efficiently.

Further information on the CNSC's IEMP, including sampling results and associated standards, can be found on the [CNSC's Website](#) [5].

CNSC staff had planned to conduct an IEMP campaign around the PLNGS in 2020, but due to constraints related to COVID-19, only soil, water and plant samples were taken in 2020. In June 2021, CNSC staff completed sampling of food, seafood, and medicinal plants of interest to Indigenous communities around PLNGS.

In July 2021, CNSC staff completed sampling of air, water, soil, sand, and vegetation around the Pickering site, and in August 2021, CNSC staff completed sampling of air, water, soil, sand, vegetation, and local food around the Darlington site. There were no results of concern found at any of the three sampling campaigns.

[IEMP results](#) from previous years (available on CNSC website) are in the same numerical range for the same media as the results submitted by licensees. This data adds to the body of evidence and supports CNSC staff's assessment that the public and the environment in the vicinity of nuclear power generating stations are protected and that the licensees' environmental protection programs are effective.

The estimated doses to the public for airborne emissions and liquid releases from 2017 to 2021 are provided in table 9. Note that the data for the DWMF, PWF and WWMF is included in that of the DNGS, PNGS and BNGS sites, respectively.

The table shows that the doses were well below the annual regulatory dose limit of 1 mSv for members of the public. A comparison of the 2021 data with that of previous years indicates that the values remained within the same general range (<0.01 mSv) as the values for 2017 to 2021.

**Table 9: Trend of estimated dose to the public from Canadian nuclear power generating sites (mSv)**

Year	Darlington Site	Pickering Site	Point Lepreau	Bruce Site	Gentilly-2*
2017	0.0007	0.0018	0.0007	0.0021	0.0070
2018	0.0008	0.0021	0.0007	0.0017	0.0090
2019	0.0004	0.0017	0.0012	0.0015	0.0030
2020	0.0004	0.0012	0.0013	0.0018	0.0010
2021	0.0006	0.0020	0.0013	0.0016	0.0010

\* Gentilly-2 data is presented for completeness, but this facility is no longer considered an NPP

## 2.10 Emergency Management and Fire Protection

In response to the COVID-19 pandemic, the NPPs and WMFs activated their Pandemic Response Plans and Business Continuity Plans (BCPs). Licensees provided frequent updates to their staff and CNSC staff about any exposures to the virus and measures they were taking to prevent an outbreak at their facilities. Licensees have demonstrated that they can safely operate their nuclear facilities while ensuring health and safety for their staff.

Note that OPG has a single, Consolidated Nuclear Emergency Plan that governs both the DNGS and PNGS sites and includes the Darlington and Pickering WMFs. The WWMF is under the nuclear emergency response plan and fire response plan for Bruce Power.

The following describes developments in 2021 related to off-site emergency planning and also provides, where needed, historical information from previous years related to the provincial nuclear emergency plans and related activities.

### Province of Ontario

#### *Provincial Nuclear Emergency Response Plan (PNERP)*

During the 2017 [PNERP](#) review, an independent Advisory Group recommended that a technical study should be conducted. [The Ontario Ministry of the Solicitor General](#) (SOLGEN) hired [ENERCON](#), a consulting firm located in the United States to perform this technical study.

The study has been completed and the Technical Study Report on the PNERP is available by contacting the Emergency Management Ontario (EMO) website (<https://www.ontario.ca/page/nuclear-incident>). The OFMEM participates in the Federal Radioactive Waste Working Group (RWWG), the Potassium Iodide (KI) Working Group and as an associate member on the Technical Committee on the rewrite of the CSA N1600, *General requirements for nuclear emergency management programs*.

### Province of New Brunswick

The [New Brunswick Emergency Measures Organization](#) (NBEMO), Provincial Nuclear Preparedness Team, enhanced the provincial nuclear preparedness program by updating the Point Lepreau Nuclear Off-site Emergency Plan as well as supporting plans. NBEMO continue to work on addressing findings from the 2019 Emergency Preparedness Review (EPREV) mission, in preparation for the follow-up mission in 2023. NBEMO actively participates in the Federal Nuclear Environmental Monitoring Strategy (NEMS) Working Group, the RWWG, the Federal Resource Analysis Project and participates as an associate member on the Technical Committee on the rewrite of the CSA N1600, *General requirements for nuclear emergency management programs*.

NBEMO completed in September 2021 a Potassium Iodide (KI Pill) distribution to replace expiring Potassium Iodide with RadBlock Potassium Iodide with an expiry date of April 2032.

The PLNGS Technical Planning Basis was finalized in April 2021, which allowed the review and issuance of the Point Lepreau Nuclear Off-Site Emergency Plan in June of 2021, and updates to the FNEP NB Annex were provided to Health Canada based on the updated PLNGS Technical Planning Basis.

The NBEMO, along with NB Power, completed Exercise Synergy Challenge 2021 conducted October 6-7, 2021. This was a Full-scale priority exercise initiated by a Cyber Security event. This exercise tested and validated emergency preparedness, response capabilities and the collaborative and consultation processes of NB Power and its stakeholders. Overall, the exercise was successful and met objectives.

### Province of Quebec

The off-site nuclear emergency response plan for Quebec (“Plan des mesures d’urgence nucléaire externe à la centrale nucléaire Gentilly-2”, or PMUNE-G2) was abolished in 2016.

However, Quebec’s broader emergency plan (“[Plan national de sécurité civile](#)” (PNSC)) remained in place to address emergencies in general. The PNSC involves the cooperation of various ministries and governmental organizations that have a defined role to play when responding to an emergency. The directorate for public health under Quebec’s Ministry of Health and Social Services will intervene in case of infectious, chemical, biological, or radiological emergencies.

## **2.11 Waste Management**

Through on-going compliance activities, CNSC staff confirm that all NPP licensees, and OPG WMFs, continued to employ effective programs for the characterization, minimization, handling, processing, transportation, storage, and disposal of radioactive and hazardous wastes during 2021.

For the nuclear facilities listed in this report, there are no changes to note regarding the preliminary decommissioning plans (PDPs) for 2021. CNSC staff verified that the documents met the regulatory requirements and guidance.

The compliance of the PDPs have been included in the assessment of the SCA ratings. Note: The PDP for Bruce Power is prepared by OPG.

The Preliminary Decommissioning Plans (PDP) for all facilities included under the OPG consolidated Financial Guarantee (FG) were last updated in 2017 and cover the five-year review period 2018-2022. There were no changes made to the PDPs for the WMFs in 2021.

UPDATE: In early 2022, OPG submitted the updated PDPs for the next review period 2023-2027 which are currently under the CNSC staff review.

The financial guarantees for decommissioning are discussed in section 2.15.

## 2.12 Security

All licensees were able to maintain operational effectiveness throughout 2021 for all the Facilities and Equipment SpA included in the Security SCA. During the COVID-19 pandemic, licensees were able to successfully manage their Business Continuity Plans, continuing through 2021, for security-related activities. As the result, the regulatory compliance of licensees for in the specific areas was not significantly impacted due to the COVID-19 pandemic.

Licensees continue to maintain their security-related equipment through lifecycle management programs. Only minor equipment related failures were reported to the CNSC staff in 2021.

The CNSC staff did not conduct any Performance Testing Exercises in 2021. Planned Force-on-Force exercises were postponed due to the increased risk to health, safety, and operational continuity to both licensee and CNSC staff resulting from the COVID-19 pandemic. Following Commission approval, all scheduled Force-on-Force exercises were pushed back 12 to 24 months in the future to reduce the risk and potential impacts to participants and relevant facilities.

Over the reporting period, licensees collaborated through the CANDU Owners Group (COG) cyber security peer group program to share lessons learned and best industry practices. The licensees continue to maintain their cyber security program to protect their cyber essential assets from cyber threats.

## 2.13 Safeguards and Non-Proliferation

CNSC staff concluded that the NPPs and WMFs met the CNSC regulatory requirements and CNSC staff's expectations for the SCA Safeguards and Non-Proliferation in 2021.

CNSC staff confirmed that the accountancy and control of nuclear material at WMFs and NPPs complied with the applicable regulatory requirements in 2021.

The CNSC published [REGDOC-2.13.1, \*Safeguards and Nuclear Material Accountancy\*](#), in February 2018, superseding RD-336, *Safeguards and Nuclear Material Accountancy* and GD-336, the associated guidance document.

REGDOC-2.13.1 sets out requirements and guidance for safeguards programs for



applicants and licensees who possess nuclear material, carry out specified types of Research & Development work related to the nuclear fuel cycle, or carry out specified types of nuclear-related manufacturing activities. The regulatory document aims to establish a common understanding of the information, access and support that licensees are to provide to the CNSC and to the IAEA in order to facilitate Canada's compliance with its safeguards agreements.

NB Power and Bruce Power implemented the new regulatory document by the end of 2019.

In 2020, OPG provided confirmation that, as of March 31, 2020, it was compliant with the requirements of REGDOC-2.13.1, with the exception of the aspects related to non-fuel nuclear material inventory. OPG initially committed to be in full compliance by April 2021. Due to COVID-19 pandemic response efforts, OPG requested a six (6) month extension to October 29, 2021, for the implementation of their plans to meet these remaining requirements. OPG has now completed the implementation plans for all non-fuel nuclear material. In October 2021, OPG stated that they are fully compliant with the requirements in CNSC regulatory document REGDOC-2.13.1.

The CNSC concluded that Hydro-Québec's Gentilly-2 Facilities already met the new requirements. No additional action was required for Hydro-Québec.

In 2021, the IAEA conducted 20 announced, 6 short-notice and 31 unannounced inspections, and 2 complementary access at the NPPs and WMFs. The numbers of activities conducted by the IAEA at each NPP and WMF in 2021 are provided in table 10.

**Table 10: IAEA safeguards activities for 2021**

Activity	DNG S	DWM F	PNGS	PWM F	BNG S A	BNG S B	WW MF	PLN GS	Gentil ly-2	Total s
Physical inventory verifications	1	1	1	1	1	1	1	1	1	9
Design information verifications	1	1	3	1	1	1	1	1	1	11
Short-notice random inspections	1	0	2	0	1	1	0	1	0	6
Unannounced inspections	4	2	3	3	4	4	5	5	0	31
Complementary access	0	0	1	0	0	1	0	0	0	2

CNSC staff verified that the licensees met the applicable regulatory requirements for access and assistance at the WMFs in 2021. Pursuant to the Canada/IAEA safeguards agreements and the facilities' licence conditions, the licensees granted timely access and provided adequate assistance to the IAEA for safeguards activities at the facilities. The IAEA considered most of the inspection results to be satisfactory.

CNSC staff confirmed that the licensees met the applicable regulatory requirements for operational and design information for the NPPs and WMFs in 2021. The licensees submitted their annual operational programs, with quarterly updates for their facilities, to the CNSC on time. The licensees also submitted their annual updates for the additional protocol to the CNSC on time, enabling CNSC staff to draft and submit Canada's additional protocol declarations to the IAEA.

CNSC staff confirmed that the licensees met the applicable regulatory requirements for safeguards equipment, containment, and surveillance for the NPPs and WMFs in 2021. The licensees supported IAEA equipment operation and maintenance activities, including maintenance and installation of surveillance and containment equipment to ensure the effective implementation of safeguards measures at each facility.

During 2021, the CNSC and licensees continued to engage with the IAEA on a revised equipment-based approach for the verification of spent fuel transfers at the CANDU sites as part of the IAEA's revised State-level approach for Canada.

## 2.14 Transport and Packaging

There were no packaging and transport events reported in 2021 that had any safety significance.

## 2.15 Other Matters of Regulatory Interest

### **Public information and disclosure programs**

CNSC [REGDOC-3.2.1, \*Public Information and Disclosure\*](#) sets out the requirements for public information and disclosure programs. The primary goal of the program 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, is shared with the public in a format relevant to the audience. The program includes a commitment and protocol for ongoing, timely dissemination of information related to the licensed facility.

CNSC staff determined that the public information and disclosure programs for the Nuclear Power Plants (NPPs) and Waste Management Facilities (WMFs) complied with REGDOC-3.2.1 in 2021. NPP and WMF operators continued executing adapted programs and hybrid program models to ensure continued commitment and relevance to their local audiences. In addition to regular updates throughout the year to staff, OPG, Bruce Power and NB Power presented the highlights of their communications programs.

Some highlights noted among licensees in 2021 included the following:

#### **Bruce Power**

Bruce Power communicated regularly with its local communities through a variety of means, including direct mail, townhalls, web updates, social and local media, and specialized talk radio, and through various Indigenous engagement

programs and local community activities. Their biannual polling indicates attitudes towards Bruce Power remain positive. According to polling results in 2021 there was an increase in preference for traditional forms of communication, as opposed to social media.

In 2021, Bruce Power had a discovery of elevated hydrogen equivalent (Heq) concentration in pressure tubes which resulted in a regulatory order. Although polling showed that awareness of the pressure tube issue among residents was low, interest in what Bruce Power is doing to ensure the safety of its reactors increased which is indicative of an audience who is interested in being provided with continued information in a variety of means.

### **Hydro-Québec**

As Hydro-Québec (HQ) completed various final steps before moving into decommissioning the Gently-2 (G2) facility, they continued to provide target audiences with updates throughout 2021 including to the municipal leaders of Bécancour, Indigenous Nations and communities, and to the public. This took place through facility visits, website updates and local media coverage. HQ also continue to disclose reportable events through regular web updates. The public information and disclosure protocol for G2 reflects the level of interest and is commensurate with the risk at the facility. Although there were few direct requests for information from the public, key audiences' specific interests included waste storage and the transfer of radioactive fuel, transportation of radioactive waste, and the next steps of the decommissioning project.

### **NB Power**

Throughout 2021, NB Power regularly shared operational updates, future project updates and exchanged information, knowledge and experiences with First Nations and local communities. In advance of the licence renewal hearing for the Point Lepreau Nuclear Generating Station, NB Power hosted several public information sessions and webinars to have an open dialogue about their future operations and discussed topics that were of interest to their audiences such as environmental monitoring, emergency preparedness and response, and future project plans.

NB Power also communicated extensively about Exercise Synergy Challenge 2021 and included interested external participants in the full-scale emergency exercise focused on cyber and physical threats.

NB Power continued to provide regular station updates and information on upcoming projects to multiple audiences through regular newsletters, virtual meetings, ongoing presence on social media, and regular, active participation in a variety of community events and through traditional media coverage.

### **Ontario Power Generation**

OPG continued to engage regularly with their local community members and elected officials in the region of Durham. Activities included but were not limited to: Community Advisory Committee meetings, regular newsletter updates printed and delivered to approximately 250,000 homes and businesses, virtual, in-person

and curbside community events and programming, including Virtual Power Kids in the spring and Tuesday's on the Trail in the summer. OPG also continued to share information about its nuclear fleet operations and projects including the Darlington Refurbishment and New Nuclear Projects.

Throughout 2021 most programs were delivered virtually or modified to follow corporate and public health and safety guidelines. However, OPG continued to provide community support in a number of ways including public interest notifications, the Virtual Power Kids program in March and April, Municipal Council meetings, and Joint Community Advisory Committee meetings.

### **Nuclear liability insurance**

The [Nuclear Liability and Compensation Act](#) (NLCA – the “Act”) requires designated nuclear installations to provide annual proof of the requisite financial security in accordance with their classification. The NLCA is administered by Natural Resources Canada (NRCan). CNSC staff confirmed with NRCan that all the licensees subject to the NLCA complied with their financial security obligations under the Act as of December 31, 2021.

### **Financial guarantees**

CNSC staff reviewed the annual reports for licensee's Financial Guarantees (FG). CNSC staff were able to confirm that the financial guarantee cost estimates were still valid and were able to confirm that the licensees had sufficient funds to meet decommissioning liabilities in 2021. Note: The Bruce Power FG is covered underneath OPG's Financial Guarantee.

In response to the COVID-19 pandemic, CNSC staff requested licensees to provide an update regarding their FGs to ensure that the economic effects caused by the pandemic did not affect the viability of each FG. In 2020, CNSC staff sent requests under section 12(2) of the *General Nuclear Safety and Control Regulations* requesting quarterly updates on each licensee's FG position. Through these requests, CNSC staff were able to confirm that all the NPP licensees, including OPG WMFs, had sufficient funding to meet their FG obligations. In 2021, CNSC staff informed OPG that quarterly reporting on the status of the OPG consolidated financial guarantee is no longer needed.

### **Prohibition of Asbestos and Asbestos Containing Products Regulations**

The [Prohibition of Asbestos and Asbestos Containing Products Regulations](#) came into force in December 2018. The Regulations included a 4-year exemption for nuclear facilities to ensure licensees have enough time to identify all products containing asbestos and determine whether technically or economically feasible asbestos-free alternatives are available. During this 4-year exemption, NPP licensees will still have to report annually to [Environment and Climate Change Canada](#) (ECCC) on their use, and prepare the appropriate asbestos management plans in accordance with Schedule 1 of the Regulations.

In 2021, no NPP licensee used asbestos or asbestos containing products to service equipment; therefore, no licensee was required to submit an annual report to

ECCC. Licensees continue to identify technically and economically feasible alternatives to asbestos and asbestos-containing products, and where they are unable to do so, will continue to use these products in accordance with the Regulations. There were no non-compliances with the Regulations in 2021.

Beginning January 1, 2023, NPP licensees will need to apply to ECCC for a permit to use asbestos and asbestos-containing products. As part of this permitting process, NPP licensees must demonstrate that there are no technically or economically feasible alternatives.

## 2.16 Indigenous Engagement

### General overview

CNSC staff efforts in 2021 supported the CNSC's ongoing commitment to meeting its consultation obligations and building relationships with Indigenous peoples with interests in Canada's nuclear power generating sites. CNSC staff continued to work with Indigenous Nations, communities, and representative organizations to identify opportunities for formalized and regular engagement throughout the lifecycle of these facilities, including meetings and facilitated workshops, aiming to discuss and address topics of interest and concern to interested Indigenous Nations and communities.

In addition, CNSC staff provided interested communities with notices of the opportunity for funding through the CNSC's Participant Funding Program to review and comment on this report and the opportunity to submit a written intervention and/or appear before the Commission as part of the Commission Meeting.

As part of consultation and engagement obligations with Indigenous Nations and communities, the CNSC also confirms that its licensees engage those Indigenous Nations and communities in a meaningful way. In 2021, CNSC staff confirmed that the licensees' dedicated Indigenous engagement programs continued to cover their operations at the NPPs and WMFs and were satisfied with the level and quality of Indigenous engagement conducted by the NPP and WMF licensees regarding their operations in 2021.

The following summarizes the engagement activities for each site conducted by CNSC staff and the licensees in 2021.

### Pickering and Darlington sites

#### *CNSC Staff engagement activities*

The DNGS, DWMF, PNGS and PWMF are located within the traditional territory of the Wendat, Anishinabek Nation, and the territory covered by the Williams Treaties with the Michi Saagiig and Chippewa Nations<sup>1</sup>. The Mohawks of the Bay

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<sup>1</sup> Williams Treaties First Nations (WTFN) include the Mississaugas of Alderville First Nation (MAFN), Curve Lake First Nation (CLFN), Hiawatha First Nation (HFN), Mississaugas of Scugog Island First Nation (MSIFN), Chippewas of Beausoleil First Nation (CBFN), Chippewas of Georgina Island First Nation (CGIFN) and Chippewas of Rama First Nation (CRFN).

of Quinte (MBQ), Six Nation of the Grand River and the Métis Nation of Ontario (MNO), on behalf of the MNO Region 8 Consultation Committee, have also asked to be kept informed of any activities related to these sites. Due to the pandemic, in 2021, CNSC staff continued to engage virtually with these Indigenous Nations and communities in recognition of their longstanding interest in the operation of the DNGS and PNGS.

In December 2019, the CNSC and the MNO signed a [Terms of Reference](#) to provide a forum through which to collaborate and address areas of interest or concern regarding CNSC-regulated facilities and activities. As the MNO is a province-wide organization, a specific engagement plan was developed between CNSC and the MNO Region 8 consultation committee, whose region includes the Pickering and Darlington sites

Curve Lake First Nation:

As committed to with Curve Lake First Nation (CLFN) as part of the [Terms of Reference](#) (ToR) for long-term engagement with the CNSC, the update below was prepared in collaboration with CLFN representatives.

In 2020, CNSC staff started discussions with CLFN to establish a formal long-term relationship with the community, and a ToR for long-term engagement was signed between the CLFN and CNSC in February 2021. This ToR ensures that CLFN is provided with adequate and meaningful funding, support, and capacity to participate in consultation and engagement activities required throughout the year. As part of the Terms of Reference a yearly work plan is developed between the CNSC and CLFN, which provides information on the scope of work, detailed activities, and timelines associated with work items for collaboration and engagement.

In 2021 the work plan included:

- Terms of Reference maintenance and updates
- Participation in the CNSC's IEMP
- Updates and discussions on specific Projects and Ongoing Operations of Existing Nuclear Facilities of Interest (including the Darlington and Pickering NGS and WMFs)
- Co-Jurisdictional Matters of Significance (i.e. *Fisheries Act* Authorization, Emergency preparedness and thermal emissions from NGS)
- Information, communication, and other topics (i.e. REGDOC updates, feedback on CNSC reporting and processes, PFP opportunities)
- Developing a plan for a Curve Lake Indigenous Knowledge (IK) Study

Even though the last item of the plan has not been completed in 2021, it is CLFN and CNSC's commitment to develop a plan for a Curve Lake IK Study in 2022.

In 2021, CLFN and CNSC staff continued to meet monthly and work collaboratively to make progress on a number of the agreed upon initiatives in the

work plan. Through routine monthly meetings and interactions, CLFN and CNSC have developed a good working level relationship; one that has been more conducive to open and direct communications.

Topics of discussion included ongoing environmental monitoring activities, fish impingement and entrainment at the DNGS and PNGS, OPG's intent to renew the licence to prepare the site for the Darlington New Nuclear Project, and the DNGS isotope project. In 2021, CLFN participated in the IEMP sampling at the Pickering Nuclear Generating Site. Having CLFN representatives participate in the sampling promotes a better understanding of sampling methods and improves input into future sampling in terms of CLFN species of interest, valued components, and potential sampling locations. CLFN also appreciates participating in sampling activities as it allows CLFN to better understand how the IEMP works and share insightful knowledge

In 2021, CLFN provided feedback through their intervention on the 2020 RORs and continue to do so through ongoing discussions. CNSC staff have made a number of improvements to reports and documentation based on the feedback, such as including land acknowledgements for each facility and creating a separate Indigenous consultation and engagement section.

CNSC staff and CLFN continue to be committed to strengthening the relationship through on-going respectful dialogue to share knowledge, information on culture, history and perspectives that help CNSC staff and CLFN learn from each other. CNSC staff will also continue to have discussions regarding areas of interest and issues, or concerns related to existing CNSC-regulated nuclear activities of interest to Curve Lake First Nation.

In 2022, CLFN and CNSC staff are planning to initiate discussions and collaboration regarding a Territory wide study of Indigenous Knowledge and Land Use Study as it relates to CNSC regulated facilities and activities. Discussions will include the specific funding and capacity needs in order for CLFN to be able to meaningfully participate and complete these important studies and research. CLFN and CNSC staff will also continue to foster and create a safe ethical space for Indigenous knowledge to be collected and shared.

Mississaugas of Scugog Island First Nation:

In September 2021, CNSC staff and MSIFN representatives started discussions to establish a long-term engagement [Terms of Reference](#). The Terms of Reference was signed in March 2022, providing a formalized structure for ongoing dialogue regarding CNSC-regulated facilities and activities of interest in the MSIFN's traditional and treaty territories. As part of the Terms of Reference a yearly work plan was developed between the CNSC and MSIFN which provides information on the scope of work, detailed activities, and timelines associated with work items for collaboration and engagement. The 2022 work plan includes activities that CNSC staff and MSIFN will be working to implement throughout 2022 and beyond, including:

- Participation in the CNSC's IEMP

- Collaborative annual reporting to the Commission and to MSIFN Chief and Council
- Updates and discussions on specific projects and ongoing operations of licensed nuclear facilities of interest
- Enhancing information sharing and communication between the CNSC and MSIFN members
- Emergency management and preparedness

Facilities of interest in the workplan related to this report include; Darlington Nuclear Generating Station, Darlington Waste Management Facility, Pickering Nuclear Generating Station, Pickering Waste Management Facility

CNSC staff and MSIFN are committed to continuing to strengthen the relationship through ongoing respectful dialogue to share knowledge, information on culture, history and perspectives that help CNSC staff and MSIFN learn from each other. CNSC staff will also continue to have discussions regarding areas of interest and issues, or concerns related to CNSC-regulated nuclear activities of interest to MSIFN

#### *Licensee engagement activities*

Throughout 2021, OPG met and shared information with interested Indigenous Nations, communities and organizations including the WTFNs, the MNO and the MBQ. Topics of discussion included the ongoing DNGS refurbishment project, environmental monitoring activities, fish impingement and entrainment at the DNGS and PNGS, OPG's intent to renew the licence to prepare the site for the Darlington New Nuclear Project, and the DNGS isotope project.

#### Bruce Site

##### CNSC Staff engagement activities

The Bruce site lies within the traditional territory of the Chippewas of Nawash Unceded First Nation and Saugeen First Nation, who together form the Saugeen Ojibway Nation (SON), as well as the asserted traditional harvesting territory of the MNO and Historic Saugeen Métis (HSM). CNSC staff engages with all 3 communities on areas of interest to them. With the pandemic preventing the ability to meet in person, CNSC staff continued to work with each community representatives through virtual forums.

As committed to with each of the communities as part of their respective Terms of Reference for long-term engagement, the updates below were prepared in collaboration with their representatives.

##### *Historic Saugeen Métis (HSM)*

A [Terms of Reference](#) was agreed upon and signed April 12, 2019, between CNSC staff and the HSM, which formally documents the engagement with their community. CNSC staff continued to meet with HSM representatives in 2021 to discuss areas of interest such as the Douglas Point decommissioning licence application and Bruce Power's *Fisheries Act* authorization, the Mitigation



Measures Study, radioactive waste, the major component replacement project, and the pressure tube findings. CNSC staff appreciated the opportunity to learn more about HSM's history and connection to the Bruce region through a series of webinars. While the HSM did not have any outstanding concerns related to the nuclear activities on the Bruce site, they continued to actively participate and make informed contributions to address any potential impacts on HSM rights and interests.

CNSC staff planned to continue to engage and update HSM on regulatory activities on a semi-annual basis as agreed upon in the Terms of Reference including active participation in the IEMP sampling campaign in 2022.

#### *Métis Nation of Ontario (MNO)*

A [Terms of Reference](#) was agreed upon and signed on December 18, 2019, between CNSC staff and the MNO, which formally documents the engagement with their nation. As the MNO is a province-wide organization, a specific engagement plan under the Terms of Reference was also signed in December 2019 with MNO Region 7, which is the consultation committee region that includes the Bruce site to address their areas of interest.

As per the engagement plan, in 2021, CNSC staff continued to meet with MNO Region 7 representatives to discuss topics such as the CNSC's IEMP, the Douglas Point decommissioning licence application, the regulation of transportation of nuclear substances, the Bruce Power Mitigation Measures Study, the Bruce Power Major Component Replacement project and the pressure tube finding.

As discussed at Bruce Power's licence renewal hearing in 2018, MNO Region 7 would like to be more involved in environmental monitoring activities and addressing the concerns their citizens have regarding perceived environmental impacts related to the Bruce site. CNSC staff will continue to collaborate and engage with the MNO Region 7 on areas of interest with regards to the Bruce site.

#### *Saugeen Ojibway Nation (SON)*

A [Terms of Reference](#) was signed in 2019 between the SON and CNSC staff, which documents the CNSC's commitment to formalize engagement and collaboration with their communities, as directed by the Commission in the Bruce Power licence renewal record of decision. Under the Terms of Reference, the SON and the CNSC collaborate on a number of areas including:

- joint review and analysis of licensee submissions, particularly around environmental protection
- participation in the CNSC's IEMP
- inclusion on the design and review of Bruce Power's study of available mitigation measures for environmental impacts
- SON community outreach
- sharing the results of CNSC's environmental oversight, such as inspection reports

- identifying federal, provincial, and municipal decision-making agencies, as needed
- coordinating meetings with federal and provincial Crown agencies, as needed
- sharing information on the Western Waste Management Facility, Douglas Point and NWMO's Adaptive Phase Management initiative

A work plan was developed, which sets out detailed tasks and timelines for each of these items.

CNSC staff understand that the SON continues to have concerns regarding the environmental impacts resulting from the nuclear activities at the BNGS, which were presented in their intervention in Bruce Power's licence renewal hearing on March 14, 2018. The focus of the activities in the work plan is to ensure SON oversight, inclusion, and a means to obtain additional information that will provide clarity, transparency and assurances for the communities and the SON leadership regarding the interactions between the BNGS facility and the environment.

In 2021, CNSC staff and the SON continued to meet and work collaboratively to complete a number of the agreed upon initiatives in the work plan. These activities included CNSC's funding support for a traditional land use and occupancy study to obtain a baseline inventory of mapped cultural sites in relation to the SON's Territory, including the Territory around the Bruce Power site. However, due to the pandemic and inability to meet with community members in person, this work has been postponed.

As part of a CNSC initiative to improve outreach activities, CNSC staff consulted with SON to learn best practices when engaging with Indigenous Nations and communities.

Throughout 2021, CNSC staff and members from the SON environment office collaborated on developing an IEMP sampling campaign rack card which provided a summary of the CNSC's IEMP and presented past results in relation to sampling activities around BNGS in a format meaningful to SON community members. These rack cards were distributed to SON community members in advance of the virtual webinar held on IEMP in May 2021.

CNSC staff participated in a number of other webinars for SON community members focused on topics of interest to the SON communities, including NWMO's Adaptive Phase Management initiative, Douglas Point decommissioning activities, management of radioactive waste is managed, and activities related to the recent BNGS pressure tube finding.

In addition, the SON completed another year of the Coastal Waters Monitoring Program (CWMP), which is an initiative funded in cooperation with Bruce Power, but designed, led, and implemented by the SON to monitor environmental conditions in the nearshore areas of the Saugeen Peninsula. CNSC staff are

interested in the results of the CWMP, as this will provide data that can be used in future environmental risk assessments in relation to the BNGS.

CNSC staff plan to continue to include SON in the 2022 IEMP sampling campaign around the BNGS site. This will include monitoring in SON communities, sampling species of interest to the SON and coordinating an outreach event around the sampling campaign to share information and answer questions from community members. CNSC staff and the SON will also continue to work collaboratively on the outcomes of the mitigation measures study over the coming years.

CNSC staff and SON will continue to work collaboratively in order to address areas related to the SON's concerns, rights and interests.

#### *Licensee engagement activities*

Throughout 2021, both Bruce Power and OPG met and shared information with interested Indigenous communities and organizations, including the SON, the MNO and the HSM.

For Bruce Power, information and discussion topics included their operations at the BNGS site, the pressure tube finding, their [Fisheries Act](#) authorization application, inclusion in the development of the mitigation measure study as well as information on environmental impacts, including impacts to fish.

Bruce Power continued to engage the SON, the MNO and the HSM on the [Fisheries Act](#) Authorization (FAA) to adequately address their information requests and concerns raised throughout the process in its final application that was previously submitted to Fisheries and Oceans Canada in November 2018.

In 2021, OPG continued its regular updates and meetings with Indigenous Nations and communities who have an interest in their operations and projects at the Bruce site.

#### Point Lepreau Site

##### *CNSC Staff engagement activities*

The Point Lepreau Nuclear Generating Site lies within the territory covered by the Peace and Friendship Treaties with the Wolastoqey, Peskotomuhkati and Mi'gmaq peoples. Indigenous Nations in New Brunswick who may have an interest in the Point Lepreau site include: six Wolastoqey communities represented by the Wolastoqey Nation in New Brunswick (WNNB); nine Mi'gmaq communities, which are represented by Mi'gmawe'l Tplu'taqnn Incorporated (MTI); and the Peskotomuhkati Nation at Skutik represented by Passamaquoddy Recognition Group Inc. Although Elsipogtog First Nation is a member of MTI, for consultation and engagement purposes and for the purposes of the licence renewal hearing, Elsipogtog First Nation is represented by its consultation and resources organization Kopit Lodge. CNSC staff regularly engages and communicates with the interested Indigenous Nations and their representative organizations on areas of interest to them. Due to the pandemic, from March 2020, meetings were held virtually.

In 2021, environmental monitors from WNNB and MTI participated in the IEMP sampling of the areas surrounding the Point Lepreau nuclear generating site. The environmental monitors from WNNB and MTI participated in both the development of the sampling plan and the harvesting of the items which included traditional foods and plants to ensure meaningful results were obtained.

In 2021, a major focus of CNSC's engagement activity was on the licence renewal application CNSC staff provided information and updates to representatives of MTI, WNNB and Passamaquoddy Recognition Group Inc. and met with them individually to discuss topics of interest, including the Point Lepreau NGS licence renewal application and the related regulatory review process, the CNSC's IEMP, the gathering and inclusion of Indigenous Knowledge, and further information on the CNSC's role with regards to regulating potential SMR projects in New Brunswick. In 2021, CNSC staff and WNNB worked together to start drafting a Terms of Reference (TOR) for long-term and routine engagement that is meaningful. CNSC staff remain willing and continue to offer the opportunity to develop a TOR with any other interested Indigenous Nations and communities. CNSC staff are committed to ongoing engagement and collaboration with interested Indigenous Nations, communities and representative organizations in New Brunswick and will continue to provide opportunities for meaningful long-term engagement.

#### *Licensee engagement activities*

In 2021, NB Power worked with several First Nation's communities and organizations, including the WNNB, MTI, the Passamaquoddy Recognition Group Inc., Kopit Lodge, Sipekne'katik First Nation, the Union of New Brunswick Indians and Mawiw Council. NB Power maintains on-going dialogue with First Nations consultative bodies and representatives through scheduled monthly meetings and technical workshops.

Information and discussion topics included NB Power's operations at Point Lepreau, its application for a *Fisheries Act* Authorization, waste management, environmental monitoring, environmental and regulatory approval processes, education, cultural awareness, and sensitivity.

First Nations field monitors from MTI, WNNB and Passamaquoddy Recognition Group Inc. participate in field related activities related to the radiological and conventional monitoring of the Point Lepreau NGS site. First Nation representatives continue to support activities related to the gathering and sharing of Indigenous Knowledge and establishing higher awareness and sensitivity among its workers and local communities. Members of New Brunswick First Nation communities are invited to lead medicine walks, participate in regular activities at the site including collaborative environmental and safety monitoring and deliver presentations to NB Power leadership. NB Power works with Indigenous Nations and communities and members of the public in their host community, through regular community liaison committee meetings, open houses, regular newsletters, website updates and regular engagement activities with local fishing communities. NB Power's regular engagement activities are an effort to

build capacity within their communities to better understand nuclear technology and its use in New Brunswick, waste management principles and procedures, new opportunities in nuclear development, and its role in New Brunswick's electricity mix.

#### Gentilly-2 site

##### *CNSC Staff engagement activities*

Le site de Gentilly-2 est situé sur le territoire traditionnel des Abénaquis de Wôlinak et d'Odanak, qui sont représentés par le Grand Conseil de la Nation Waban-Aki (GCNWA), ainsi que de la Nation huronne-wendat. En 2021, les employés de la CCSN ont continué de tenir les communautés autochtones informées par le biais du Rapport de surveillance réglementaire des sites de centrales nucléaires de 2020, que le GCNWA a révisé.

##### *Licensee engagement activities*

En 2021, Hydro-Québec a poursuivi son engagement avec les communautés autochtones intéressées par ses opérations et ses sites, et a rencontré et partagé des informations avec les communautés et les organisations des Premières Nations intéressées, en particulier la GCNWA. Les relations avec la Nation Waban-Aki se font sur une base régulière et touchent les projets en cours et à venir.

En 2021, les discussions ont porté sur la réalisation de travaux de nature archéologique par le GCNWA sur les terrains appartenant à Hydro-Québec près des installations de Gentilly-2.

Une visite au terrain en novembre 2019 avait permis aux représentants du GCNWA de valider leur intérêt pour poursuivre des sondages de ce secteur. Les autorisations nécessaires ont été données par la direction des installations de Gentilly-2, permettant à l'équipe du Bureau du Ndakina d'obtenir les permis requis pour les travaux visés auprès des autorités provinciales. Les travaux au terrain ont été réalisés en octobre 2021. Des échanges sont en cours pour une planification de travaux archéologiques à l'été/automne 2022.

### 3 NUCLEAR POWER PLANT AND WASTE MANAGEMENT FACILITY SAFETY PERFORMANCE AND REGULATORY DEVELOPMENTS

#### 3.1 Darlington Nuclear Generating Station

##### 3.1.0 Introduction

The [Darlington site](#) is located on the north shore of Lake Ontario in Clarington, Ontario, 5 kilometers outside the town of Bowmanville and 10 kilometers southeast of Oshawa. The Darlington site lies within the traditional territory of the Wendat, Anishinabek Nation, and the territory covered by the Williams Treaties with the Michi Saagiig and Chippewa Nations.



The Darlington site includes the Darlington Nuclear Generating Station (DNGS), the Tritium Removal Facility (TRF), and the Darlington Waste Management Facility (DWMF). The CNSC regulates the DNGS and the TRF under a Power Reactor Operating Licence (PROL), and the DWMF separately under a Waste Facility Operating Licence (WFOL).

The DNGS consists of 4 Canada Deuterium Uranium (CANDU) reactors that are rated at 881 MWe (electrical megawatts) each. The TRF, which is housed in the Heavy Water Management Building, is used to remove tritium that builds up gradually heavy water contained in some plant systems as a result of day-to-day operations. Removing the tritium minimizes the amount released into the environment and reduces the potential radiation exposure of workers. The tritium is extracted from the reactor's heavy water and stored safely in stainless steel containers as titanium tritide within a concrete vault.

OPG continues to execute its plan to refurbish the 4 reactors at the DNGS. The refurbishment project began with Unit 2 in October 2016, which continued through to June 2020. Unit 3 refurbishment began in September 2020 with defueling of the reactor, followed by draining and removal of the reactor core components. Installation of new reactor core components began in late 2021 and is expected to be complete in late 2022, with the unit returning to commercial operation in mid-2023. Unit 1 refurbishment began in February 2022 and is expected to be complete in late 2024. OPG continues to operate the Retube Waste Processing Building, where removed reactor core components are volume-reduced before being sent to onsite storage facilities.

## Licensing

The Commission renewed the PROL for the DNGS, which also governs the TRF, in December 2015, with an expiry date of November 30, 2025.

## Fisheries Act Authorization

[Fisheries and Oceans Canada](#) issued a *Fisheries Act* Authorization (FAA) on June 24, 2015, to OPG for the DNGS. The authorization contains a condition for OPG to report to the staff of Fisheries and Oceans Canada (DFO) and CNSC on the offset plan (compensation for residual harm to fish and fish habitats).

Note: There are two conditions (C1 and C2) in the Darlington FAA for 2021 (all the requirements for 2021 were met):

- C1 is an ongoing condition: “*The current location of the Cooling Water System intake and the design features (e.g. porous veneer intake) shall be maintained in proper working order*”. There were no reportable events related to the Cooling Water System intake that occurred at DNGS in 2021
- C2: Monitoring report on vegetation encroachment (perimeter assessment), as per conditions 5.1.1.3 & 5.2.3 of the FAA (due date 3/31/2021). DFO has received the vegetation encroachment report for 2021 from OPG and is conducting a technical review of the report

## Integrated Implementation Plan

CNSC [RD-360, Life Extension of Nuclear Power Plants](#) set requirements applicable to the DNGS Refurbishment Project. In preparation for a life extension or refurbishment project, RD-360 required that a licensee wishing to extend the life of a reactor conduct an Integrated Safety Review (ISR) to address the Safety Factors from the International Atomic Energy Agency Safety Standards Series, as well as the CNSC safety areas and programs. RD-360 also required the licensee to participate in an EA, and that the results of the ISR and EA be compiled into a Global Assessment Report (GAR) and an IIP.

OPG planned and is currently executing the Darlington Refurbishment project while complying with RD-360. The DNGS ISR consisted of an assessment of the plant design; systems, structures, and component (SSCs) condition; and plant performance, to determine the extent to which the DNGS conforms to modern standards and practices. From the ISR, OPG identified reasonable and practical modifications to SSCs and to the management of the station to enhance the safety of the plant to a level approaching that of modern nuclear power plants and to allow for long-term operation. The results of the EA, and ISR assessments were incorporated into the DNGS IIP. In 2015, the IIP was presented to the Commission and, implementation of the IIP became a requirement of the Darlington PROL.

The DNGS IIP consisted of 625 items, with three IIP task items removed from the scope after approval by the Commission. OPG has completed 431 IIP items and

are progressing according to the schedule for each IIP item. CNSC staff are satisfied with the progress on the IIP to date.

## Refurbishment

The refurbishment project has four phases for each reactor:

1. Lead-in – preparation activities such as defuelling and dewatering the reactor
2. Component removal – removal of key components, in particular pressure tubes, calandria tubes and feeder pipes
3. Installation – installation of reactor components and the associated testing /quality control verifications to demonstrate fitness-for-service
4. Lead-out – transition from the end of the installation phase to full-power operation

Throughout the first half of 2021, CNSC staff actively monitored and conducted compliance verification inspections of the project, with emphasis on the removal and start of installation phase of DNGS Unit 3, which started its refurbishment outage on September 2020. For Unit 3 refurbishment, CNSC staff conducted compliance verification activities as established in the Darlington Refurbishment Project Multi-Unit Compliance Plan. Unit 3 is expected to be returned to service in 2023.

In 2021, the IIP was progressing according to schedule, and CNSC staff were satisfied with this progress. Table 11 indicates the overall planned, completed, and closed IIP commitments. It also indicates IIP tasks planned for completion in 2021, completed by the licensee in 2021 (irrespective of planned completion dates) and IIP items closed by CNSC in 2021.

**Table 11: DNGS IIP (based on planned dates)**

Total commitments	Overall	2021
Planned by OPG	622	8
Completed by OPG	431	23
Closed by CNSC	400	31

## Periodic Safety Review

In February 2020, OPG notified the CNSC of their intent to commence a Periodic Safety Review (PSR), intended to review the status of the DNGS to support operations beyond 2025. The PSR Basis Document was submitted in September 2020 and accepted by CNSC staff in January 2021. Fifteen Safety Factor Reports were submitted to CNSC staff for review between July and September 2021. CNSC staff technical reviews were completed in January 2022 and regulatory review and integration completed and 89 comments communicated to OPG in March 2022. Safety Factor Reports are not formally accepted by CNSC staff but do form the basis for completion of the Global Assessment Report (GAR) and Integrated Implementation Plan (IIP), the latter of which requires acceptance. The



completed IIP will be submitted for CNSC staff acceptance, per [REGDOC-2.3.3, Periodic Safety Reviews](#), which supersedes RD-360.

Work on this project is expected to continue into 2024 and will contribute to the re-licensing of DNGS beyond 2025.

## Compliance Program

The inspections at the DNGS that were considered in this regulatory oversight report are tabulated in table 12 (inspection reports were included if they were sent to OPG by February 1, 2022). The Quarterly Type II inspections include 38 field inspections conducted at DNGS in 2021.

**Table 12: List of Inspection Reports at DNGS**

Safety and Control Area	Report Title	Report Issue Date
Management System	DRPD-2021-03511 - Inspection Report - TII - Contractor Management and Project Oversight	June 2021
	DRPD-2021-09205 - INSPECTION REPORT - TII - Refurbishment Configuration Management	May 2021
	REPORT - PRPD-06985-2021/DRPD-2021-09519-Type II OPG Fleet wide Supply Management Compliance Verification Report	May 2021
	DRPD-2021-10178 and PRPD-2021-10730 - Inspection Report – OPG Fleet-wide Contractor Management Type II Inspection	March 2022
Human Performance	DRPD-2021-07533 - DESKTOP INSPECTION REPORT - Desktop Inspection - Design, Development and grading of Simulator-Based Initial Reactor Operator Certification Examinations	July 2021
	DRPD-2021-09563 - INSPECTION REPORT - TII - Conduct of Simulator-Based Initial Certification Examinations for Reactor Operator Shift Personnel	June 2021
	DRPD-2021-10174 Inspection Report - RHP Certified Training Program	January 2022
	PRPD-2021-06811 and DRPD-2021-07525 - Report - TII - Non-Certified Training Programs at Pickering NGS and Darlington NGS	June 2021

Safety and Control Area	Report Title	Report Issue Date
	DRPD-2021-10225 - Inspection Report – TII – Simulator Examination (Conduct) and Requalification Tests (Conduct and Grading)	January 2022
	REPORT - PCD Desktop Inspection - Design, Development and Grading of CRSS Simulator-Based Initial Certification Examinations	February 2021
Operating Performance	CNSC Compliance Inspection Report - Darlington Nuclear Generating Station Quarterly Field Inspection Summary Report Quarter 1 2021-2022 DRPD-2021-10086	September 2021
	CNSC Type II Inspection Report - DRPD-2021-07716 - D2011 Outage Inspection	September 2021
	DRPD-2021-09939 - INSPECTION REPORT - Q4 FY20-21 Quarterly Inspection Report	July 2021
	DRPD-2021-10229 - Inspection Report – TII – Q2 Quarterly Report	December 2021
	CNSC Field Inspection Report, Darlington Nuclear Generating Station, Safe Operating Envelope (SOE) Systems and Parameters or Performance Measures Report DRPD-2021-10721	September 2021
	Darlington NGS: CNSC Field Inspection Report: DRPD-2021-12688 – Safe Operating Envelope Systems and Parameters	December 2021
Physical Design	DRPD-2021-07175 Report - Pressure Boundary Program Type II Inspection	April 2021
	DRPD-2021-10194 - Inspection Report – TII – Fire Protection	October 2021
	DRPD-2021-10223 - Inspection Report – DNGS Preservation of Seismic Design Basis Type II Inspection	December 2021
Fitness for Service	CNSC Type II Inspection Report - DRPD-2021-07715 DNGS Chemistry Control	May 2021
	DRPD-2021-09894 - REPORT - TII - Electrical Systems	July 2021
	DRPD-2021-10213 - Inspection Report	December 2021

Safety and Control Area	Report Title	Report Issue Date
	– TII – Maintenance - Software	
	DRPD-2021-07391-INSPECTION REPORT-TII-Type II Negative Pressure Containment System Inspection	June 2021
Radiation Protection	Darlington NGS: CNSC Type II Inspection Report: DRPD-2021-08027 – Worker Dose Control	May 2021
	DRPD-2021-10224 - Inspection Report – TII – Radiological Hazard Control	January 2022
	DRPD-2021-11099 - Inspection Report – TII – Radiation Protection Inspection: RP Activities Associated with Core Disassembly	November 2021
Environment Protection	DRPD-2021-07527-INSPECTION REPORT-TII-Type II Effluent Control and Monitoring	May 2021
	DRPD-2021-10195 - Inspection Report – TII – Hazardous Waste (non-rad)	November 2021
Emergency Management and Fire Protection	DRPD-2021-10175 - Inspection Report – TII – Fire Response	December 2021
Security	DRPD-2021-09094 - Report - NSO Minimum Required Training	March 2021
	DRPD-2021-10173 – Inspection Report – FI – Systems and Devices that Control Access to Vital Areas	August 2021

### 3.1.1 Management System

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Management System at the DNGS in 2021. CNSC staff inspections in the configuration management area identified some non-compliances, with one being of medium significance relating to documentation being inconsistent with the design, and a finding of low safety significance related to physical configuration not matching the configuration documents for a modification. CNSC staff were satisfied with DNGS's progress in correcting the non-compliances.

CNSC staff determined that DNGS continued to maintain and implement a records and document management system that complied with the requirements of CSA N286-12, *Management system requirements for nuclear facilities*. CNSC staff inspections in the records management area identified some non-compliances of low safety significance, regarding radiation protection, fire protection and software maintenance, with some standards inspected not having a specified review cycle, not being reviewed prior to their review date or for

ensuring records are completed, identifiable, retrievable, preserved, and retained as specified. CNSC staff were satisfied with DNGS's progress in correcting the non-compliances.

CNSC staff conducted an inspection of OPG's fleet-wide supply management program in February 2021. In the specific area of Contractor Management, CNSC staff identified two findings of low safety significance regarding technical requirements in a sample set of purchase orders not being met. OPG provided appropriate corrective measures to correct the non-compliances to the satisfaction of CNSC staff.

OPG continued to meet business continuity requirements. Throughout 2021, OPG submitted 17 event reports related to business continuity in response to the COVID-19 pandemic, such as employees, or close contacts with others, that tested positive for COVID-19. CNSC staff reviewed the event reports and found that OPG took adequate corrective actions and has adequate measures in place relating to business continuity in the event of disabling circumstances such as a pandemic, severe weather, or labor actions.

### **3.1.2 Human Performance**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Human Performance at the DNGS in 2021. CNSC staff identified 5 findings of low safety significance. In one instance, CNSC staff found that OPG was not compliant with the rules of conduct given in CNSC-EG2, for examination team members prompting candidate's during simulator-based initial examinations. OPG has implemented corrective measures to address this non-compliance. The other four findings of low safety significance were related to the maintenance of training qualification records for duty crew and contractors. OPG implemented corrective actions to address these findings and CNSC staff continue to follow-up and verify the implementation of corrective actions.

There was one event report regarding OPG being below minimum shift complement at Darlington due to an out of plant coordinator role being held by an individual with expired qualifications. The error was recognized and corrected within 2 hours, and the safety significance of this event was determined to be low. CNSC staff continue to follow-up on the event and are awaiting additional licensee submissions relating to this event.

OPG's statement of compliance with REGDOC-2.2.4 was submitted to CNSC in July 2021. CNSC staff intend to verify OPG's statement of compliance with the implementation of the REGDOC in 2022.

OPG Darlington reported zero hours of work violations in 2021.

### **3.1.3 Operating Performance**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Operating performance at DNGS in 2021.

OPG continued to operate DNGS in a safe manner within the bounds of the operating policies and operational safety requirements. All reactor units operated at the conditions prescribed by Power Reactor Operating Licence (PROL) within the power limits identified in the licence conditions handbook (LCH) for DNGS. Operating practices observed during the year were adequate and effective.

CNSC staff reviewed routine station performance data submitted by OPG for the 2021 calendar year, and found there were 0 unplanned reactor trips, 1 stepback, and 0 setbacks. CNSC staff are satisfied that OPG controlled reactor power transients in accordance with their operational procedures. CNSC staff were satisfied with DNGS procedures assessed through compliance activities and, in general, found that they met regulatory requirements. The reactor trips performance against the target for 2021 was better than industry performance target (0.0 for Units 1-4). All DNGS units met WANO's PHWR target of 1.0 trip per 7,000 hours of operation. All transients were controlled properly, and power reduction was automatically initiated by the reactor control systems.

CNSC staff concluded that OPG's management of planned outages at DNGS met applicable regulatory requirements and expectations. Staff confirmed that during planned outages, OPG used an approved reactor shutdown guarantee state, monitored heat sinks and components, completed regulatory undertakings, and operated the main control room in accordance with its operations program.

DNGS was compliant with the regulatory requirements with respect to scheduled REGDOC-3.1.1 reports in 2021. DNGS submitted 60 REGDOC-3.1.1 unscheduled reports, or event reports, in 2021. CNSC staff found, in each event report where corrective actions were proposed, that OPG's corrective action plans were satisfactory; staff continue to monitor OPG's progress to implement corrective measures.

CNSC staff identified some deficiencies in DNGS' documentation of the station's safe operating envelope, specifically as it applies to calculations of instrumentation uncertainties and documentation of as-found calibration results. OPG has provided a corrective action plan that CNSC has determined to be acceptable; CNSC staff continue to monitor OPG's progress in implementing this corrective action plan.

### **3.1.4 Safety Analysis**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Safety Analysis at the DNGS in 2021.

The industry in a joint effort has developed a composite analytical approach (CAA) as a risk control measure (RCM) to address the large break LOCA (LBLOCA) safety margin issues (AA9, PF9 and PF10). Bruce Power has taken a lead role in implementing the CAA in its application for Bruce B reactors. CNSC staff review of the Bruce Power's LBLOCA CAA analysis has identified some areas requesting additional discussions for clarification. In an initial phase OPG plans to using the Composite Analytical Approach (CAA) to analyze DNGS LBLOCA and then subsequently the methodology will be applied to PNGS.

Similarly, Loss Of Reactor Power Regulation (LORPR) analysis will be initially done for DNGS site and once completed the same methodology will be applied to the PNGS site.

DNGS maintains the Fire Hazard Assessment (FHA) and the Fire Safe Shut Down Analysis (FSSA) in accordance with the requirements of the CSA N293, *Fire protection for nuclear power plants*. The FHA and FSSA are required to be revised or reaffirmed at least once every five years or updated to reflect plant modifications, significant changes in fire hazards, operating experience, and operational changes. The Darlington 2021 FHA and FSSA report updates were submitted as required.

CNSC staff completed the review of the 2020 Darlington PSA update and concluded that the DNGS was compliant with REGDOC 2.4.2. DNGS fully implemented REGDOC 2.4.2 in accordance with the implementation plan included in its LCH.

### 3.1.5 Physical Design

CNSC staff concluded that OPG met the applicable regulatory requirements, and that its performance met CNSC staff's expectations, for the physical design SCA at the DNGS in 2021.

In 2021, OPG continued to implement and maintain its pressure boundary program in accordance with CSA N285.0, *General requirements for pressure-retaining systems and components in CANDU nuclear power plants*. OPG also maintained a formal agreement with an Authorized Inspection Agency. CNSC staff concluded that OPG continued to meet the regulatory requirements for the pressure boundary program.

CNSC staff conducted several compliance verification activities in 2021 related to component design, including a 'Preservation of Seismic Design Basis' inspection. The inspection verified compliance with regulatory requirements for the preservation of seismic design basis.

CNSC staff concluded that OPG operated within the design and operating limits, with one finding of low safety significance relating to environmental qualification of safety relief valves to ensure they perform as expected in design basis events.

In 2021, DNGS identified that end fitting latches manufactured and installed for Unit 2 refurbishment did not meet the manufacturing specification for radius of a latch component. OPG DNGS evaluation and testing demonstrated that the latches meet their requirements for the current operating condition, and fuel bundles that traverse the latches continue to meet the fuel specification requirements. CNSC staff have reviewed the event reports and are satisfied with OPG's dispositions on the issue.

As a result of the review of the 2020 Annual Fuel Performance Report, submitted in 2021, CNSC staff concluded that the report followed the applicable reporting requirements, and the overall fuel performance at the Darlington NGS sites remained safe in 2020. CNSC staff observed that Darlington NGS continues to

experience low defect rates and decreasing trends in observed bundle wear. Fuel inspections during 2020 confirmed one defect, which had been discharged from Unit 4. OPG operated within the applicable design and operating limits, iodine limits and maximum bundle power and channel power limits. Darlington completed a total of 56 standard fuel bundle inspections during 2020 which exceeds the minimum expectation of 20 bundles per operating unit per year (Units 2 and 3 were in refurbishment outage).

### 3.1.6 Fitness for Service

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Fitness for Service at the DNGS in 2021. CNSC staff confirmed that all special safety systems for DNGS met their unavailability targets in 2021.

OPG continues to implement activities for aging management of structures, systems, and components (SSCs) within a systematic and integrated framework in accordance with CNSC REGDOC-2.6.3, *Fitness for Service: Aging Management*.

CNSC staff determined that DNGS's chemistry control program met the applicable regulatory requirements. DNGS maintained acceptable system chemistry performance in 2021. During a Chemistry Control Inspection at DNGS, CNSC staff noticed a non-compliance with the reporting requirements in Section 3.1 Quarterly report on safety performance indicators and Appendix B Chemistry Compliance Index of REGDOC-3.1.1. CNSC staff identified some discrepancies in the calculation method used in Safety Performance Indicator "Chemistry Compliance Index". OPG performed a gap analysis and corrective action have been implemented. CNSC staff were satisfied with the corrective actions taken. See Section 3.3.3 for more details.

In light of the information reported by Bruce Power, in relation to the analysis of pressure tube sampling that brought into question the validity of the currently used hydrogen equivalent concentration predictive models, OPG has demonstrated that the DNGS pressure tubes continue to be fit for service based on the very low likelihood that flaws greater than 0.15 mm in depth are expected to exist in the outlet rolled joint region of interest in the population of uninspected pressure tubes in the Darlington Units.

Following the discovery of the elevated Heq in Bruce Units 3 and 6, OPG has committed to investigating enhancements to the PNGS Units 5-8 scrape program as an effort to ensure condition monitoring is as conservative as possible. Scrape results from PNGS are used to inform DNGS and OPG-wide analysis on Heq ingress over the service life of pressure tubes. CNSC staff have requested a formalized plan detailing the enhancements to the scrape program for review and acceptance.

OPG provided results from the experimental validation of crack initiation models at high Heq in order to demonstrate that the Delayed Hydride Cracking (DHC) initiation threshold is not affected by a high level of Heq, however the current results suggested that high Heq does have some effect on the DHC initiation

threshold. OPG has committed to improve understanding of the reasons for the unexpected observations in DHC initiation behaviour.

CNSC staff determined that DNGS's maintenance program met the applicable regulatory requirements and CNSC staff expectations. DNGS maintained the critical corrective maintenance backlog very low. The average preventive maintenance completion ratio was 95% which was acceptable. The corrective critical maintenance backlog, deficient critical maintenance backlog, and the number of critical preventive maintenance deferrals are given in table 13.

**Table 13: Trend of maintenance backlogs and deferrals for critical components for DNGS, 2019 to 2021**

Parameter	Average quarterly work orders per unit			Three year trending	Quarterly 2021 work orders per unit				Industry average for 2021
	2019	2020	2021		Q1	Q2	Q3	Q4	
Corrective maintenance backlog	1	0	0	Steady	0	0	0	1	1
Deficient maintenance backlog	5	1	1	Down	1	1	1	1	4
Deferrals of preventive maintenance	2	1	3	Steady	3	4	4	2	2

### 3.1.7 Radiation Protection

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Radiation Protection at the DNGS in 2021.

CNSC staff determined that OPG's application of ALARA at the DNGS in 2021 was compliant with requirements and met CNSC staff's performance expectations. For 2021, OPG established dose targets, tracked collective and individual dose performance against approved targets and established limits, and undertook various initiatives to aid in the control of occupational exposures in the future.

CNSC staff determined that OPG met applicable regulatory requirements for worker dose control at the DNGS in 2021. Radiation doses to workers at the DNGS were below the regulatory dose limits, as well as the action levels in OPG's radiation protection program (reference section 2 tables and figures).

In 2021, CNSC staff noted that with the implementation of the new [Radiation Protection Regulations](#), there were some programmatic gaps. The identified gaps were related to the implementation of new or amended regulatory requirements. CNSC staff determined that the gaps in the program were not safety significant, in



that they did not cause a deviation from the safety case for the facilities (and they did not increase the risk to health, safety or security of persons), and that OPG had implemented suitable corrective actions to resolve them. OPG employed standardized performance metrics and performed self-assessments to monitor and control performance in all aspects of the radiation protection program. Operating experience and benchmarking with industry was used to improve performance.

CNSC staff determined that OPG implemented controls that met the applicable regulatory requirements for control of radiological hazards and the protection of workers at the DNGS in 2021. OPG did not exceed any action levels for contamination control at DNGS in 2021.

### 3.1.8 Conventional Health and Safety

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Conventional Health and Safety at Darlington NGS in 2021.

OPG is compliant with the relevant requirements of the “Occupational Health and Safety Act of Ontario”, the “Labour Relations Act”, and OPG’s “Occupational Health and Safety Policy”. The conventional health and safety conditions at Darlington NGS continued to achieve a high degree of personnel safety. Darlington NGS staff adequately identified workplace hazards in 2021.

There were of 20 reportable events, of which 13 were COVID-19 related, CNSC staff were satisfied with OPG’s corrective actions.

DNGS achieved over 5 million person-hours without a lost time accident. The ASR for Darlington was unchanged at 0.0 between 2020 and 2021 and it is notably less than 5-year average value. The AF for the Darlington decreased from 0.17 in 2020 to 0.08 in 2021 and is less than 5-year average value. The accident rate (ISAR) at Darlington was unchanged at 0.0 between 2020 and 2021.

### 3.1.9 Environmental Protection

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the Environmental Protection SCA at DNGS in 2021. OPG made adequate provision for the protection of the environment and health of persons.

In 2021 OPG submitted its 2020 update report to the Environmental Risk Assessment for the Darlington Site. CNSC staff completed its review and accepted OPG’s update to the Darlington Nuclear Generating Site Environmental Risk Assessment. CNSC staff found that the Darlington ERA is compliant with the requirements of CSA N288.6-12 – *Environmental risk assessments at class I nuclear facilities and uranium mines and mills* and performance expectations.

OPG’s monitoring, analysis and reporting of environmental data was consistently implemented in 2021. Results from CNSC staff assessments of the quarterly and annual reports determined that OPG met regulatory requirements in [REGDOC-](#)

[3.1.1](#) and [REGDOC-2.9.1](#), *Environmental Protection: Environmental Principles, Assessments and Protection Measures*, Version 1.2.

CNSC staff's technical assessment of quarterly and annual scheduled compliance reports has not resulted in non-compliant findings in the specific area of Effluent and Emissions Control. In 2021, the releases remained well below the derived release limits and action levels.

The dose to the public from the Darlington site (0.0006 mSv) remained below the regulatory limit of 1 mSv/yr, and in the similar range to previous year, which shows that radionuclides concentrations measured in the environment remains low. There are negligible risks posed to human health and the environment from releases of non-radiological (hazardous) substances from operations at Darlington, given that they meet applicable release authorizations issued by Ontario.

CNSC IEMP sampling activities took place at Darlington locations in 2021. Curve Lake First Nation representatives accompanied CNSC staff, and participated actively in sampling of air, soil, water, and vegetation. CNSC Laboratory staff are currently analyzing the samples.

### **3.1.10 Emergency Management and Fire Protection**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Emergency Management and Fire Protection at the DNGS in 2021.

CNSC staff concluded that OPG has sufficient provisions for preparedness and response capability to mitigate the effects of accidental releases of nuclear and hazardous substances on the environment and protect the health and safety of persons.

### **3.1.11 Waste Management**

CNSC staff concluded that OPG met applicable regulatory requirements and CNSC staff expectations for the SCA Waste Management at DNGS in 2021.

CNSC staff confirmed that OPG continued to implement an effective waste management program at the DNGS in 2021. CNSC staff were satisfied with the values of the safety performance indicator SPI 25 (Low and Intermediate-Level Radioactive Solid Waste Generated) for DNGS in 2021. In 2021, CNSC staff conducted inspections at DNGS that resulted in two compliant Waste Management SCA findings.

### **3.1.12 Security**

CNSC staff concluded that OPG did not meet all the applicable regulatory requirements for the SCA Security at the DNGS in 2021. Over the 2021 year, CNSC staff have conducted five field inspections at Darlington NGS, two in

facilities and equipment, two in response arrangement, and one in security practices.

There were two findings of medium safety significance within Facilities and Equipment and Security Practices that indicate OPGs performance significantly deviated from expectations and requirements. The details of the findings contain prescribed information and are therefore classified as confidential.

Although the findings from both field inspections were of medium safety significance, CNSC staff conclude that there is no immediate risk to safety and security.

UPDATE: A regulatory warning letter was issued to OPG on February 9, 2022, related to the non-compliances at both DNGS and PNGS, and the need for OPG to implement compensatory and corrective measures. Since identifying both issues, OPG has taken corrective actions, and CNSC staff plan on verifying the implementation of the corrective actions in 2022.

OPG has an adequate cyber security program that focuses on protecting systems and components that perform or impact functionality related to nuclear safety, nuclear security, and emergency preparedness.

### 3.1.13 Safeguards and Non-Proliferation

CNSC staff concluded that OPG met the applicable CNSC regulatory requirements and CNSC staff's expectations for the SCA Safeguards and Non-Proliferation at the DNGS in 2021.

CNSC staff determined that OPG implemented and maintained a program for accountancy and control of nuclear material at the DNGS in a satisfactory manner to comply with the applicable regulatory requirements of [REGDOC-2.13.1, Safeguards and Nuclear Material Accountancy](#). During the reporting period of 2021, OPG provided the required nuclear material accountancy and control reports to the CNSC and the IAEA for their safeguards verification activities.

OPG granted the required access and assistance to the IAEA for safeguards activities, including inspections and for the maintenance of IAEA equipment at the DNGS. During an IAEA unannounced inspection of a Dry Storage Container (DSC) loading in July 2021, the failure of the IAEA's equipment negatively impacted the results of the inspection. OPG provided additional information on the selected spent fuel bundles and the IAEA performed neutron scanning of the DSC at the Darlington WMF in January 2022 to resolve the issue. Separately, during the IAEA's physical inventory verification in October 2021, the licensee broke a seal applied to a spent fuel bay gantry that had been applied by the IAEA to maintain continuity of knowledge of the nuclear material overnight. OPG identified the cause as misalignment in communication between OPG staff and issued corrective actions. The IAEA reviewed additional information and concluded that the broken seal did not impact the overall inspection results. Both issues were resolved to the satisfaction of CNSC staff and did not have an impact on overall safeguards implementation at the facility.

OPG submitted the required annual operational programme with quarterly updates and the annual update to the Additional Protocol to the CNSC in a timely manner. The CNSC reviewed these documents and determined that they met requirements and expectations.

CNSC staff determined that OPG met the applicable regulatory requirements for safeguards equipment, containment, and surveillance in 2021 at the DNGS. In 2021, OPG provided the assistance required for the IAEA's safeguards equipment, containment, and surveillance activities, including inspections at the DNGS.

### **3.1.14 Packaging and Transport**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Packaging and Transport at DNGS in 2021.

The packaging and transport program was effectively implemented for DNGS and the transport of nuclear substances to and from the facility was conducted safely in 2021.

In 2021, CNSC staff conducted an inspection of the implementation of DNGS packaging and transportation program. CNSC staff verified that contractors engaged in transport-related activities had valid training certificates, radioactive materials to be transported were appropriately classified and packaged, all safety markings were appropriately displayed on packages and the documentation accompanying the shipments was properly completed. No items of non-compliance were observed during the inspections.

There were no REGDOC-3.1.1 reportable events related to Packaging and Transport in 2021.

## 3.2 Darlington Waste Management Facility

### 3.2.0 Introduction

The CNSC regulates the DWMF under a waste facility operating licence (WFOL). At the DWMF, OPG processes and stores dry storage containers (DSCs) containing used nuclear fuel (high-level radioactive waste) generated at the DNGS. OPG also manages the intermediate level radioactive waste generated from the refurbishment of the DNGS in Darlington storage overpacks (DSOs) at the Retube Waste Storage Building (RWSB) at the DWMF.



The DWMF consists of an amenities building, one DSC processing building, two DSC storage buildings (Storage Buildings #1 and #2), and the RWSB. The DWMF has the capacity to store 983 DSCs and 490 DSOs. The transfer route of the loaded DSCs and DSOs from the DNGS to the DWMF is on OPG property.

With the exception of the RWSB, the DWMF is contained within its own protected area, which is separate from the protected area of the DNGS but within the boundary of the Darlington site. The RWSB is also located within the boundary of the Darlington site but not within a protected area.

The WFOL for the DWMF authorizes OPG to construct 2 additional DSC storage buildings (Storage Buildings #3 and #4).

### Licensing

The [Commission renewed](#) the WFOL for the DWMF in March 2013, with an expiry date of April 30, 2023.

### Compliance Program

CNSC staff did not conduct inspections at the DWMF in 2021. Due to COVID-19 Pandemic situation, a type II planned radiation protection inspection was deferred from 2020 and completed end 2021/2022 fiscal year. CNSC staff will consider the inspection completed in the safety assessments in next year's regulatory oversight report.

### 3.2.1 Management System

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Management System at the DWMF in 2021.

Changes to licensing-basis documents are reviewed by CNSC staff to ensure that the OPG maintains its management system at the DMWF and that changes don't impact safety.

OPG has adequate contingency plans in place to maintain or restore critical safety and business functions in the event of disabling circumstances. In 2021, OPG continued to meet business continuity requirements in response to the COVID-19 pandemic.

### **3.2.2 Human Performance Management**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Human Performance at DWMF in 2021.

In 2021, there were no significant Human Performance observations to report for DWMF. OPG revised its human performance program documentation to incorporate identified enhancements, and to reflect organizational changes as well as changes to other governance. CNSC staff reviewed and are satisfied with OPG's revision. CNSC staff concluded that DWMF continued to implement its Human Performance program in accordance with regulatory requirements.

CNSC staff review of OPG's 2021 DWMF quarterly and annual operations report did not result in non-compliant findings for the specific area of Personnel Training.

### **3.2.3 Operating Management**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Operating performance at DWMF in 2021.

In total, OPG processed 58 Dry Storage Containers (DSCs) at the DWMF in 2021, which exceeded their target by one DSC. In 2021, OPG submitted all scheduled quarterly and annual reports as required and within the appropriate timelines. CNSC staff's reviews of OPG's operational reports did not identify any issues or situations that suggested that licensed activities at the DWMF were unsafe. The reviews also confirmed that OPG's reporting and trending, and its responses to comments and requests for follow-up information and clarification, met CNSC staff's expectations.

### **3.2.4 Safety Analysis**

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations for the SCA Safety Analysis at the DWMF in 2021.

CNSC staff concurred with OPG DWMF 2016 safety report that applicable regulatory requirements were met. In late 2021, OPG submitted to CNSC staff the required 5-year update to the safety analysis report for DWMF which is currently under review.

### 3.2.5 Physical Design

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff expectations, for the SCA Physical Design at the DWMF in 2021.

CNSC staff confirm that OPG maintains an effective design program and pressure boundary program, implements modifications to the facilities in accordance with established engineering control process to maintain the design basis. In 2021, OPG reported its design modification activities at the DWMF. CNSC staff reviewed and accepted OPG's proposal to reduce Dry Storage Container (DSC) lid-to-base weld height to 5/8 inch at DWMF.

DWMF continues to implement its fire protection program in accordance with CSA N393 *Fire protection for facilities that process, handle, or store nuclear substances*, requirements.

### 3.2.6 Fitness for Service

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff expectations, for the SCA Fitness for Service at the DWMF in 2021.

As part of the aging management activities for DSCs, OPG submitted the aging management report for the OPG DWMF. CNSC staff reviewed the submission and determined that it complied with OPG's aging management program.

### 3.2.7 Radiation Protection

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Radiation Protection at the DWMF in 2021.

CNSC staff's reviews of quarterly reports submitted by OPG and licensee responses to reportable events confirmed that:

- The DWMF achieved its year-end collective dose target
- OPG did not exceed any action levels for dose to workers. The annual effective doses for all DWMF workers were well below the regulatory limit of 50 mSv
- OPG did not exceed any action levels for contamination control.
- The perimeter dose rates at the DWMF were within OPG's targets and consistent with the results of the previous years
- Measures were implemented to ensure that the DWMF was compliant with regulatory requirements related to Radiation Protection

### 3.2.8 Conventional Health and Safety

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Conventional health and safety at the DWMF in 2021.

In 2021, CNSC staff compliance verification activities did not identify any non-compliant findings relevant to conventional health and safety. OPG did not report any lost-time accidents at the DWMF in 2021.

### 3.2.9 Environmental Protection

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the Environmental Protection SCA at DWMF in 2021. OPG made adequate provision for the protection of the public and the environment.

CNSC staff reviews of quarterly and annual reports have not resulted in findings for the Effluent and Emission control SPA, releases remained well below the DRLs and Action Levels.

CNSC technical assessment (annual report) has not resulted in findings related to the Assessment and Monitoring SPA. Dose to the public remained low (0.6 uSv), and in a similar range to the previous years, which shows that radionuclides concentrations measured in the environment remains low.

#### 3.2.10 Emergency Management and Fire Protection

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Emergency Management and Fire Protection at the DWMF in 2021.

OPG has a facility emergency program for the DWMF. Main fire response is done by [Clarington Fire Department](#) (CFD). To ensure familiarity with the facility, CFD staff are given orientation tours at the DWMF. CFD staff train with Darlington Emergency Response Team (ERT) at OPG's live fire training facility near Wesleyville, Ontario.

Overall, OPG has an adequate Fire Protection Program (FPP) to minimize both the probability of occurrence and the consequences of fire at DWMF. The FPP complies with the CSA N393-13 requirements.

#### 3.2.11 Waste Management

CNSC staff concluded that OPG met the applicable regulatory requirements for the SCA Waste Management at the DWMF in 2021.

CNSC staff review of OPG's 2021 DWMF quarterly and annual operations report did not result in non-compliant findings for the SCA Waste Management.



### 3.2.12 Security

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the Security SCA at the DWMF in 2021.

CNSC staff reviewed the DWMF quarterly, annual operational reports, as well as the threat and risk assessment report, and confirmed that OPG met all the applicable regulatory requirements pertaining to all specific areas for the security SCA.

### 3.2.13 Safeguards and Non-Proliferation

CNSC staff concluded that OPG met the applicable CNSC regulatory requirements and CNSC staff's expectations, for the SCA Safeguards and Non-Proliferation at the DWMF in 2021.

CNSC staff determined that OPG's accountancy and control of nuclear material complied with the applicable regulatory requirements at the DWMF. OPG granted the required access and assistance to the IAEA for safeguards activities, including inspections and for the maintenance of IAEA equipment at the DWMF.

CNSC staff determined that OPG met the applicable regulatory requirements for operational and design information in 2021 at the DWMF. OPG provided the required operational and design information to facilitate IAEA safeguards activities.

OPG provided the assistance required for the IAEA's safeguards equipment, containment, and surveillance activities, including inspections.

### 3.2.14 Packaging and Transport

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Packaging and Transport at DWMF in 2021.

OPG maintains a packaging and transport program for the Darlington WMF that ensures compliance with the [\*Packaging and Transport of Nuclear Substances Regulations, 2015\*](#) and the [\*Transportation of Dangerous Goods Regulations\*](#). No transport of nuclear substances were completed at the facility in 2021.

## 3.3 Pickering Nuclear Generating Station

### 3.3.0 Introduction

The [Pickering site](#) is located on the north shore of Lake Ontario in Pickering, Ontario, 32 kilometers northeast of Toronto and 21 kilometers southwest of Oshawa. The Pickering site lies within the traditional territory of the Wendat, Anishinabek Nation, and the territory covered by the Williams Treaties with the Michi Saagiig and Chippewa Nations.



The Pickering site consists of the Pickering Nuclear Generating Station (PNGS) and the Pickering Waste Management Facility (PWMF), both owned and operated by OPG. The CNSC regulates the PNGS and PWMF under 2 separate, independent licences – a power reactor operating licence (PROL) for the PNGS and a waste facility operating licence (WFOL) for the PWMF.

The PNGS consists of 8 CANDU reactors. Units 1, 2, 3 and 4 (formerly known as PNGS A) went into service in 1971-1973. Units 2 and 3 were defueled in 2008 and remain in a safe shutdown state; there are no plans to put them back into operation. Units 5, 6, 7 and 8 (formerly known as PNGS B) continue to operate safely since they were brought into service in 1983-1986.

Each operating reactor for Units 1 and 4 has a gross electrical output of 542 MWe (megawatts electrical). Each operating reactor for Units 5–8 has a gross electrical output of 540 MWe.

### Licensing

In 2018, the [Commission renewed](#) the PROL for a 10-year period covering September 1, 2018, to August 31, 2028. This licence period includes 3 phases of operational activities:

- Continued commercial operation until December 31, 2024
- Stabilization phase (post-shutdown de-fuelling and de-watering), which lasts approximately 3 to 4 years
- Beginning of safe storage for Units 1 and 4 and Units 5–8

Following end of commercial operation and permanent shutdown, each unit will undergo stabilization activities in preparation for an extended phase of safe storage with surveillance. The safe storage with surveillance phase is anticipated to begin in 2028. OPG requires Commission approval should the licensee decide to operate PNGS on power beyond December 31, 2024. In December 2021 OPG informed CNSC staff in a letter of its intention to pursue Commission approval for operation of Pickering Units 5-8 until December 31, 2025.

The PROL was not amended in 2021.

## Fisheries Act Authorization

On January 17, 2018, [Fisheries and Oceans Canada](#) (DFO) issued a *Fisheries Act* Authorization (FAA) to OPG for the PNGS, under Paragraph 35(2)(b) of the *Fisheries Act*. In 2021, OPG submitted the 2020 report in accordance with its FAA. CNSC staff and DFO each independently completed the review of OPG’s report submitted for 2020 and concluded that the report was acceptable and complied with the conditions of the *Fisheries Act* Authorization.

In 2021, Fisheries and Oceans Canada (DFO) held discussions on OPG’s request to amend the *Fisheries Act* Authorization (FAA). DFO is reviewing OPG’s request and is engaging Indigenous Nations and communities.

### Thermal Plume Monitoring

In 2021, OPG submitted the “Potential Effects of the Pickering Nuclear Generating Station Thermal Plume on the Survival of Round Whitefish Embryos, 2018-2020” report to CNSC staff. This report provides results of thermal plume monitoring over 2 periods (2018 to 2019 and 2019 to 2020), as directed by the Commission in the Record of Decision for the PNGS PROL renewal application.

OPG concluded that the thermal plume monitoring report supports the 2018 Pickering Environmental Risk Assessment (ERA) conclusion that there is no adverse effect on Round Whitefish embryo survival or on the local or regional Round Whitefish population from the thermal plume at the PNGS. Upon completing the reviews of OPG’s submission above, CNSC staff and Environment and Climate Change Canada (ECCC) each concluded independently that there are likely no adverse effects to the Round Whitefish embryo survival or on the local or regional Round Whitefish population from the thermal plume at Pickering.

## Integrated Implementation Plan

OPG developed an Integrated Implementation Plan (IIP) for the PNGS that defines resolution actions to address issues identified through the periodic safety review conducted in support of the 2018 licence renewal. Each IIP resolution action is completed through the execution of 1 or more IIP actions. OPG established a schedule to manage the completion of the 35 IIP resolution actions and the 63 supporting IIP actions.

In 2021, the IIP was progressing according to schedule, and CNSC staff were satisfied with OPG’s progress. Table 14 indicates the overall planned, completed, and closed IIP commitments. It also indicates IIP tasks planned for completion in 2021, completed by the licensee in 2021 (irrespective of planned completion dates) and IIP items closed by CNSC in 2021.

**Table 14: PNGS IIP Status**

Total commitments	Overall	2021
Planned by OPG	98	5

Completed by OPG	96*	5
Closed by CNSC	96	27

\* 1 IIP action and 1 IIP resolution action were de-scoped from the IIP after being approved by the Commission

In 2021, OPG requested the Commission to extend the due date to 2021 for 5 IIP commitments (3 IIP actions and 2 IIP resolution actions) and to de-scope 2 IIP commitments (1 IIP action and 1 IIP resolution action) from the IIP. The extensions and de-scope was approved by the Commission on April 13, 2021.

In May 2021, OPG completed all required IIP commitments and CNSC staff have closed all PNGS IIP commitments as of June 2021.

## Compliance Program

The inspections at the PNGS that were considered in this regulatory oversight report are tabulated in table 15 (inspection reports were included if they were sent to OPG by February 1, 2022). The Quarterly Type II inspections include 44 field inspections conducted at PNGS in 2021.

**Table 15: List of Inspection Reports at PNGS**

Safety and Control Area	Report Title	Report Issue Date
Management System	REPORT - PRPD-06985-2021/DRPD-2021-09519-Type II OPG Fleet wide Supply Management Compliance Verification Report	May 2021
Human Performance	PRPD-2021-06811 and DRPD-2021-07525 - Report - TII - Non-Certified Training Programs at Pickering NGS and Darlington NGS	June 2021
	PRPD-2021-11760- REPORT - TII - Simulator Examinations and Requalification Tests at Pickering NGS	February 2022
Operating Performance	PRPD-2021-07742 - Report - TII - Unit 6 Outage at Pickering NGS	July 2021
	PRPD-2021-07752 - REPORT - TII - Quarterly Field Inspection Report Q3 2020-2021	March 2021
	PRPD-2021-07753 - REPORT - TII - Quarterly Field Inspection Report Q4 2020-2021	June 2021
	PRPD-2021-11197 - Report - TII - Quarterly Field Inspection Report Q2 2021-2022	December 2021
	REPORT - PRPD-2021-08860 - P2181 Unit 8 Planning Maintenance Outage - Compliance Inspection Report	October 2021

Safety and Control Area	Report Title	Report Issue Date
	PRPD-2021-10582 - Report - TII - Quarterly Field Inspection Report Q1 2021-2022	September 2021
Physical Design	PRPD-2021-10881 Type II Inspection Environmental Qualification Programs Pickering NGS	September 2021
Fitness for Service	PRPD-2021-11748 - Report - TII - System Inspection of Irradiated Fuel Bays at Pickering NGS	February 2022
	REPORT - CNSC Type II Inspection report - PRPD-2021-11416 - Chemistry Control at Pickering NGS	November 2021
	REPORT - Pickering NGS - Desktop Inspection Report PRPD-2021-07065 Software Quality Assurance Program	August 2021
Emergency Management and Fire Protection	PRPD-2021-07777 - Type II Pickering Fire Response Program - Compliance Verification Report	June 2021

### 3.3.1 Management System

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the Management System SCA at the PNGS in 2021.

CNSC staff conducted 12 inspections that provide inputs to the SCA Management System assessment. These inspections resulted in some findings of low safety significance. Four low safety significant findings were identified in the specific area of Records Management, which also includes the control of documentation. One finding pertains to training material records for fuel handling nuclear operators being incomplete, and the second finding relates to the training program documents not being controlled consistently with their intended use. In addition, one finding was identified for incomplete records of the Pickering Powerhouse inspection checklist form. CNSC staff continue to follow-up and verify the implementation of corrective actions by OPG.

During an inspection on OPG's environmental qualification program, one finding of low safety significance was identified in the specific area of Change Management. The finding was related to practices ensuring that EQ related deficiencies are identified, recorded, assessed and dispositioned in accordance with station expectations [PRPD-2021-10881]. OPG is implementing the appropriate corrective actions to address the low safety significant findings, and CNSC staff will continue to follow-up and verify the implementation of corrective actions.

During an inspection on the Unit 6 outage, CNSC staff identified one finding of low safety significance related to the specific area of Configuration Management.

The non-compliance was related to the physical configuration of equipment not conforming with documentation configuration. Another non-compliance of low safety significance was identified during an inspection on OPG's fire response program. OPG was non-compliant with their document control requirements under the Records Management specific area, as the pre-fire plans in the Incident Command Truck were not the current version. OPG is implementing corrective actions to address these two findings of low safety significance, and CNSC staff will continue to follow-up and verify the implementation of corrective actions.

CNSC staff conducted an OPG fleet-wide inspection on Supply Management in February 2021. In the specific area of Contractor Management, CNSC staff identified two findings of low safety significance, and one finding of negligible safety significance. The negligible and one low finding were related to OPG not being compliant with their own processes resulting in one purchase order not having accurate purchasing requirements (negligible significance), and technical requirements not being met in some purchase orders (low significance). The second finding of low safety significance was related to some items and materials not being handled and stored as required. OPG implemented the necessary corrective actions to address the non-compliances, and CNSC staff are satisfied with the actions taken by OPG.

OPG continued to meet business continuity requirements. Throughout 2021, OPG submitted 8 event reports related to business continuity in response to the COVID-19 pandemic, such as employees, or close contacts with others, that tested positive for COVID-19. CNSC staff reviewed the event reports and found that OPG took adequate corrective actions and has adequate measures in place relating to business continuity.

### **3.3.2 Human Performance Management**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Human Performance at the PNGS in 2021.

CNSC staff identified 1 finding of negligible safety significance and 3 findings of low safety significance in inspections within this SCA. Two findings of low safety significance were identified during an inspection of non-certified training programs. The first low finding was related to discrepancies between the Job and Task Analysis (JTA) and Continuing Training (CT) Plans documents for the Fuel Handling Nuclear Operator training program, and the second low finding was related to deficiencies and discrepancies identified in the Fuel Handling Nuclear Operator training materials that were reviewed during this inspection. OPG is implementing corrective actions to address these two findings of low safety significance, and CNSC staff will follow-up and verify the implementation of corrective actions.

The third finding of low safety significance was identified during an inspection of OPG's Fire Response Program. CNSC staff identified a non-compliance related to the Emergency Response Team that could go below minimum shift complement by following OPG's procedure and sending three Emergency Response Managers

to the hospital when responding to a contaminated casualty scenario. OPG is implementing corrective actions to address this finding, by updating their governance for emergency response to contaminated casualty events. CNSC staff will follow-up and verify the implementation of the corrective actions.

There were two event reports regarding OPG being below minimum shift complement at Pickering. One was due to a supervisor mistakenly allowing a mechanical maintainer to leave the station. The error was recognized and corrected within 2 hours, and the safety significance of this event was determined to be low. In a separate event, after a Critical Safety Parameter Qualified Nuclear Operator was stepped up to a Supervising Nuclear Operator (SNO) position to replace a staff who took a sick leave, the supervisor did not realize that this led to being below minimum shift complement for about an hour. CNSC staff have reviewed the event reports and were satisfied with OPG's corrective actions to resolve these issues and prevent reoccurrence of these events.

OPG's statement of compliance with [REGDOC-2.2.4, \*Fitness for Duty, Volume II: Managing Alcohol and Drug Use\*](#), version 3, was submitted to CNSC in July 2021. CNSC staff will verify OPG's statement of compliance with the implementation of the REGDOC in 2022.

### 3.3.3 Operating Performance

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Operating performance at PNGS in 2021.

OPG continued to operate PNGS in a safe manner within the bounds of the operating policies and operational safety requirements. All reactor units operated at the conditions prescribed by Power Reactor Operating Licence (PROL) within the power limits identified in the licence conditions handbook (LCH) for PNGS. Operating practices observed during the year were adequate and effective.

In 2021, Pickering Units 1&4 experienced no automatic reactor trips and no setbacks. Pickering Units 5-8 experienced no reactor trips, no stepbacks and five setbacks. There was no impact on reactor safety. CNSC staff confirmed that OPG staff followed approved procedures and took appropriate corrective actions for all transients and power reductions. The reactor trips performance against the target for 2021 was better than industry performance target (0.0 for Pickering Units 1&4 and 0.0 for Pickering Units 5-8). All PNGS units met WANO's PHWR target of 1.0 trip per 7,000 hours of operation. All transients were controlled properly, and power reduction was automatically initiated by the reactor control systems.

In 2021, PNGS experienced five forced outages among its 6 operating reactors. One of these was reported to the Commission in CMD 21-M16. All forced outages were adequately followed up by OPG.

CNSC staff concluded that OPG's management of planned outages at PNGS met applicable regulatory requirements and expectations. CNSC staff confirmed that during planned outages, OPG used an approved reactor shutdown guarantee state,

monitored heat sinks and components, completed regulatory undertakings, and operated in accordance with its operations program.

CNSC staff issued three outage inspection reports in 2021. For the Unit 4 Planned Maintenance Outage, CNSC staff identified 1 non-compliant finding of low safety significance, related the identification and resolution of known adverse conditions associated with pressure indication drifting during the outage execution. No enforcement action was required as OPG took appropriate corrective action prior to the inspection report being issued. During the Unit 6 Planned Maintenance Outage CNSC staff identified 3 non-compliant findings of low safety significance related to configuration management, foreign material exclusion and work protection practices. OPG took immediate action to correct the non-compliant findings. However, a Notice of Non-Compliance was raised requesting OPG to provide an update upon completion of all the corrective actions identified in response to the configuration management finding. OPG provided the requested information, and the Action Item was subsequently closed. In the Unit 8 Planned Maintenance Outage, CNSC staff identified 1 non-compliant finding of negligible safety significance related to plant status control. No enforcement action was required for the non-compliant finding as OPG took action to correct the finding before the inspection report was issued.

PNGS was compliant with the regulatory requirements in [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants](#). All scheduled REGDOC-3.1.1 reports were submitted to the CNSC in a timely manner.

In 2021, OPG performed a gap analysis on the methods for quarterly reporting for REGDOC-3.1.1 SPI 19 Chemistry Index and SPI 20 Chemistry Compliance Index, to identify differences among Canadian NPP licensees. As a result of this gap analysis, OPG notified the CNSC of a change to its method for calculating the inputs for SPI 20. CNSC staff concluded that the changes OPG was implementing would improve reporting and consistency between stations and resolve the inaccuracy in reporting SPI 20 parameters.

Based on the information provided by OPG, CNSC staff also requested OPG to modify its treatment of the PHTS conductivity parameter reported under SPI 19. To ensure CNSC staff are able to perform effective surveillance and trending on both SPI 19 and SPI 20 and provide a baseline for comparing performance, OPG was also requested to recalculate the affected SPI 19 and SPI 20 parameters dating back to Q1 of 2020 and resubmit the quarterly data to the CNSC. OPG has committed to provide the recalculated SPI parameters for both PNGS and DNGS by March 31, 2022. CNSC staff are satisfied with OPG's response to this request.

OPG PNGS reported 49 REGDOC-3.1.1 reportable events in 2021. These included reportable COVID-19 cases at PNGS. CNSC staff followed up on all reportable events in a graded approach based on risk significance of the event. CNSC staff found, in each event report where corrective actions were proposed, that OPG's corrective action plan were satisfactory and continue to monitor OPG's progress to implement corrective measures.



### 3.3.4 Safety Analysis

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the Safety Analysis SCA at the PNGS in 2021.

OPG has developed a REGDOC-2.4.1 implementation plan which defines the REGDOC-2.4.1 compliant analyses to be commenced in the 2018-2021 timeframe. 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. OPG's REGDOC-2.4.1 implementation plan is ongoing in accordance with the implementation plan, which currently covers the period 2022-2024.

During the update of the Heat Transport (HT) system aging analysis, a gap was found in the Out of Core Small Break Loss of Coolant Accidents (SBLOCA) when 12200 Effective Full Power Days (EFPD) of HT system aging is considered. For this scenario, the predicted fuel sheath temperature for a small break at the time of the backup trip was found to be higher than the bounding SBLOCA scenario. An updated analysis, confirming the acceptability of this scenario is currently being reviewed by CNSC staff.

A research finding identified a gap in the analysis of Emergency Coolant Injection (ECI) Pipe Breaks Causing Large Break Loss of Coolant Accidents (LBLOCAs). The gap in the LBLOCA does not pose any operability issue. Based on an Engineering Assessment, the safety margins are expected to be maintained and the Derived Acceptance Criteria are expected to be met. The LBLOCA analysis to confirm the safety margins will be using the new Composite Analytical Approach (CAA) methodology.

For the Software Quality Assurance Program Inspection, which includes both aspects of probabilistic and deterministic Safety Analysis (SA), CNSC staff identified six (6) non-compliant findings of negligible and low safety significance. CNSC staff concluded that the licensee was in compliance with the regulatory requirements; however non-compliances with the licensee's own governance were observed by CNSC staff.

OPG has provided its corrective action plan for the NNCs raised in the inspection report. The corrective action plans (CAPs), for two of the notices of non-compliance, did not fully meet the expectations of the CNSC staff, and OPG was asked to review them. OPG is expected to provide an update on the CAPs implementation by the end of August 2022.

PNGS submitted additional reports in 2021 to address additional requirements in REGDOC 2.4.2, not covered in the Pickering B 2017 and Pickering A 2018 PSA updates respectively. CNSC staff concluded that PNGS was compliant with REGDOC 2.4.2 in accordance with the implementation plan included in its LCH.

### 3.3.5 Physical Design

CNSC staff concluded that OPG met the applicable regulatory requirements, and that its performance met CNSC staff's expectations, for the physical design SCA at the PNGS in 2021.

The quarterly pressure boundary reports were provided in a timely manner and CNSC staff found them to comply with the reporting requirements. CNSC staff conducted a type II seismic inspection in March 2021 and verified that the seismic upgrades on seismic supports, as part of a previous OPG commitment have been fulfilled.

CNSC staff conducted two Environmental Qualification (EQ) inspections in 2021 and concluded that the licensee continued to meet the regulatory requirements for the EQ program.

In 2021, as a result of the review of the 2020 Annual Fuel Performance Report, CNSC staff concluded that OPG followed the applicable reporting requirements, and the overall fuel performance at the Pickering NGS sites remained safe in 2020. CNSC staff note that there has been a continued reduction in the severity of black deposits to the extent that there were none observed from any fuel discharged from Unit 1 in 2020. OPG operated within the applicable design and operating limits, iodine limits and maximum bundle power and channel power limits. Although the inspection rate at PNGS is lower than the industry rate, it met the minimum expectation of 20 bundles per unit per year. Similarly, the defect rate per unit did not exceed the CNSC expectation of 1 defect per unit per year.

### 3.3.6 Fitness for Service

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Fitness for Service at the PNGS in 2021.

CNSC staff confirmed that all special safety systems for PNGS met their unavailability targets in 2021.

There was one medium finding in the maintenance specific area based on the review of an event reported by OPG. On September 30, 2021, Unit 5 low generator stator cooling water (SCW) flow led to a turbine trip and reactor setback. The event occurred due to debris passing through the degraded SCW filter resulting in low SCW flow and a flashover in one of the stator cooling water boxes. OPG indicated that the preventive maintenance of periodic filter replacement was improperly retired in 2018 based on the incorrect assumption that a passing filter was not a major failure mode. CNSC staff confirmed that OPG has taken the acceptable corrective actions after this event, including replacing the filters for the other units. OPG initiated a root cause evaluation which will be submitted to CNSC in May 2022. CNSC staff will review the evaluation upon its submission.

There was also a medium finding during a Type II Pickering Fire Response Program inspection. As part of the inspection, CNSC staff observed and noted through signage that personnel are permitted to enter Building 37 when approval is granted by the Pickering Duty Shift Emergency Response Manager (SERM), and if wind gusts are less than 20 km per hour. Previously, Building 37 stored fire response equipment for the Emergency Response Team. OPG notified CNSC staff that Building 37 was a condemned building following the receipt of a structural assessment report in August 2019. CNSC staff issued a letter to OPG outlining the significant risk to OPG personnel due to continued use of Building 37. CNSC staff requested OPG to provide justification for usage of Building 37 as OPG personnel continued to be permitted access under certain environmental conditions.

OPG provided a response to CNSC staff to outline details of further access restrictions and measures including establishing an exclusion perimeter around Building 37 with signage, indicating that the SERM must be contacted prior to accessing the building. OPG indicated that all noncritical access has been suspended, and safety precautions are in place for critical and emergency access. In addition, OPG submitted photographs, following the inspection, identifying the areas around the Building 37 to show the barriers and signage that have been established. CNSC staff were satisfied with OPG submissions and closed the associated Action Item.

PNGS maintained the critical corrective maintenance backlog very low. The corrective critical maintenance backlog, deficient critical maintenance backlog, and the number of critical preventive maintenance deferrals are given in table 16.

**Table 16: Trend of maintenance backlogs and deferrals for critical components for PNGS, 2019 to 2021**

Parameter	Average quarterly work orders per unit			Three year trending	Quarterly 2021 work orders per unit				Industry average for 2021
	2019	2020	2021		Q1	Q2	Q3	Q4	
Corrective maintenance backlog	1	0	0	Steady	0	0	0	0	1
Deficient maintenance backlog	7	2	3	Down	4	3	2	2	4
Deferrals of preventive maintenance	5	4	4	Steady	7	3	2	1	2

PNGS continues to implement activities for aging management of structures, systems and components (SSCs) within a systematic and integrated framework in accordance with CNSC [REGDOC-2.6.3, \*Fitness for Service: Aging Management\*](#).

CNSC staff determined that PNGS's chemistry control program met the applicable regulatory requirements.

CNSC staff chemistry inspections resulted in all compliant findings with the exception of one negligible non-compliant finding found during a field inspection which was addressed by OPG. A review of the chemistry control data in the quarterly [REGDOC-3.1.1](#) reports, and the related safety performance indicators (SPIs) demonstrated that the PNGS chemistry performance was acceptable.

In March 2021 OPG provided the CNSC with the Pickering 2020 Integrated Operational Plan (IOP) Periodic Inspection Program (PIP) Final In-Service Inspection Reports for Units 0, 1, 4, and 5 to 8. CNSC staff noted that OPG did not satisfy the 60-day notification requirement from the CSA standard N285.5-18 *Periodic inspection of CANDU nuclear power plant containment components* on multiple occasions. CNSC staff concluded that the resulting OPG corrective action plan adequately addressed this non-compliance.

In light of the information reported by Bruce Power, in relation to the analysis of pressure tube sampling that brought into question the validity of the currently used hydrogen equivalent concentration predictive models, OPG has demonstrated that the PNGS pressure tubes continue to be fit for service based on the very low likelihood that flaws greater than 0.15 mm in depth are expected to exist in the outlet rolled joint region of interest in the population of uninspected pressure tubes in the Pickering Units.

OPG provided results from the experimental validation of crack initiation models at high Heq in order to demonstrate that the Delayed Hydride Cracking (DHC)

initiation threshold is not affected by a high level of Heq. The current results suggested that high Heq does have some effect on the DHC initiation threshold and OPG has committed to working further to understand the reasons for the unexpected observations in DHC initiation behaviour.

Following the discovery of the elevated Heq in Bruce Units 3 and 6, OPG has committed to investigating enhancements to the PNGS Units 5-8 scrape program as an effort to ensure condition monitoring is as conservative as possible. At the end of 2021, the implementation of the enhancements was in progress and will continue into future outages.

Assessment of Calandria Tube to Liquid Injection Shutdown System (CT-LISS) Nozzle Gap Inspection Results and Request for Extension of Final Assessment was reviewed by staff and the conclusions were satisfactory. One channel was assessed to be at risk of contact, but OPG implemented a design modification to increase the gap during a planned maintenance outage. CNSC staff concurred with OPG's evaluation that the outcome from the mitigating action was satisfactory and that the most limiting CT-LISS nozzle gap is expected to the end of planned PNGS operation.

### 3.3.7 Radiation Protection

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Radiation Protection at the PNGS in 2021.

For 2021, OPG established dose targets, tracked collective and individual dose performance against approved targets and established limits, and undertook various initiatives to aid in the control of occupational exposures. Radiation doses to workers at the PNGS were below the regulatory dose limits, as well as the action levels in OPG's radiation protection program (see figures, 8, 9 and 10 in section 2.7).

CNSC staff determined that OPG implemented controls that met the applicable regulatory requirements for control of radiological hazards and the protection of workers at the PNGS in 2021. OPG did not exceed any action levels for contamination control at PNGS in 2021.

In 2021, a CNSC inspection identified non-compliances regarding OPG's implementation of the new [Radiation Protection Regulations](#). The non-compliances concerned documentation and communication gaps regarding: ascertaining dose to the lens of the eye methodology; informing all current nuclear energy workers at PNGS in writing of the revised equivalent dose limit for the lens of an eye; consideration of equivalent doses to the extremities from non-OPG facilities when implementing exposure control levels. CNSC staff determined that the gaps in OPG's radiation protection program were not safety significant, in that they did not cause a deviation from the safety case for the facilities (and they did not increase the risk to health, safety or security of persons), and that OPG had implemented suitable corrective actions to resolve them. OPG employed standardized performance metrics and performed self-assessments to monitor and control performance in all aspects of the radiation

protection program. Operating experience and benchmarking with industry was used to improve performance.

### 3.3.8 Conventional Health and Safety

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Conventional Health and Safety PNGS in 2021. OPG PNGS continued to implement and maintain a safe conventional health and safety program in accordance with provincial and federal regulatory requirements.

OPG is compliant with the relevant requirements of “Occupational Health and Safety Act of Ontario”, “Labour Relations Act”, and OPG governance. The conventional health and safety conditions at OPG PNGS continued to achieve a high degree of personnel safety. OPG adequately identified workplace hazards in 2021.

The Accident Severity Rate (ASR) for PNGS remained steady at 0.00, as in 2020 and 2019, and is below the industry average of 0.05. The Accident Frequency (AF) decreased from 0.14 in 2020 to 0.07 in 2021 and is below the industry average of 0.16. The Industrial Safety Accident Rate (ISAR) remained steady at 0.00 in 2021 and below the industry average of 0.03.

### 3.3.9 Environmental Protection

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the Environmental Protection SCA at PNGS in 2021. OPG made adequate provision for the protection of the environment and health of persons.

There were no Derived Release Limits (DRL) exceedances. In 2021, OPG reported two (2) Gross Beta-Gamma Environmental Action Level (EAL) exceedances. The first exceedance was related to sewage releases and the second was related to the reactor building service water. No consequences to the public and environment are expected as a result of these exceedances. The CNSC reviewed the provided event reports and followed up during an effluent monitoring field inspection.

OPG has implemented and maintained a corporate environmental management system in accordance with CNSC requirements and CNSC staff expectations. In 2021, OPG completed implementation of [REGDOC-2.9.1, \*Environmental Protection Principles, Assessments and Protection Measures\*](#) Version 1.1.

The dose to the public from the Pickering site (0.002 mSv) remained below the regulatory limit of 1 mSv/yr, and in the similar range to previous year, which shows that radionuclides concentrations measured in the environment remains low.

### 3.3.10 Emergency Management and Fire Protection

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Emergency Management and Fire Protection at the PNGS in 2021.

CNSC staff concluded that OPG has sufficient provisions for preparedness and response capability to mitigate the effects of accidental releases of nuclear and hazardous substances on the environment and protect the health and safety of persons.

The inspection activities conducted at PNGS in 2021 resulted in two findings of negligible safety significance. The two negligible findings were for non-compliances with the requirements for the Inspection Testing and Maintenance of Fire Protection Programs and Equipment, for not ensuring the consistent inspection of fire protection equipment (such as fire hoses or fire extinguishers) for two (2) out of fifty-four (54) items verified during one inspection, and in one out of the 57 instances in a separate inspection.

Three of the four notices of non-compliance, raised as a result of the Full Scale Emergency Exercise conducted in October 2020, and discussed in 2020 NPGS ROR, were satisfactorily addressed by OPG by the end of 2021. At the end of 2021, there was one remaining item to be addressed by OPG in relation to OPG's emergency exercise controllers adhering to the documented exercise schedule.

UPDATE: OPG's update on the implementation of the corrective action plan was submitted to the CNSC in May 2022. CNSC subsequently closed the action item.

At CNSC staff's request, OPG has provided an implementation plan for the CSA N293-12 (R2017), *Fire protection for nuclear power plants*, calling for a full implementation date of June 2023. OPG's response was considered acceptable by CNSC Staff.

### 3.3.11 Waste Management

CNSC staff concluded that OPG met applicable regulatory requirements and CNSC staff expectations for the SCA Waste Management at PNGS in 2021. CNSC staff confirmed that OPG continued to implement an effective waste management program at the PNGS in 2021. CNSC staff were satisfied with the values of the safety performance indicator SPI 25 (Low and Intermediate-Level Radioactive Solid Waste Generated) for PNGS in 2021.

In 2021, CNSC staff conducted inspections that resulted in two (2) non-compliant findings of negligible safety significance. There was one instance of radioactive waste incorrectly stored and one instance of a bucket of waste not labelled correctly. OPG addressed each of these deficiencies and no enforcement actions were raised.

### 3.3.12 Security

CNSC staff concluded that OPG did not meet all applicable regulatory requirements and CNSC staff expectations for the SCA Security at the PNGS in 2021.

Although OPG meets applicable requirements in the specific areas of Response Arrangements; Drills and Exercises; and, Cyber Security, non-compliances remain in the specific area of Facilities and Equipment that originated from a 2020 Field Inspection.

UPDATE: A regulatory warning letter was issued to OPG on February 9, 2022, related to these non-compliances at both DNGS and PNGS, and the need for OPG to implement compensatory and corrective measures. The findings related to these non-compliances have a medium safety significance. The details of the non-compliances are confidential; however, since identifying the issue OPG has taken corrective action, and CNSC staff plan on verifying the implementation of the corrective actions in 2022.

UPDATE: On January 21, 2022, CNSC staff conducted a reactive field inspection at Pickering NGS, because of observations made at Darlington NGS related to issues in the specific area Security Practices. This inspection identified one (1) finding of medium safety significance. The details of the inspection are confidential; however, CNSC staff will continue to verify that the necessary actions are being completed by OPG.

The medium safety significant findings within Facilities and Equipment and Security Practices indicates OPG performance deviated from expectations and requirements. Although the findings from both field inspections were of medium safety significance, CNSC staff conclude that there is no immediate risk to safety and security. As a result of the two medium findings, and the continued need for OPG to implement appropriate compensatory and corrective measures, the safety performance rating for 2021 was downgraded.

OPG has an adequate cyber security program that focuses on protecting systems and components that perform or impact functionality related to nuclear safety, nuclear security, and emergency preparedness.

### 3.3.13 Safeguards and Non-Proliferation

CNSC staff concluded that OPG met the applicable CNSC regulatory requirements and CNSC staff's expectations for the SCA Safeguards and Non-Proliferation at the PNGS in 2021.

CNSC staff determined that OPG implemented and maintained a program for accountancy and control of nuclear material at the PNGS in a satisfactory manner to comply with the applicable regulatory requirements of [REGDOC-2.13.1, \*Safeguards and Nuclear Material Accountancy\*](#). During the reporting period, OPG provided the required nuclear material accountancy and control reports to the CNSC and the IAEA for their safeguards verification activities.



OPG granted the required access and assistance to the IAEA for safeguards activities, including inspections, and for the maintenance of IAEA equipment at the PNGS. In 2021, the IAEA closed the outstanding issue relating to the inability of IAEA inspectors to adequately verify some spent fuel at PNGS due to accessibility issues which was first raised in 2017 as the result of an IAEA inspection in 2016. CNSC staff are satisfied with OPG's corrective actions. Discussions will continue with the IAEA on the resolution of accessibility to a small number of stacks of irradiated fuel bundles for which nuclear material will remain under IAEA seal and surveillance until it is available for verification in the future (e.g., during decommissioning activities).

OPG submitted the required annual operational programme with quarterly updates and the annual update to the Additional Protocol to CNSC staff in a timely manner. CNSC staff reviewed these documents and determined that they met requirements and expectations.

CNSC staff determined that OPG met the applicable regulatory requirements for safeguards equipment, containment, and surveillance in 2021 at the PNGS. In 2021, OPG provided the assistance required for the IAEA's safeguards equipment, containment, and surveillance activities, including inspections at the PNGS.

### **3.3.14 Packaging and Transport**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the Packaging and Transport SCA at PNGS in 2021.

The packaging and transport program was effectively implemented for PNGS and the transport of nuclear substances to and from the facility was conducted safely in 2021.

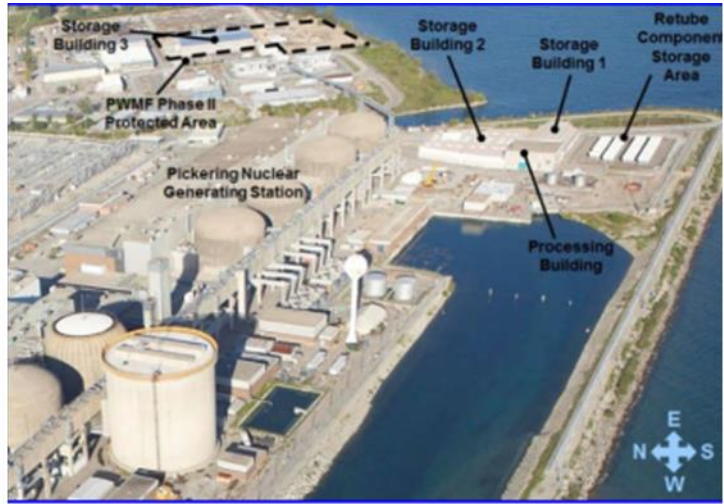
In 2021, CNSC staff conducted 2 field inspections of the PNGS packaging and transportation program. CNSC staff verified that contractors engaged in transport-related activities had valid training certificates, radioactive materials to be transported were appropriately classified and packaged, all safety markings were appropriately displayed on packages and the documentation accompanying the shipments was properly completed. No items of non-compliance were observed during the inspections.

There were no REGDOC-3.1.1 reportable events related to Packaging and Transport in 2021.

## 3.4 Pickering Waste Management Facility

### 3.4.0 Introduction

The CNSC regulates the PWMF under a waste facility operating licence (WFOL). At the PWMF, OPG processes and stores dry storage containers (DSCs) containing used nuclear fuel (high-level radioactive waste) generated at the PNGS. OPG also manages the intermediate-level radioactive waste generated from the refurbishment of the PNGS Units 1-4 in 36 above-ground dry storage modules (DSMs) located at the Retube Component Storage Area (RCSA) at the PWMF. With the exception of periodic inspection, monitoring, and maintenance of DSMs and the RCSA, there have been no operational activities for RCSA since 1993.



The PWMF spans over 2 separate areas - Phase I and Phase II - within the overall boundary of the Pickering site. Phase I is located within the protected area of the PNGS and consists of the DSC Processing Building, two DSC storage buildings (Storage Buildings #1 and #2) and the RCSA. Phase II of the PWMF is located northeast of Phase I and is contained within its own protected area, but within the boundary of the Pickering site. Phase II contains Storage Building #3 and #4. OPG's commissioning report for storage building (SB) #4 was reviewed and accepted by CNSC staff in 2021. The PWMF currently has the capacity to store 1,778 DSCs. The transfer route of the loaded DSCs from the PWMF Phase I to the PWMF Phase II is on OPG property.

Under the WFOL for the PWMF, OPG is authorized to construct 2 additional DSC storage buildings in Phase II (Storage Buildings #5 and #6) and 1 DSC processing building to replace the current DSC Processing Building. The additional storage buildings would allow OPG to store all of the used fuel generated at the PNGS to the end of its commercial operational life.

### Licensing

In April 2017, the [Commission renewed](#) the WFOL for the period April 1, 2018 to August 31, 2028.

## Compliance Program

CNSC staff did not conduct inspections at the PWMF in 2021. Due to COVID-19 Pandemic situation, a type II planned radiation protection inspection was deferred from 2020 and completed at the beginning of 2022. CNSC staff will consider the inspection completed in the safety assessments in next year's regulatory oversight report.

### 3.4.1 Management System

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Management System at the PWMF in 2021.

Changes to licensing-basis documents are reviewed by CNSC staff to ensure that OPG maintains its management system at the PWMF and that changes don't impact safety.

OPG has adequate contingency plans in place to maintain or restore critical safety and business functions in the event of disabling circumstances. In 2021, OPG continued to meet business continuity requirements in response to the COVID-19 pandemic.

### 3.4.2 Human Performance Management

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Human Performance at PWMF in 2021.

In 2021, there were no significant Human Performance observations to report for PWMF. OPG revised its human performance documentation to incorporate identified enhancements, and to reflect organizational changes, as well as changes to other governance. CNSC staff reviewed and are satisfied with OPG's revision. CNSC staff concluded that PWMF continued to implement its Human Performance program in accordance with the regulatory requirements.

CNSC staff review of OPG's 2021 PWMF quarterly and annual operations report did not result in non-compliant findings for the specific area of Personnel Training.

### 3.4.3 Operating Performance

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Operating performance at PWMF in 2021.

In total, OPG processed 61 Dry Storage Containers (DSCs) at the PWMF in 2021, which exceeded their target by one DSC. In 2021, OPG submitted all scheduled quarterly and annual reports as required and within the appropriate timelines. CNSC staff's reviews of OPG's operational reports did not identify any issues or situations that suggested that licensed activities at the PWMF were unsafe. The reviews also confirmed that OPG's reporting and trending, and its responses to comments and requests for follow-up information and clarification, met CNSC staff's expectations.

### 3.4.4 Safety Analysis

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations for the SCA Safety Analysis at the PWMF in 2021.

### 3.4.5 Physical Design

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff expectations, for the SCA Physical Design at the PWMF in 2021.

CNSC staff confirm that OPG maintains an effective design program and pressure boundary program, implements modifications to the facilities in accordance with established engineering control process to maintain the design basis. In 2021, OPG reported its design modification activities at the PWMF. CNSC staff reviewed and accepted OPG's proposal to reduce Dry Storage Container (DSC) lid-to-base weld height to 5/8 inch at PWMF.

PWMF continues to implement its fire protection program in accordance with CSA N393 requirements.

### 3.4.6 Fitness for Service

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Fitness for service at the PWMF in 2021.

As part of the aging management activities for DSCs, OPG submitted the aging management report for the PWMF. CNSC staff reviewed the submission and determined that it complied with OPG's aging management program.

### 3.4.7 Radiation Protection

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Radiation Protection at the PWMF in 2021.

CNSC staff's reviews of quarterly reports submitted by OPG and licensee responses to reportable events confirmed that:

- OPG did not exceed any action levels for dose to workers. The annual effective doses for all PWMF workers were well below the regulatory limit of 50 mSv
- OPG did not exceed any action levels for contamination control
- The perimeter dose rates at the PWMF were within OPG's targets and consistent with the results of the previous years
- Measures were implemented to ensure that the PWMF was compliant with regulatory requirements related to Radiation Protection

### **3.4.8 Conventional Health and Safety**

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Conventional health & safety at the PWMF in 2021.

In 2021, CNSC staff compliance verification activities did not identify any non-compliant findings relevant to conventional health and safety. OPG did not report any lost-time accidents at the PWMF.

### **3.4.9 Environmental Protection**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the Environmental Protection SCA at PWMF in 2021. OPG made adequate provision for the protection of the public and the environment.

CNSC staff reviews of quarterly and annual reports have not resulted in findings for the Effluent and Emission control SPA; releases remained well below the DRLs and Action Levels.

CNSC technical assessment (annual report) has not resulted in findings related to the Assessment and Monitoring SPA. Dose to the public remained low (2.0 uSv) which is in a similar range as previous years and shows that radionuclides concentrations measured in the environment remains low.

### **3.4.10 Emergency Management and Fire Protection**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Emergency Management and Fire Protection at the PWMF in 2021.

OPG has a facility emergency program for the PWMF. Main fire response is done by the Pickering Fire Department (PFD). To ensure familiarity with the facility, PFD staff train with the Pickering ERT at OPG's live fire training facility near Wesleyville, Ontario.

CNSC staff's review of the Commissioning Report for PWMF storage building 4, fire protection program audit identified no issues. Overall, OPG has an adequate Fire Protection Program (FPP) to minimize both the probability of occurrence and the consequences of fire at PWMF. The FPP comply with the CSA N393-13 requirements.

### **3.4.11 Waste Management**

CNSC staff concluded that OPG met the applicable regulatory requirements for the SCA Waste Management at the PWMF in 2021.

CNSC staff review of OPG's 2021 PWMF quarterly and annual operations report did not result in non-compliant findings for the SCA Waste Management.

### 3.4.12 Security

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the Security SCA at the PWMF in 2021.

CNSC staff reviewed the PWMF quarterly, annual operational reports, as well as the threat and risk assessment report, and confirmed that OPG met all the applicable regulatory requirements pertaining to all specific areas for the security SCA.

### 3.4.13 Safeguards and Non-Proliferation

CNSC staff concluded that OPG met the applicable CNSC regulatory requirements and CNSC staff's expectations, for the SCA Safeguards and Non-Proliferation at the PWMF in 2021.

CNSC staff determined that OPG's accountancy and control of nuclear material complied with the applicable regulatory requirements at the PWMF. OPG granted the required access and assistance to the IAEA for safeguards activities, including inspections and for the maintenance of IAEA equipment at the PWMF.

CNSC staff determined that OPG met the applicable regulatory requirements for operational and design information in 2021 at the PWMF. OPG provided the required operational and design information to facilitate IAEA safeguards activities.

OPG provided the assistance required for the IAEA's safeguards equipment, containment, and surveillance activities, including inspections. OPG supported the IAEA re-verification of a small number of DSCs due to the failure of IAEA equipment. The operator provided the support required to facilitate this IAEA activity.

### 3.4.14 Packaging and Transport

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Packaging and Transport at PWMF in 2021.

OPG maintains a packaging and transport program for the Pickering WMF that ensures compliance with the [Packaging and Transport of Nuclear Substances Regulations, 2015](#) and the [Transportation of Dangerous Goods Regulations](#).

No transport of nuclear substances were completed at the facility in 2021.

## 3.5 Bruce Nuclear Generating Station

### 3.5.0 Introduction

[Bruce A and Bruce B Nuclear Generating Stations](#) (BNGS A and B) are located on the shores of Lake Huron, in the Municipality of Kincardine, ON. The facilities are operated by Bruce Power under a lease agreement with the owner, Ontario Power Generation (OPG). The Bruce site lies within the traditional territory of the Anishinabek Nation: the peoples of the three fires known as Ojibway, Odawa, and Pottawatomie Nations, as well as the homeland of the Historic Saugeen Métis and the Métis Nation of Ontario. The Bruce region is also homeland to the Historic Saugeen Métis and to the Métis Nation of Ontario.



BNGS A station has 4 CANDU reactors with a gross power of 841 MWe (megawatts electrical) each (Units 1-4). BNGS B station has 4 CANDU reactors with a gross power of 872 MWe each (Units 5-8). 7 units were operational throughout 2021. Unit 6 at BNGS B was on planned Major Component Replacement (MCR) outage since January 2020.

This report groups the 2 stations together because BNGS A and B have 1 Power Reactor Operating Licence (PROL) and Bruce Power uses common programs at both stations.

The Western Waste Management Facility (WWMF) is also located at the same site. However, since it is operated by OPG under a different licence and is assessed separately in section 3.6 of this regulatory oversight report.

### Licensing

The PROL for BNGS A and B was [renewed](#) by the Commission in 2018 for a period of ten years. The licence, combined for both stations, is valid from October 1, 2018 to September 30, 2028. Licence renewal for period of ten years encompasses Bruce Power's operation, as well as activities related to the Major Component Replacement (MCR), which started in 2020 at Unit 6. One amendment was made to the BNGS A and B PROL (PROL 18.02/2028) during the reporting period in relation to the production of Cobalt-60 and Lutetium-177.

## Fisheries Act Authorization

In December 2019, [Fisheries and Oceans Canada](#) (DFO) issued a *Fisheries Act* authorization (FAA) for the ongoing operation of BNGS A and B. The authorization covers the death of fish through impingement and entrainment due to the water intakes that draw water from Lake Huron for the cooling water systems. The conditions of the FAA include monitoring and inspections, as well as maintenance of mitigation structures (velocity cap/chain rope barrier) at the water intake to reduce fish impingement.

Bruce Power submitted the 2021 annual report in accordance with its FAA. The 2021 report was the third in a series of annual reports that Bruce Power will be submitting until the authorization expires on December 31, 2028. The 2021 annual report indicated there were no failures in the avoidance and mitigation structures that required repair in 2021.

Both DFO and CNSC staff reviewed the results of fish impingement monitoring and maintenance of mitigation structures in 2021 and confirmed that Bruce Power met the conditions of the FAA for 2021.

## Periodic Safety Review

Bruce Power conducted a periodic safety review in support of its PROL renewal and the planned refurbishment of Units 3 to 8. Bruce Power also continued implementation of its integrated implementation plan (IIP) that identifies safety improvements.

Bruce Power's IIP was timely in implementing the plan during the reporting period. In 2022, CNSC staff reviewed Bruce Power's 2021 IIP annual report and confirmed that Bruce Power made acceptable progress on all IIP items.

In 2021, six planned IIP tasks were completed by Bruce Power and closed by CNSC staff. CNSC staff also reviewed four remaining IIP tasks from the previous year. Two remaining tasks were closed at the end of 2021. Two IIP items require additional information prior to accepting the work as complete. Table 17 summarizes the IIP tasks that were planned, completed, under review and closed, in 2021.

**Table 17: IIP Tasks Status (based on planned dates as of December 2021)**

IIP Task Status	Overall	2021
Planned by Bruce Power	191	8
Completed by Bruce Power	53	7
Closed by CNSC	44	8

UPDATE: In March 2022, Bruce Power submitted the 2021 IIP annual report. CNSC staff reviewed this update and confirmed that acceptable progress has been made on all IIP items. Seven IIP items were completed in 2021.



## Refurbishment

The MCR project involves Units 3 to 8 and started in January 2020 with Unit 6. The MCR project includes replacing major components such as the steam generators, fuel channels and feeders. Oversight of execution began in January 2020 with the Unit 6 MCR outage. Status updates on MCR are now a normal part of each update on the Status of Power Reactors which are presented at each Commission Meeting and will be included in each Regulatory Oversight Report until completed.

The MCR project has the following phases:

- *Preparation phase* – preparation works on reactor defueling, dewatering and bulkhead installation
- *Component removal* – removal of key components, including pressure and calandria tubes
- *Component installation* – installation of key components and the associated testing and quality control verifications to demonstrate fitness for service
- *Completion phase* – transition from the end of the installation phase to full-power operation of reactor

The removal phase of the Unit 6 MCR project was finished in the fall of 2021. Bruce Power has removed the feeders, end fittings, pressure tubes and calandria tubes. Steam generators were replaced during the 2021. Moderator and safety system work was also completed at the end of the year. Over the year, a number of inspections were conducted by CNSC staff on the maintenance work, chemistry-controlled conditions, contractor management and MCR construction. In response to CNSC staff findings in contractor management, Bruce Power implemented corrective actions to improve contractor performance. CNSC staff determined that addressing these issues during the year was adequate and will continue to monitor this area through future compliance activities.

UPDATE: The current projected completion for Unit 6 Calandria tube installation is June 2022, after which fuel channel installation begins. Upper feeder work continues with 55% of feeders installed. Other works including: Digital Control Computer (DCC) X replacement, valve work on the end shield cooling system and installation of permanent start-up instrumentation is in progress. To support the refilling of the moderator this fall, a few systems, including electrical and cooling water systems, have begun to return to service. It is expected that further systems will begin returning to service later in sprint of 2022 and into the summer. The current date for the first regulatory hold point (loading fuel) removal is February 2023.

## Compliance Program

The inspections at the BNGS A and B that were considered in this regulatory oversight report are tabulated in table 18 (inspection reports were included if they

were sent to Bruce Power by February 1, 2022). The Quarterly Type II inspections include 48 field inspections conducted at BNGS in 2021.

**Table 18: List of Inspection Reports at BNGS**

Safety and Control Area	Report Title	Report Issue Date
Management System	BRPD-AB-2021-09657 - IR - Problem Identification and Resolution - Type I Inspection at Bruce	June 2021
	BRPD-AB-2021-11391 - Report – Change Management	September 2021
	BRPD-MCR-2021-09704 - Report - T2 - INS-01-04 - Contractor Management	June 2021
Human Performance	BRPD-A-2021-09429 - Inspection Report - DI - Design, Development and Grading of a Written Requalification Test	June 2021
	BRPD-A-2021-09486 - Inspection Report - DI - Design, Development and Grading of Simulator Examinations and Written Requalification Tests - Bruce A CRSSIT Simulator Examination Inspection	August 2021
	BRPD-A-2021-11141 - Report - TII - Simulator based U0 CRO exam inspection	October 2021
	BRPD-A-2021-11786 REPORT DTI Design, Development and Grading of a U0 Control Room Operator Simulator-Based Certification Examination	January 2022
	BRPD-AB-2021-11059 - INSPECTION REPORT - Desktop Inspection Fuel Handling Training Program	October 2021
	BRPD-AB-2021-11240 - Report - TI - Fitness for Duty: Managing Worker Fatigue	February 2022
Operating Performance	BRPD-A-2021-09492 - Inspection Report - TII - Bruce A 2021 Unit 1 Planned Outage	June 2021
	BRPD-A-2021-10376- Inspection Report-TII-Bruce A	December 2021

Safety and Control Area	Report Title	Report Issue Date
	Unit 3 A2131 Planned Outage	
	BRPD-AB-2021-10575 - Report - Bruce Safe Operating Envelope - Type II Inspection at Bruce	September 2021
	BRPD-AB-2021-10343 - INSPECTION REPORT - Quarterly Field Inspection Summary Report Q1 2021-22	June 2021
	BRPD-AB-2021-11255 - INSPECTION REPORT - Quarterly Field Inspection Summary Report Q2 2021-22	December 2021
	BRPD-AB-2021-12349 - INSPECTION REPORT - quarterly Field Inspection Summary Report Q3 2021-22	December 2021
	BRPD-AB-2021-09455 - INSEPTION REPORT - Quarterly Field Inspection Summary Report for Q4 2020-21	June 2022
Physical Design	BRPD-AB-2021-08767 - Inspection Report - TII - Environmental Qualification	May 2021
	BRPD-MCR-2021-11580 Report: Type II Compliance Inspection - U6 MCR Construction Installation and Special Process	January 2022
Fitness for Service	BRPD-A-2021-09156 - TII - System Inspection - ECI	March 2021
	BRPD-B-2021-10967 - Report – TII – Type II Emergency Coolant Injection System Inspection	September 2021
	BRPD-AB-2021-10202 - Report - TII – Reliability	September 2021
	BRPD-AB-2021-11649 - Inspection Report - TII - Software Maintenance	January 2022
	BRPD-B-2021-11967- Inspection Report-TII-System Inspection-Shutdown System	November 2021

Safety and Control Area	Report Title	Report Issue Date
	#1 (SDS1)	
	BRPD-MCR-2021-08823 - Inspection Report - Unit 6 Maintenance Planning and Scheduling	April 2021
	BRPD-MCR-2021-08159 - Inspection Report - TII - Maintenance Work Execution	May 2021
	BRPD-MCR-2021-09303 - Inspection Report - TII - Chemistry Controlled Lay-Up Conditions	May 2021
Radiation Protection	BRPD-AB-2021-11909 - Report - TII - Worker Dose Control	December 2021
Environment Protection	BRPD-AB-2021-11428 - Inspection Report - TII - Hazardous Waste Management	December 2021

### 3.5.1 Management System

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Management System at BNGS A and B in 2021.

CNSC staff concluded that Bruce Power is compliant with the requirements of CSA N286-12, *Management system requirements for nuclear facilities*. Bruce Power's organizational structure is adequately defined, and roles and responsibilities are documented. Bruce Power submitted, through [REGDOC-3.1.1](#) reports, information about organizational changes which were found to be acceptable by CNSC staff.

During 2021 management system focused inspections, as well as other inspections with management system components, some findings of low safety significance were identified. The findings were in the management system, records management, change management, management of contractors and performance assessment, improvement, and management review specific areas. CNSC staff determined that adequate corrective actions have been or are being implemented by Bruce Power. CNSC staff are monitoring the full implementation of outstanding corrective actions. The non-compliances that were identified during field inspections were promptly addressed by Bruce Power before the quarterly inspection reports were issued. CNSC staff recommendations issued following the inspections were taken into consideration or addressed.

Due to the COVID-19 pandemic, Bruce Power submitted a request that the nuclear safety and security culture assessment (NSSCA), planned for 2021, be

deferred until 2022. Following submission of key milestones related to the NSSCA by Bruce Power, CNSC staff approved the deferral, on the basis that Bruce Power retain the 5-year periodicity for the conduct of NSSCA required by [REGDOC-2.1.2, Safety Culture](#), with NSSCAs being carried out in 2022 and 2026.

Bruce Power continued to meet business continuity requirements. Throughout 2021, Bruce Power submitted 15 event reports related to business continuity in response to the COVID-19 pandemic. CNSC staff reviewed the event reports and found that Bruce Power took adequate corrective actions and has adequate measures in place relating to business continuity in the event of disabling circumstances such as a pandemic, severe weather, or labour actions.

Throughout 2021, Bruce Power continued to update its management system documentation as part of its efforts to implement an updated management system structure. CNSC staff reviewed those changes for compliance with applicable requirements during the year and made recommendations to improve the governance. All recommendations were satisfactorily addressed by Bruce Power. CNSC staff plan to conduct a compliance verification activity following Bruce Power's full implementation of its updated management system.

### **3.5.2 Human Performance Management**

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Human Performance at BNGS A and B in 2021.

CNSC staff identified 9 findings of negligible and 5 findings of low safety significance. The Low findings in Personnel Training and Personnel Certification were addressed through the year or adequate corrective actions are being implemented by Bruce Power. CNSC staff are monitoring the full implementation of outstanding corrective actions.

There were two event reports regarding Bruce Power being below minimum complement at BNGS A and B due to sudden sickness of staff and family emergency, and one event report regarding the shift complement qualification expiration. CNSC staff have reviewed the event reports and were satisfied with Bruce Power's corrective actions to resolve these issues and prevent reoccurrence of these events.

Bruce Power reports non-compliances with hours of work limits by certified staff to the CNSC quarterly in a timely manner, and these reports were compliant with the [REGDOC-3.1.1](#) reporting requirements.

### **3.5.3 Operating Performance**

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations for the SCA Operating performance at BNGS A and B in 2021.

Bruce Power continued to operate both stations in a safe manner within the bounds of the operating policies and operational safety requirements. All reactor

units operated at the conditions prescribed by Power Reactor Operating Licence (PROL) within the power limits identified in the licence conditions handbook (LCH) for BNGS A and B. Operating practices observed during the year were adequate and effective.

In 2021, BNGS A experienced no automatic trips, one stepback and two setbacks. BNGS B experienced no trips, no stepbacks and two setbacks. There was no impact on reactor safety. CNSC staff confirmed that Bruce Power staff followed approved procedures and took appropriate corrective actions for all transients and power reductions. The reactor trips performance against the target for 2021 was better than industry performance target (0.0 for BNGS A and 0.0 for BNGS B). All BNGS A and B units met WANO's PHWR target of 1.0 trip per 7,000 hours of operation. All transients were controlled properly, and power reduction was automatically initiated by the reactor control systems.

In 2021, BNGS A experienced one forced outage (at Unit 1). BNGS B experienced two forced outages (at Unit 7 and 8). All forced outages were manual, and they were mainly caused by events related to service equipment. CNSC staff concluded that all forced outages were adequately followed up by Bruce Power.

In 2021, BNGS A had two planned outages (at Unit 1 and 3) and BNGS B had no major planned outages. CNSC staff conducted compliance inspections on these planned outages and confirmed that all outage-related undertakings, such as reactor shutdown guarantees, and heat sink strategy management were performed safely by Bruce Power. CNSC staff concluded that all planned outages were followed up appropriately.

CNSC staff performed a safe operating envelope (SOE) inspection of BNGS A and B containment parameters. CNSC staff determined that SOE limits were compliant with SOE limits and conditions. However, the inspection identified that the uncertainties are not adequately considered and incorporated; delays in the production or update of SOE documentation were also observed. CNSC staff continue monitoring Bruce Power's corrective actions to address these issues.

All REGDOC-3.1.1 scheduled reports were submitted in a timely manner and were compliant with the reporting requirements. The trend of safety performance indicators for 2021 is stable and currently has improved from the historic values. During 2021, Bruce Power submitted to CNSC 89 REGDOC-3.1.1 event reports, comparable with the average number from previous years. There were five late event reports at BNGS A and B delayed due to internal miscommunication at Bruce Power. All reported events were followed up by Bruce Power and were supported with adequate root cause analysis, when appropriate. CNSC staff found, in each event report where corrective actions were proposed, that Bruce Power's corrective action plan were satisfactory and continue to monitor Bruce Power's progress to implement corrective measures.

### 3.5.4 Safety Analysis

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Safety Analysis at BNGS A and B in 2021.

CNSC staff concluded that Bruce Power had a well-managed program on conducting deterministic safety analysis and is adequately implementing [REGDOC-2.4.1, \*Deterministic Safety Analysis\*](#). There were only compliant findings in the deterministic safety analysis SpA from the related inspections conducted by CNSC staff in 2021.

CNSC staff determined that Bruce Power's criticality safety program is comprehensive, complete and compliant with the requirements of [RD-327, \*Nuclear Criticality Safety\*](#). There were no criticality events and no ongoing issues identified at BNGS A and B during 2021 and no change to the status of the booster fuel assemblies in storage. In 2021, CNSC staff continued review of the Bruce Power's Unit 6 MCR safety analysis submissions. The purpose of the MCR safety analysis is to demonstrate that the reactor can be restarted safely following the MCR outage.

In December 2021, Bruce Power submitted its Regulatory Communication Plan (RCP) for Probabilistic Safety Assessment (PSA) 2024 update. CNSC staff concluded that there are no significant non-compliances against REGDOC-2.4.2 requirements. On CNSC staff request, Bruce Power provided additional clarifications in the area of Level 1 At-Power PSA. CNSC staff are now reviewing Bruce Power's responses.

Considering some new data and developments in seismic hazard modelling, which could potentially affect seismic hazard estimates, CNSC staff requested Bruce Power update their seismic hazard assessment as part of the 2024 PSA update. In 2021, Bruce Power committed to update the Probabilistic Seismic Hazard Assessment and the Seismic Hazard Characterization in the next revision of 2024 Bruce seismic PSAs.

CNSC staff completed the review of Bruce Power's PSA update and concluded that it was compliant with REGDOC 2.4.2. Bruce Power fully implemented REGDOC 2.4.2 in accordance with the implementation plan included in its LCH.

The PSA update included the BNGS A Internal Fires PSA where the Large Release Frequency (LRF) met the safety goal, but was above the administrative target. Bruce Power credited Very Early Smoke Detection Apparatus (VESDA), which improved the LRF; however, it was still slightly above the administrative target. As per the Bruce Power's PSA governance, Bruce Power is to perform an identification and a review of the proposed mitigation strategies to identify cost effective improvements which can be implemented as part of Business Risk Management, in order to reduce the LRF value below the administrative target. In 2021, Bruce Power did not provide its plans to improve the PSAs for internal fire risk, therefore, the Commission action to report on enhancements remains open until these plans are submitted.

As per the Bruce Power's procedure on PSA, Bruce Power is to perform an identification and a review of the proposed mitigation strategies to identify cost effective improvements which can be implemented, in order to reduce the LRF value below the administrative target.

In 2021, Bruce Power did not provide its plans to improve the PSAs for internal fire risk, therefore, the Commission action to report on enhancements remains open until these plans are submitted.

### 3.5.5 Physical Design

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations for the SCA Physical Design at the BNGS A and B in 2021.

Bruce Power continued to implement and maintain a design program at BNGS A and B to confirm that safety-related systems, structures and components, and any modifications to them, continue to meet their design basis given new information arising over time and to confirm that SSCs continue to be able to perform their safety functions under all plant states, in accordance with the conditions prescribed in the PROL and LCH.

CNSC staff confirmed that Bruce Power operated its units within the applicable fuel power limits, the fuel condition was satisfactory, and fuel has been operated safely in 2021. The fuel design and inspection program met the regulatory requirements and performance expectations at BNGS A and B. Both stations met the expectations for fuel bundle inspections.

CNSC staff concluded that Bruce Power continued to meet the applicable Environmental Qualification (EQ) requirements of CSA standard N290.13-05, *Environmental qualification of equipment for CANDU nuclear power plants* for BNGS A and B in 2021.

CNSC staff conducted a compliance inspection on EQ and confirmed compliance for the sample of EQ barriers and assessments; however, non-compliances with the governance were observed related to EQ documentation updates. CNSC staff are satisfied with Bruce Power's corrective actions in response to these non-compliances.

The fire protection measures at Bruce Power are controlled and coordinated to meet regulatory requirements. CNSC staff concluded that Bruce Power continues to implement its Fire protection program at BNGS A and B in accordance with the requirements of CSA N293-12, *Fire protection for CANDU nuclear power plants*.

In 2021, BNGS A experienced one reportable event of a small fire in Unit 0 and BNGS B experienced two reportable events of small fires at Unit 6 undergoing MCR. One was related to welding work, and one was related to a switchyard Hydro One lunch trailer. CNSC staff have reviewed these event reports and are satisfied with Bruce Power's corrective actions in response to the events.



### 3.5.6 Fitness for Service

CNSC staff concluded that BNGS A and B met the performance objectives and applicable regulatory requirements with the exception of elevated hydrogen equivalent concentration (Heq) in pressure tubes, for the SCA Fitness for Service in 2021.

CNSC staff determined that the reliability program at BNGS A and B met the requirements described [in REGDOC-2.6.1, Reliability Programs for Nuclear Power Plants](#). CNSC staff conducted a Type II inspection for the Reliability Program at Bruce A and B in 2021 with one notice of non-compliance that shall be reflected in 2022 ARR.

For BNGS A and B, all special safety systems met their Predicted Unavailability Targets in 2021. However, BNGS A Emergency Core Injection System, BNGS B Emergency Core Injection System, and BNGS B Negative Pressure Containment System exceeded the Actual Past Unavailability (APU) Target. However, there were no impact on nuclear safety from these events causing the APU and which have been addressed through Bruce Power's corrective action process. CNSC staff follow up on the effectiveness of Bruce Power's corrective actions. In 2021, CNSC staff conducted numerous maintenance-related inspections that confirmed that maintenance program at BNGS A and B consistently met the applicable regulatory requirements.

BNGS A and B continuously reduced the critical deficient maintenance backlog and reached the industry average. In 2020, the average preventive maintenance completion ratio fell from 90% to approximately 87% and 85% for BNGS A and B respectively. CNSC staff noted that in 2021 the preventive maintenance completion ratio at both BNGS A and B has recovered to above 93%.

Bruce Power's maintenance program met the applicable regulatory requirements at both stations. BNGS A and B maintained both the critical corrective maintenance backlog and the number of critical preventive maintenance deferrals very low. The corrective critical maintenance backlog, deficient critical maintenance backlog and the number of critical preventative maintenance deferrals are given in tables 19 and 20.

**Table 19: Trend of maintenance backlogs and deferrals for critical components for BNGS A, 2019 to 2021**

Parameter	Average quarterly work orders per unit			Three year trending	Quarterly 2021 work orders per unit				Industry average for 2021
	2019	2020	2021		Q1	Q2	Q3	Q4	
Corrective maintenance backlog	1	1	0	steady	0	0	0	0	1
Deficient maintenance	10	5	6	down	12	6	2	4	4

backlog									
Deferrals of preventive maintenance	0	1	0	steady	0	0	0	0	2

**Table 20: Trend of maintenance backlogs and deferrals for critical components for BNGS B, 2019 to 2021**

Parameter	Average quarterly work orders per unit			Three year trending	Quarterly 2021 work orders per unit				Industry average for 2021
	2019	2020	2021		Q1	Q2	Q3	Q4	
Corrective maintenance backlog	0	0	0	steady	0	0	0	0	1
Deficient maintenance backlog	11	2	2	down	3	3	3	1	4
Deferrals of preventive maintenance	0	0	0	steady	0	1	0	0	2

Bruce Power continues to implement activities for aging management of structures, systems and components (SSCs) within a systematic and integrated framework in accordance with CNSC [REGDOC-2.6.3, Aging Management](#).

CNSC staff determined that Bruce Power's chemistry control program met the applicable requirements. Bruce Power maintained acceptable system chemistry performance in 2021. The two non-compliances of negligible safety significance, identified at field inspections for units undergoing extended outages, were promptly addressed. BNGS A has improved its Chemistry Compliance Index (CCI) performance over 2021 due to improved compliance with its D2O moderator specifications.

The Fuel Channel Life Cycle Management Plan met its objectives of identifying degradation in pressure tubes.

The main pressure tube (PT) issue is elevated hydrogen equivalent concentration (Heq) near the outlet and inlet rolled joints that exceeded the licensing limit of 120 ppm. This demonstrates that current Heq uptake models do not accurately predict hydrogen diffusion near the rolled joints and the material fracture toughness at these locations cannot be confirmed at this time. Furthermore, models used to predict crack initiation for flaws must be validated for higher levels of Heq. A compensatory measure for the outlet end of PTs was implemented and accepted by the Commission. Bruce Power is addressing the

elevated Heq at the inlet end of PTs and this issue will be discussed separately in a Commission meeting.

### 3.5.7 Radiation Protection

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Radiation Protection at BNGS A and B in 2021.

For the application of ALARA at the BNGS A and B sites in 2021 CNSC staff determined that Bruce Power was compliant with requirements and met CNSC staff performance expectations. Bruce Power's commitment to the ALARA principle has been demonstrated through the ALARA program implemented at BNGS A and B. ALARA planning, shielding and specialized tooling are used to reduce occupational exposures, and to maintain worker dose ALARA. In 2021, Bruce Power continued to implement a Five-Year Dose Reduction Plan for BNGS A and B which incorporates ALARA initiatives that are expected to reduce collective dose. On-going ALARA initiatives are documented, tracked, and have assigned owners.

CNSC staff determined that Bruce Power was compliant with regulatory requirements for worker dose control at the BNGS A and B in 2021. In 2021, Bruce Power maintained worker doses below the regulatory dose limits (refer to table and figures in Section 2) and ensured continuous tracking of individual and collective doses during normal operations, execution of maintenance outages, and during the execution of Major Component Replacement (MCR) activities at Unit 6. CNSC staff noted that there were no adverse trends or safety significant unplanned exposures at BNGS A and B. There were no action level exceedances at BNGS A and B due to unplanned exposures. The overall performance in the area of worker dose control met CNSC staff expectations during normal operations, maintenance outages, and during execution of MCR 6 activities.

CNSC staff confirmed that Bruce Power continually measured the performance of its radiation protection program against industry-established objectives, goals, and targets. In 2021, Bruce Power's self-assessments and benchmarking activities identified improvements to its radiation protection (RP) program to protect health and safety of workers and to monitor and control radiation hazards (including alpha hazard). Several implementing procedures of Bruce Power RP program have been or are being updated to streamline their governance and to reflect recent amendments to the CNSC [Radiation Protection Regulations](#) (RPRs).

CNSC staff determined that Bruce Power implemented controls for radiological hazards at BNGS A and B that met the regulatory requirements. Bruce Power's radiation protection program ensures that there are measures in place to monitor and control radiological hazards including contamination control, dose rate control, and airborne radiation monitoring and control. Bruce Power also undertakes continuous tracking of RP performance metrics, including ongoing monitoring of unplanned exposures, personal contamination events, worker dose and dose rate alarms, low-level tritium exposures and other internal radiation

exposures (including alpha). The RP performance metrics are reported to different stakeholders including Bruce Power ALARA committees and shared with CNSC staff on a regular basis.

### 3.5.8 Conventional Health and Safety

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations for the SCA Conventional Health and Safety at BNGS A and B in 2021.

Bruce Power is compliant with the relevant requirements of the “Occupational Health and Safety Act of Ontario”, the “Labour Relations Act”, and Bruce Power’s “Occupational Health and Safety Policy”. The conventional health and safety conditions at BNGS A and B continued to achieve a high degree of personnel safety. BNGS A and B staff adequately identified workplace hazards in 2021.

All minor procedural non-compliances, identified during CNSC field inspections, related to the posting of barriers and signage, up-to-date inspection tags and housekeeping were promptly and adequately addressed by Bruce Power before the quarterly inspection reports were issued. There were no significant reportable issues in this area during the reporting year.

The ASR for the BNGS A and B decreased from 1.14 in 2020 to 0.13 in 2021 and it is notably less than 5-year average value. The AF for the BNGS A and B decreased from 0.3 in 2020 to 0.23 in 2021 and it is less than 5-year average value. The Number of Calendar Days lost at BNGS A and B decreased significantly from 49 in 2020 to 5 in 2021 due to effective prevention of work injuries. Accident Rate (ISAR) slightly increased from 0.02 in 2020 to 0.03 for 2021 BNGS A and B due to 5 days lost in Q1.

### 3.5.9 Environmental Protection

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations for the Environmental Protection SCA at BNGS A and B in 2021. Bruce Power made adequate provision for the protection of the environment and health of persons.

CNSC staff conducted a variety of compliance assessments, technical assessments, and inspections to verify compliance of all outputs associated with the Environmental Protection SCA. Environmental releases were well below the DRLs for BNGS A and B in 2021. No radiological releases to the environment from the facility exceeded the regulatory limits. CNSC staff verified that the Bruce Power environmental management program effectively prevents and mitigates adverse environmental impacts at BNGS A and B, and was in compliance with [REGDOC-2.9.1, Environmental Protection: Environmental Principles, Assessments and Protection Measures](#), Version 1.2.

Bruce Power met applicable release authorizations issued by Ontario, resulting in only negligible risks posed to human health and the environment from releases of non-radiological (hazardous) substances from operations at BNGS A and B.

Bruce Power's monitoring, analysis and reporting of environmental data was well developed and consistently implemented. Results from CNSC staff assessments of the quarterly and annual reports determined that Bruce Power had met regulatory requirements.

In 2021, CNSC staff reviewed the Annual Report on Environmental Protection and concluded that it met all reporting requirements outlined in [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants](#). The dose to the public from the Bruce site (0.0016 mSv) remained well below the regulatory limit of 1 mSv/yr, and in the similar range to previous year, which shows that radionuclides concentrations measured in the environment remains low.

Bruce Power continued to implement and maintain an effective environmental risk assessment (ERA) and management program at the BNGS A and B in 2021. The existing ERA remains compliant with CSA N288.6-12, *Environmental risk assessments at Class I nuclear facilities and uranium mines and mills*, and it is demonstrated that there is no unreasonable risk to the environment posed by the operation of BNGS A and B.

### 3.5.10 Emergency Management and Fire Protection

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Emergency Management and Fire Protection at the BNGS A and B in 2021. Bruce Power has sufficient provisions for preparedness and response capability to mitigate the effects of accidental releases of nuclear and hazardous substances on the environment and protect the health and safety of persons.

In 2021, CNSC staff has reviewed Bruce Power's update on compliance with [REGDOC-2.10.1, Nuclear Emergency Preparedness and Response](#), Version 2. CNSC staff is satisfied with Bruce Power's conclusion that they comply with REGDOC-2.10.1, Version 2 requirements.

Only compliant findings were identified at numerous field inspections in 2021. There were no significant reportable issues on this area during the reporting year.

CNSC conducted a review of a quarterly update on plant data transfer system implementation submitted in March 2021 and concluded that Bruce Power has made sufficient progress in implementing this system such that further quarterly update submissions are no longer required.

The Bruce Power's project on radio system replacement continued on-schedule in 2021. CNSC staff were satisfied with the project's progress, which entailed installation of radio hardware/software as well as HVAC upgrades to rooms housing sensitive electronic equipment.

Bruce Power has an extensive fire drill and training program. All minor procedural non-compliances, identified during field inspections, related to the fire protection equipment availability requirements were promptly and adequately addressed by Bruce Power before the quarterly inspection reports were issued. CNSC staff also reviewed Bruce Power's submission, which provided the 2020

third party fire protection program audit and evaluation of industrial fire brigade drill reports and found the reports to be acceptable.

### 3.5.11 Waste Management

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations for the SCA Waste Management BNGS A and B in 2021.

Bruce Power continued to implement effective programs for the characterization of radioactive and hazardous wastes during 2021. CNSC staff confirmed through the field inspections that Bruce Power complied with the applicable regulatory requirements for waste management practices associated with waste transfer documents. Minor procedural non-compliances on the radioactive waste control and minimization, identified at these inspections, were promptly addressed by Bruce Power before the quarterly inspection reports were issued. There were no significant reportable issues on this area during the reporting year.

The safety performance indicator (SPI) Low and Intermediate level Radioactive Solid Waste Generated for BNGS A and B in 2021 had no deviations from the historic values.

### 3.5.12 Security

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations, for the Security SCA at the BNGS A and B in 2021.

CNSC staff reviewed the annual site security report and threat and risk assessment, as well as quarterly operational safety reports for Bruce Power and found them acceptable. COVID-19 restrictions necessitated deferrals of physical fitness/medical/firearms certification renewals and site security clearances, as well as a postponement of scheduled 2021 Force on Force (FOF) exercise. The CNSC staff inspections conducted confirmed that security practices continued to be compliant with applicable regulatory requirements.

The events reported by Bruce Power were deemed not safety or security significant. Performance information from the quarterly operational safety reports and the Bruce Power's drill and exercise program met CNSC staff expectations.

Bruce Power has an adequate cyber security program that focuses on protecting systems and components that perform or impact functionality related to nuclear safety, nuclear security, and emergency preparedness. In 2021, CNSC staff reviewed Bruce Power's submission providing an update regarding implementation of CSA N290.7-14 *Cyber security for nuclear power plants and small reactor facilities*. CNSC concluded that Bruce Power has completed all activities associated with the implementation milestones, except for some field work associated with the "Design and Implementation of Cyber Security Controls" milestone.

### 3.5.13 Safeguards and Non-Proliferation

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations for the Safeguards and Non-Proliferation SCA at the BNGS A and B in 2021.

CNSC staff determined that Bruce Power implemented and maintained a program for accountancy and control of nuclear material at BNGS A and B in a satisfactory manner to comply with the applicable regulatory requirements of [REGDOC-2.13.1, \*Safeguards and Nuclear Material Accountancy\*](#). During the reporting period of 2021, Bruce Power provided the required nuclear material accountancy and control reports to the CNSC and the IAEA for safeguards verification activities. Bruce Power submitted the required annual operational programme with quarterly updates and the annual update to the Additional Protocol to the CNSC in a timely manner. The CNSC reviewed these documents and determined that they met applicable regulatory requirements and staff expectations.

Bruce Power granted the required access and assistance to the IAEA for safeguards activities, including inspections and for the maintenance of IAEA equipment onsite. During the IAEA's annual physical inventory verifications in 2020, the inspectors were not able to meet their objectives for some spent fuel assemblies as several stacking frames randomly selected in the secondary bays were only partially accessible by the IAEA's verification equipment. After discussions with CNSC and Bruce Power staff, the IAEA performed additional verification activities during their planned 2021 inspection and closed this action.

CNSC staff determined that Bruce Power met the applicable regulatory requirements for safeguards equipment, containment, and surveillance in 2021. In 2021, Bruce Power provided the assistance required for the IAEA's safeguards equipment, containment, and surveillance activities, including inspections. In 2021, there were only compliant findings from field inspections at BNGS A and B related to safeguards equipment, containment and surveillance and Access and assistance to the IAEA.

### 3.5.14 Packaging and Transport

CNSC staff concluded that Bruce Power met the applicable regulatory requirements and CNSC staff expectations for the SCA Packaging and Transport at BNGS A and B in 2021.

The packaging and transport program was effectively implemented for BNGS A and B and the transport of nuclear substances to and from the facility was conducted safely in 2021.

In 2021, CNSC staff conducted 2 inspections of the packaging and transportation program. CNSC staff verified that contractors engaged in transport-related activities had valid training certificates, radioactive materials to be transported were appropriately classified and packaged, all safety markings were appropriately displayed on packages and the documentation accompanying the shipments was properly completed. No items of non-compliance were observed

during the inspections. There were three packaging and transport related events reported by Bruce Power in 2021. The events were not safety significant and CNSC staff are satisfied with the corrective actions taken by Bruce Power.



## 3.6 Western Waste Management Facility

### 3.6.0 Introduction

The CNSC regulates the WWMF under a waste facility operating licence (WFOL) and the nearby RWOS-1 under a waste nuclear substance licence (WNSL). The WWMF and RWOS-1 are owned and operated by OPG.

At the WWMF, OPG processes and stores dry storage containers (DSCs) containing used nuclear fuel (high level radioactive waste) generated at Bruce A and B.

At this facility, OPG also manages the low and intermediate-level radioactive wastes (L&ILW) generated from the operation of OPG-owned facilities. In addition to receipt of low- and intermediate-level wastes from BNGS, the WWMF receives transfers of low- and intermediate-level wastes from the Pickering and Darlington sites, for the processing and storage of those wastes. OPG also manages the L&ILW generated from the BNGS A and B Major Component Replacement at the WWMF.

The WFOL for the WWMF allows limited activities of import and export of nuclear substances, which occur primarily as contaminants in laundry, packaging, shielding or equipment.

The WFOL spans 2 separate areas - the L&ILW Storage Facility and the Western Used Fuel Dry Storage Facility (WUFDSF) - within the overall boundary of the Bruce site.

The L&ILW Storage Facility consists of the Waste Volume Reduction Building; the Transportation Package Maintenance Building; 14 above-ground, low-level storage buildings (LLSBs), 2 above-ground, refurbishment waste storage buildings; and various in-ground containers, trenches, and tile holes for the storage of ILW.

The WUFDSF is located within its own protected area, separate from the protected area of Bruce A and B, but within the boundary of the Bruce site.

The WUFDSF contains 1 DSC processing building and 4 DSC storage buildings (Storage Buildings #1, #2, #3, and #4). The WWMF currently has the capacity to store 2,000 DSCs. The transfer of loaded DSCs from Bruce A and B to the WWMF is conducted on property controlled by Bruce Power and OPG. In 2021,



OPG constructed two additional DSC storage buildings (Storage Buildings #5 and #6).

Under the WFOL for the WWMF, OPG is authorized to construct 2 additional DSC storage buildings (Storage Buildings #7 and #8), 11 additional LLSBs, 270 additional in-ground containers, 30 in-ground containers for heat exchangers, 1 large object processing building, and 1 waste sorting building. The new structures will provide additional storage for used nuclear fuel and additional storage to manage L&ILW.

At RWOS-1, OPG stores L&ILW generated at the Douglas Point Nuclear Generating Station and PNGS Units 1-4. The RWOS-1 site is comprised of a number of in-ground waste storage structures, including concrete-lined trenches and steel-lined concrete holes.

The RWOS-1 site is no longer receiving waste and is in a state of storage with surveillance by OPG.

## Licensing

The [Commission renewed](#) the WFOL for the WWMF in May 2017 for a period of 10 years until May 31, 2027. The WNSL for RWOS-1, issued under a Designated Officer, is valid until October 31, 2029.

## Compliance Program

The inspections at the WWMF that were considered in this regulatory oversight report are tabulated in table 21 (inspection reports were included if they were sent to OPG by February 1, 2022).

**Table 21: List of Inspection Reports at WWMF**

Safety and control area	Inspection title	Inspection report sent date
Management System	Management System Inspection: OPG-WWMF-2020-02	April 2021
Operating Performance	General Inspection: OPG-WWMF-2020-01	April 2021

### 3.6.1 Management System

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Management System at the WWMF in 2021.

OPG took measures to ensure that their management system met the regulatory requirements and took appropriate corrective actions to address deficiencies identified during a CNSC Type II management systems inspection to CNSC staff's satisfaction.

During that inspection, CNSC staff found that OPG conducted self and independent assessments and management systems reviews regularly. CNSC staff also found the following areas of non-compliance:

- 1) Lessons learned from the recent outages were not disseminated to workers
- 2) Some documents associated with licensee programs and associated implementing procedures did not provide clear direction to staff or were not revised as per requirements
- 3) Some documents were not kept secure to prevent destruction (fire, water)

As a result of the inspection findings, OPG has taken adequate corrective actions to address the deficiencies identified during the inspection. CNSC staff are satisfied with OPG's corrective actions.

OPG has adequate contingency plans in place to maintain or restore critical safety and business functions in the event of disabling circumstances.

### **3.6.2 Human Performance Management**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Human Performance at WWMF in 2021.

CNSC staff review of OPG's 2021 WWMF quarterly and annual operations report did not result in non-compliant findings for the specific area of Personnel Training. During a type II inspection, CNSC staff verified that OPG was compliant with the requirements of their training procedures, regarding worker qualifications.

For the WWMF, there were 5 events reported to the CNSC in 2021, including undocumented monthly inspection of fire doors. CNSC staff reviewed the events and verified that there were no Human Performance implications.

There were no significant Human Performance observations to report for WWMF in 2021. In 2021, OPG revised its human performance documentation to incorporate identified enhancements, and to reflect organizational changes as well as changes to other governance. CNSC staff reviewed and are satisfied with OPG's revision. CNSC staff concluded that WWMF continued to implement its Human Performance program in accordance with requirements.

### **3.6.3 Operating Performance**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Operating performance at WWMF in 2021.

In 2021, OPG processed a total of 128 Dry Storage Containers (DSCs) at the WUFDSE. The total volume of radioactive waste received at the Western Low and Intermediate Level Waste Storage Facility (WLILWSF) in 2021 was 4,360.7 m<sup>3</sup>. During 2021, the incinerator operated for 209.5 days on solids and 236 days on liquids. In 2021, OPG submitted all scheduled quarterly and annual reports as required and within the appropriate timelines.

CNSC staff's reviews of OPG's quarterly and annual reports did not identify any issues or situations that suggested that licensed activities at the WWMF were unsafe. The reviews also confirmed that OPG's reporting and trending, and its responses to comments and requests for follow-up information and clarification, met CNSC staff's expectations.

RWOS-1 is in a state of care and maintenance; no waste was placed in or removed from RWOS-1 in 2021.

### 3.6.4 Safety Analysis

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations for the SCA Safety Analysis at the WWMF in 2021.

In 2021, CNSC staff completed their reviewed the safety analysis summary for transfer, handling, and storage of the Bruce Power MCR for retube and steam generator waste for Unit 6 and Unit 3. The safety assessment evaluated the impact of the retube waste containers and steam generators on the WWMF safety assessment under normal operations and considered accidents and malfunctions. CNSC staff were satisfied with OPGs disposition of their comments.

### 3.6.5 Physical Design

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff expectations, for the SCA Physical Design at the WWMF in 2021.

CNSC staff conclude that OPG maintains an effective design program and pressure boundary program and implements modifications to the facilities in accordance with established engineering control process to maintain the design basis. OPG reported their design modifications activities in 2021 at the WWMF. CNSC staff reviewed and accepted OPG's proposal to reduce Dry Storage Container (DSC) lid-to-base weld height to 5/8 inch at WWMF.

At the WWMF, the following activities were completed:

- 1) Construction of the non-security scope of Used Fuel Dry Storage Buildings 5 and 6
- 2) Installation of a new overhead door on Used Fuel Dry Storage Building 2
- 3) Installation of the Liner Heat Detection Project in Low Level Storage Buildings (LLSB). OPG also commenced construction/installation of new IC-18's (inground storage containers)

As part of CNSC's ongoing compliance verification activities, CNSC staff identified that required monthly fire doors inspections were not being documented. OPG took appropriate corrective actions to address the situation and to prevent reoccurrence. Furthermore, OPG provided an acceptable revised completion plan for the Fire Detection Project of the Low-Level Storage Buildings (LLSB) 1-11 associated with the Fire Hazard Assessment

recommendations. CNSC staff conclude that WWMF continues to implement its Fire protection program in accordance with CSA N393 requirements.

### 3.6.6 Fitness for Service

As part of the aging management activities for DSCs, OPG submitted the aging management report for the OPG WWMF. CNSC staff reviewed the submission and determined that it complied with OPG's aging management program.

### 3.6.7 Radiation Protection

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Radiation Protection at the WWMF/RWOS-1 in 2021.

CNSC staff's reviews of quarterly and annual reports submitted by OPG and licensee responses to reportable events confirmed that:

- WWMF/RWOS-1 did not exceed any action levels for dose to workers
- The annual effective doses for all WWMF/RWOS-1 workers were well below the regulatory limit of 50 mSv
- WWMF/RWOS-1 did not exceed any action levels for contamination control
- There were no recordable radiological exposures for OPG staff performing caretaking duties at RWOS-1
- The perimeter dose rates at the WWMF were within OPG's targets and consistent with the results of the previous years

### 3.6.8 Conventional Health and Safety

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Conventional health and safety at the WWMF in 2021.

CNSC staff compliance verification activities did not identify any non-compliant findings relevant to conventional health and safety in 2021. OPG did not report any lost-time accidents at the WWMF in 2021. OPG reported 1 medically treated injury (MTI) for WWMF in 2021 which resulted in a total recordable injury frequency of 0.43 for all the OPG WMFs. Furthermore, during the Type II inspection, CNSC staff observed OPG staff wearing appropriate personal protective equipment (PPE).

CNSC staff concluded that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Conventional health and safety at RWOS-1 in 2021.

CNSC staff compliance verification activities did not identify any non-compliant findings relevant to conventional health and safety in 2021. OPG did not report any lost-time accidents at the RWOS-1 in 2021. Furthermore, during a Type II inspection, CNSC staff observed OPG staff wearing appropriate PPE.

### 3.6.9 Environmental Protection

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the Environmental Protection SCA at WWMF and RWOS-1 in 2021. OPG made adequate provision for the protection of the public and the environment.

CNSC staff reviewed the WWMF 2021 annual, quarterly compliance reports and confirmed that OPG met all the applicable regulatory requirements.

In 2021, OPG reported the unplanned unavailability of Carbon-14 monitoring of the incinerator emissions above OPG's operating procedures. C-14 emissions have consistently been below derived release limits, so there was no estimated dose to the public from this event. OPG completed an evaluation to prevent reoccurrence and is proactively increasing maintenance activities. CNSC staff have reviewed the full event report and are satisfied with OPG's corrective actions.

In 2021, hazardous substances released to the environment from WWMF were below the regulatory limits. CNSC staff concluded that people were protected from the impacts of the non-radiological substances released from the facility in 2021. CNSC staff concurred with OPG WWMF 2016 site-wide ERA that applicable regulatory requirements were met. The required 5-year update to the site-wide ERA was submitted by OPG at the end of 2021 and is currently under review.

### 3.6.10 Emergency Management and Fire Protection

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the SCA Emergency Management and Fire Protection at the WWMF and RWOS-1 in 2021.

OPG has a facility emergency program for the WWMF that includes basic fire response for facility staff to respond to small fires with fire extinguishers. Main fire response is done by Bruce Power Emergency Response Team (BP ERT). To ensure familiarity with the facility, BP ERT are given orientation tours in addition to participating in annual fire response drills.

CNSC staff also reviewed one reportable event report, as well as four quarterly operations reports, for WWMF, and confirmed that OPG met all the applicable regulatory requirements pertaining to all specific areas.

### 3.6.11 Waste Management

Based on CNSC staffs' regulatory oversight of OPG's activities, CNSC staff conclude that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Waste Management at the WWMF in 2021.

CNSC staff observed appropriately labelled waste containers for ILW and noted that waste characterization data was available in OPGs inventory records. However, some DSC labels were observed to be faded or illegible. OPG is

reviewing the degraded labels and validating the information against their data collection system. OPG is also reviewing its procedures with respect to labeling requirements. CNSC staff have reviewed and are satisfied with OPGs corrective action plan and continue to monitor its implementation.

Based on CNSC staffs' regulatory oversight of OPG's activities, CNSC staff conclude that OPG met the applicable regulatory requirements, and its performance met CNSC staff's expectations, for the SCA Waste Management at RWOS-1 in 2021. RWOS-1 is in storage with surveillance and no waste was placed in or removed from RWOS-1 in 2021.

### **3.6.12 Security**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations, for the Security SCA at the WWMF in 2021.

Inspections conducted in 2021 identified that WWMF was compliant with regulatory requirements. CNSC staff reviewed the WWMF quarterly, annual operational reports as well as the threat and risk assessment report and confirmed that OPG met all the applicable regulatory requirements pertaining to all specific areas for the security SCA.

### **3.6.13 Safeguards and Non-Proliferation**

CNSC staff concluded that OPG met the applicable CNSC regulatory requirements and CNSC staff's expectations, for the SCA Safeguards and Non-Proliferation at the WWMF in 2021.

CNSC staff determined that OPG's accountancy and control of nuclear material complied with the applicable regulatory requirements at the WWMF. OPG granted the required access and assistance to the IAEA for safeguards activities, including inspections and for the maintenance of IAEA equipment at the WWMF.

CNSC staff determined that OPG met the applicable regulatory requirements for operational and design information in 2021 at the WWMF. OPG provided the required operational and design information to facilitate IAEA safeguards activities.

OPG provided the assistance required for the IAEA's safeguards equipment, containment, and surveillance activities, including inspections. IAEA re-verification of a small number of DSCs were required due to either the failure of IAEA equipment or paint flaws on the weld flange. The operator provided the notifications and support required to facilitate the IAEA activity.

### **3.6.14 Packaging and Transport**

CNSC staff concluded that OPG met the applicable regulatory requirements and CNSC staff expectations for the SCA Packaging and Transport at WWMF in 2021.

OPG maintains a packaging and transport program for the WWMF that ensures compliance with the [Packaging and Transport of Nuclear Substances](#)

[Regulations, 2015](#) and the [Transportation of Dangerous Goods Regulations](#). The program was effectively implemented and the transport of nuclear substances to and from the facility was conducted safely. There were no packaging and transport events reported in 2021.



## 3.7 Point Lepreau Nuclear Generating Station

### 3.7.0 Introduction

The [Point Lepreau site](#) is located on the Lepreau Peninsula, 40 kilometres southwest of Saint John, New Brunswick. The Point Lepreau site lies within the traditional territory covered by the Peace and Friendship Treaties with the Wolastoqey, Peskotomuhkati and Mi'gmaq peoples.



The facilities are owned and operated by New Brunswick Power Corporation (NB Power) and include a single CANDU reactor with a rated capacity of 705 megawatts electrical (MWe). The Point Lepreau site also includes the Solid Radioactive Waste Management Facility (SRWMF), which is a short distance from the power reactor and within the exclusion zone. The CNSC regulates the PLNGS and the SRWMF under a single power reactor operating licence (PROL).

Radioactive waste storage includes short-term storage in the service building prior to transfer of the waste to the SRWMF for long-term storage. The SRWMF is used for the storage of solid radioactive waste, including used nuclear fuel that is produced at PLNGS.

The SRWMF is comprised of the following Phase I, II and III sites:

- Phase I of the facility is used to store operational waste
- Phase II is a dry storage facility for used fuel
- Phase II Extension is an additional area prepared in 2006 to allow for dry storage of used fuel. Approval is required in accordance with the PROL prior to commissioning and use
- Phase III of the facility stores waste from fuel channel replacement and other operations completed during the refurbishment outage

### Licensing

In June 2021, NB Power submitted an application for the renewal of the PLNGS PROL, pursuant to Section 24(2) of the [Nuclear Safety and Control Act](#).

UPDATE: The [Commission Public Hearing Part 1](#) for NB Power's licence renewal application was held on January 26, 2022. CNSC's submission for the hearing can be found in CMD 22-H2.

The Commission Public Hearing Part 2 was held from May 10 – 12, 2022. CNSC's submission for the hearing can be found in CMD 22-H2.1B. The Commission released a summary record of decision, approving a 10-year renewal of the Point Lepreau licence, effective July 1, 2022. The Commission directed NB

Power and CNSC staff to provide a comprehensive update on the licensed activities during a public meeting at the mid-point of the licence term.

## Fisheries Act Authorization

The Department of Fisheries and Oceans Canada determined that the FAA application consultation requirements were met. As a result, the review of the FAA application resumed on May 31st and a decision on the application is expected by August 28th, 2022.

## Periodic Safety Review

The PROL requires NB Power to perform a PSR in accordance with [REGDOC-2.3.3, Periodic Safety Reviews](#). CNSC staff accepted the revised IIP on June 30, 2021, and confirmed that NB Power conducted the PSR in accordance with the requirements of REGDOC-2.3.3. CNSC staff noted that the PSR did not identify any major gaps between current state of the NPP and modern requirements for the PSR validity period (2022-2032).

**Table 22: PLNGS IIP Status**

Total commitments	Overall	2021
Planned by NB Power	346	290
Completed by NB Power	291	281*
Closed by CNSC	202	0

\*Submitted for closure in October 2021

## Compliance Program

The inspections at the PLNGS that were considered in this regulatory oversight report are tabulated in table 22 (inspection reports were included if they were sent to NB Power by February 1, 2022). The Quarterly Type II inspections include 41 field inspections conducted at PLNGS in 2021.

**Table 23: List of Inspection Reports at PLNGS**

Safety and Control Area	Report Title	Report Issue Date
Management System	GPLRPD-2021-09500 - Inspection Report - TII - Contractor Management	May 2021
	GPLRPD-2021-11779 - Inspection Report - TII - Engineering Change Control	December 2021
Human Performance	GPLRPD-2021-12054 - Inspection Report - TII - Simulator Examinations (Conduct)	February 2022
	GPLRPD-2021-12325 – Inspection Report – DTI – Engineering Support Personnel Training	March 2022
	GPLRPD-2021-11381 - Inspection	December 2021

Safety and Control Area	Report Title	Report Issue Date
	Report - TII - Non-Certified Training Programs	
Operating Performance	GPLRPD-2021-09368 - Quarterly Field Inspection Report - Q4 FY 2020/2021	July 2021
	GPLRPD-2021-10408 - Inspection Report - Type II - Quarterly Field Inspection Report - Q1 - FY 21/22	October 2021
	GPLRPD-2021-10412 - Inspection Report - TII - Safe Operating Envelope	November 2021
	GPLRPD-2021-11242 - Inspection Report - Type II - Quarterly Field Inspection Report - Q2 - FY 21/22	December 2021
Fitness for Service	GPLRPD-2021-09441- Inspection Report - TII - System Inspection - Spent Fuel Bay	May 2021
	GPLRPD-2021-10411 - Inspection Report - TII - Maintenance Planning and Scheduling	August 2021
Radiation Protection	GPLRPD-2021-11083 - Inspection Report - TII - Solid Radioactive Waste Management Facility (SRWMF)	October 2021
Emergency Management and Fire Protection	GPLRPD-2021-11566 - Inspection Report - TII - Emergency Exercise	December 2021
	GPLRPD-2021-11600 - Preliminary Findings - SM - PHT PM-3 Fire	September 2021
	GPLRPD-2021-08312 - Inspection Report - TII - Fire Response	April 2021
	GPLRPD-2021-08887 - Inspection Report - TII - Fire Protection	April 2021
Security	GPLRPD-2021-11427 - Update on Issuing Report - TII - Security	December 2021

### 3.7.1 Management System

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Management System at the PLNGS in 2021.

CNSC staff concluded that NB Power is compliant with the requirements of CSA N286-12, *Management system requirements for nuclear facilities*. CNSC staff inspections identified 8 non-compliances of negligible safety significance and 1 non-compliance of low safety significance. For 3 of the non-compliances of

negligible safety significance, no enforcement was needed as NB Power took corrective actions to address the deficiencies. For the remaining non-compliances, CNSC staff issued Notices of Non-Compliance, requiring NB Power to take corrective actions. CNSC staff will continue to monitor NB Power's response to these non-compliant findings.

CNSC staff inspections identified several compliant findings in the specific area of organization. However, the Maintenance Planning and Scheduling inspection identified 1 non-compliance of negligible safety significance pertaining to this specific area.

CNSC staff determined that NB Power continued to meet the applicable regulatory requirements for Performance Assessment, Improvement, and Management Review. The results of a Synergy Exercise inspection identified 1 non-compliance of negligible safety significance as the self-assessment report was not submitted to the CNSC within forty (40) days. NB Power is currently working to address these findings. CNSC staff will continue to monitor NB Power's response to this non-compliance.

CNSC staff determined that NB Power met regulatory requirements applicable to the change management specific area. CNSC inspections identified 1 non-compliance of negligible safety significance related to Training Change Management (TCM) forms and documentation not being filled out consistently. NB Power is currently working to address these findings CNSC staff will continue to monitor NB Power's response to this non-compliance.

NB Power provided an implementation plan for [REGDOC-2.1.2, Safety Culture](#) in May 2019. CNSC staff reviewed NB Power's implementation plan and were satisfied that it had the required information to meet the requirements of REGDOC-2.1.2. NB Power further submitted updated governance in July 2021 and conducted a safety culture self-assessment in December 2021. CNSC staff are reviewing NB Power's governance and plan to conduct compliance verification activities to verify NB Power's compliance with REGDOC 2.1.2 in 2022.

CNSC staff inspections identified 5 non-compliances of negligible safety significance and 1 non-compliance of low safety significance in the area of records management. NB Power took corrective actions to address 3 of the non-compliances and no enforcement action was issued. NB Power has provided a response to two non-compliances which are currently being reviewed by CNSC staff and NB Power is working to address the remaining non-compliance.

CNSC staff determined that NB Power's response to the COVID-19 pandemic met all applicable business continuity requirements.

Throughout 2021, NB Power submitted 3 event reports related to business continuity in response to the COVID-19 pandemic. CNSC staff reviewed the event reports and found that NB Power took adequate corrective actions and has adequate measures in place relating to business continuity in the event of disabling circumstances such as a pandemic, severe weather, or labour actions.

### 3.7.2 Human Performance Management

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Human Performance at the PLNGS in 2021.

CNSC staff identified 1 finding of low safety significance. The non-compliant finding was related to procedural adherence requirements not being met when completing work orders.

UPDATE: NB Power responded with their corrective action in January 2022 which are currently being reviewed by CNSC staff.

CNSC staff concluded that NB Power has a well-documented and robust systematic approach to training (SAT) based training system. This was based on a review of the findings from compliance verification activities conducted in 2021 which resulted in non-compliances of negligible safety significance. CNSC staff are satisfied with NB Power's progress in correcting all non-compliances of negligible safety significance.

In early 2021, New Brunswick Power (NBP) notified the CNSC of its intention to apply the Multiple Choice Question (MCQ) methodology for its general certification examination. This correspondence included all the modified governance to reflect the Generals MCQ methodology within the NBP management system. During the review, CNSC staff held progress meetings with NBP staff to share comments and concerns throughout the review process to ensure timely feedback and to allow compensatory actions to be taken as required. CNSC staff reviewed all the supplementary documentation submitted by NBP following the meetings and updates.

CNSC staff concluded that NB Power's proposed MCQ examination methodology provides an adequate examination model to distinguish candidates who possess the required knowledge of the general training material from those who do not. As a result, CNSC staff approved NB Power's use of the proposed MCQ examination methodology on a pilot basis for administering General certification examinations.

As part of the pilot program, CNSC conducted a technical assessment of the design, development and marking of the examination as well as a field inspection of the conduct of the July 30, 2021, examination in order to assess NB Power's implementation of the program. In addition, CNSC staff identified areas and parts of the governance that would need to be updated or revised and NBP provided a timeline for changes to governance and associated processes. CNSC staff accepted the proposed timeline, which would be completed by end of year 2021.

CNSC staff determined that NB Power met requirements for managing fitness for duty in 2021 and performance in this area met CNSC expectations. There were no hours of work violations or exceedances and no minimum shift complement (MSC) violations by certified staff at PLNGS. There were however two occasions of an MSC violation by non-certified staff as detailed below.

On August 15, 2021, the Emergency Response Team (ERT) was below minimum shift complement (MSC) for 4 hours as a result of an ERT member unavailability. CNSC staff were satisfied with the efforts that were made to find a replacement. In order to alleviate the duration under minimum complement, two ERT members (on separate shifts) worked the maximum hours allowable as per process.

On December 24, 2021, the ERT was below MSC for 6.5 hours as a result of illness. No replacement was available, however, one ERT member from the subsequent shift came in early and worked the maximum allowable hours as per process.

Given the trend of violations in the previous years, CNSC staff plan to conduct an ERT-Focused Minimum Shift Complement Field Inspection in early 2022 which will explore the causes, rationale, mitigating actions, staffing, trending, and contingencies of each of these MSC events.

### 3.7.3 Operating Performance

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations for the SCA Operating performance at Point Lepreau in 2021.

PLNGS continued to operate the station in a safe manner within the bounds of the operating policies and operational safety requirements. The reactor was operated at the conditions prescribed by Power Reactor Operating Licence (PROL) within the power limits identified in the licence conditions handbook (LCH). Operating practices observed during the year were adequate and effective.

In 2021, PLNGS experienced no automatic trips, 0 stepbacks and two setbacks. There was no impact on reactor safety. CNSC staff confirmed that PLNGS staff followed approved procedures and took appropriate actions for all transients and power reductions. The reactor trips performance against the target for 2021 was better than industry performance target (0.0 for PLNGS). The unit met WANO's PHWR target of 1.0 trip per 7,000 hours of operation. All transients were controlled properly, and power reduction was automatically initiated by the reactor control systems.

In 2021, PLNGS experienced three outages. During the PLNGS planned and unplanned outages in 2021, CNSC staff conducted compliance verification activities in the areas of radiation protection, conventional health and safety, procedural use and adherence, training, maintenance & operations, and adherence to COVID-19 protocols. For the unplanned outage that began on January 16, 2021, a field inspection was completed on January 18, 2021. The intent of this field inspection was to obtain more information about the event to observe the rupture disc areas to verify that the guaranteed shutdown state (GSS) was in place, and to verify the heat sink checks had been completed. The field inspection met its objectives, and no enforcement actions were issued.

All REGDOC-3.1.1 scheduled reports were submitted to CNSC in a timely manner. NB Power was compliant with the regulatory requirements in REGDOC-3.1.1, [Reporting Requirements for Nuclear Power Plants](#) in 2021.

### 3.7.4 Safety Analysis

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Safety Analysis at the PLNGS in 2021.

CNSC staff reviewed NB Power's responses to questions and comments regarding Loss of Reactivity Control (LORC) Safety Analysis in 2021. CNSC staff determined that NB Power's responses were adequate and the LORC analysis was accepted.

NB Power continues their efforts for [REGDOC-2.4.1](#) implementation in 2021 and submitted an updated implementation schedule stating that implementation is ongoing with expected completion by the end of 2024.

NB Power has been compliant with [REGDOC-2.4.2](#) since 2016 and in November 2021, submitted their updated PSA reports. CNSC staff's review of the PSA updates is ongoing with an expected completion by the end of 2022 calendar year.

CNSC staff reviewed NB Power's revised Safety Report in 2021 and found all updates to be acceptable.

### 3.7.5 Physical Design

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Physical Design at the PLNGS in 2021.

In 2021, NB Power continued to implement and maintain its pressure boundary program in accordance with CSA N285.0, *General requirements for pressure-retaining systems and components in CANDU nuclear power plants*. NB Power also maintained a formal agreement with an Authorized Inspection Agency. CNSC staff concluded that NB Power continued to meet the regulatory requirements for the pressure boundary program.

The PLNGS fuel design and inspection program met the regulatory requirements and performance expectations. PLNGS has met the minimum expectations for fuel bundle inspections and has an established strategy to address the recent elevated defects levels.

Overall, the fuel condition was satisfactory, and fuel has been operated safely.

### 3.7.6 Fitness for Service

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Fitness for Service at the PLNGS in 2021.

CNSC staff confirmed that all special safety systems for PLNGS met their unavailability targets in 2021.

NB Power maintained both the critical corrective maintenance backlog and the number of critical preventive maintenance deferrals very low. The critical deficient maintenance backlog was trending slightly up in the past 3 years and

was above the industry average (noting that the industry average was improved in last 5 years). CNSC staff is continuously monitoring the number and trending of the critical deficient maintenance backlog through the baseline compliance activities, and if necessary, augmented oversight will be added. The average preventative maintenance completion ratio was around 92%, which was acceptable. There were no safety significant findings in the maintenance specific area based on the review of the events reported by the licensee.

CNSC staff conducted a maintenance work planning and scheduling inspection in 2021. The inspection identified several deficiencies in the maintenance work planning and scheduling process, such as a lack of adequate review of vendor procedures and the incompleteness of several work assessment walkdowns. An action item was opened to track NB Power's corrective actions to address these deficiencies. The safety significance of these deficiencies was determined to be low since the safety functions of the relevant systems have not been affected. NB Power submitted corrective actions to address all notices of non-compliance in February 2022. CNSC staff are currently in the process of reviewing the submission.

CNSC staff determined that PLNGS's maintenance program met the applicable regulatory requirements and CNSC staff expectations. The critical corrective maintenance backlog, critical deficient maintenance backlog, and the number of critical preventive maintenance deferrals are given in table 23.

**Table 23: Trend of maintenance backlogs and deferrals for critical components for PLNGS, 2019 to 2021**

Parameter	Average quarterly work orders per unit			Three year trending	Quarterly 2021 work orders per unit				Industry average for 2021
	2019	2020	2021		Q1	Q2	Q3	Q4	
Corrective maintenance backlog	1	1	1	Steady	1	0	0	1	1
Deficient maintenance backlog	15	17	17	Up	15	17	21	13	4
Deferrals of preventive maintenance	1	1	0	Steady	0	1	0	0	2

### 3.7.7 Radiation Protection

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Radiation Protection in 2021.

CNSC staff determined that NB Power's application of ALARA at the PLNGS in 2021 was compliant with requirements and met CNSC staff's performance



expectations. For 2021, NB Power established dose targets, tracked collective and individual dose performance against approved targets, and undertook various initiatives to assist in maintaining radiation doses ALARA.

CNSC staff determined that NB Power met applicable regulatory requirements for worker dose control at the PLNGS in 2021. Radiation doses to workers at the PLNGS were below the regulatory dose limits, as well as the action levels in NB Power's radiation protection program.

CNSC staff determined that NB Power met applicable regulatory requirements for Radiation Protection Program Performance at the PLNGS in 2021. NB Power employed standardized performance metrics and performed self-assessments to monitor and control performance in all aspects of the radiation protection program. Operating experience and benchmarking with industry were also used to improve performance. As required by REGDOC-3.1.1, NB Power reported information for SPIs 1-4: collective radiation exposure, personal contamination events, unplanned dose/unplanned exposures, and loose contamination events. No regulatory follow-up was required for the reported information.

CNSC staff determined that NB Power implemented controls that met the applicable regulatory requirements for control of radiological hazards and the protection of workers at the PLNGS in 2021. NB Power did not exceed any action levels for contamination control at PLNGS in 2021. Radiologically controlled areas were posted with the required radiation warning signage, routine monitoring for contamination was performed, and monitoring of personnel and material prior to leaving contaminated or potentially contaminated areas was conducted as required.

### **3.7.8 Conventional Health and Safety**

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Conventional Health and Safety at the PLNGS in 2021.

There were no lost-time accidents at PLNGS in 2021. There were 4 accidents that resulted in minor injuries. CNSC staff followed up on these accidents and were satisfied with NB Powers response. CNSC staff compliance verification activities identified 4 non-compliant findings relevant to conventional health and safety in 2021. In response, actions were taken by NB Power to ensure housekeeping met station expectations and regulatory requirements and no enforcement action was required.

All performance indicators in this SCA improved in 2022. The accident severity rate was 0.00, in comparison to the 2020 value of 0.34. In 2021, the Accident Frequency (AF) for PLNGS was 0.36, in comparison to the 2020 value of 0.51. The Industrial Safety Accident rate in 2021 at Point Lepreau NGS was 0.00, in comparison to the 2020 value of 0.08.

### 3.7.9 Environmental Protection

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations for the Environmental Protection SCA at PLNGS in 2021. NB Power made adequate provision for the protection of the environment and health of persons.

NB Power's monitoring, analysis and reporting of environmental data was consistently implemented in 2021. Results from CNSC staff's assessments of the quarterly and annual reports determined that NB Power met regulatory requirements in REGDOC-3.1.1 and REGDOC-2.9.1. CNSC staff did not note any safety-significant environmental exceedances or spills at the PLNGS in 2021. The dose to the public from the Point Lepreau site (0.0013 mSv) remained well below the regulatory limit of 1 mSv/yr, and in the similar range to previous year, which shows that radionuclide concentrations in the environment remains low.

Airborne and waterborne effluents released from the PLGS were within Derived Release Limits and action levels. There are negligible risks posed to human health and the environment from releases of non-radiological (hazardous) substances from operations at PLNGS, given that they meet applicable release authorizations issued by New Brunswick.

In 2020, NB Power submitted an updated environmental risk assessment (ERA) in accordance with the requirements set out in CSA standard N288.6-12, *Environmental risk assessment at Class I nuclear facilities and uranium mines and mills*. In June 2021, NB Power revised the PLNGS 2020 ERA to address CNSC comments. CNSC staff can confirm that there is no unreasonable risk to the environment posed by the operation of PLNGS.

### 3.7.10 Emergency Management and Fire Protection

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Emergency Management and Fire Protection at the PLNGS in 2021. CNSC staff concluded that NB Power has sufficient provisions for preparedness and response capability to mitigate the effects of accidental releases of nuclear and hazardous substances on the environment and protect the health and safety of persons.

CNSC staff conducted an inspection to verify that NB Power's Emergency Preparedness and Response complied with regulatory requirements. The inspection focused on NB Power's emergency preparedness management and Synergy Challenge 2021 exercise implementation and response. The inspection identified three (3) non-compliant findings of negligible safety significance, in the areas of Performance, Assessment, Improvement, and Management Review (Self Assessments); Personnel Training (Training and Qualifications); and Procedures (Procedure Adequacy). The non-compliant findings related to NB Power not submitting to the CNSC, a self-assessment report within 40 days of the exercise, a pair of evaluators not being trained and qualified to evaluate exercises and NB Power's emergency procedures not being aligned with regulatory requirements. As a result of these non-compliant findings, CNSC staff issued enforcement

actions to which NB Power is expected to provide corrective actions by April 2022.

Through licensing and CNSC compliance verification activities performed during the reporting period, CNSC staff concluded that NB Power maintains a comprehensive fire response capability and fire protection program that met the applicable regulatory requirements. NB Power has an extensive fire drill and training program which includes a training facility where live fire training is conducted at the PLNGS site.

In addition to CNSC staff compliance verification activities, NB Power conducts expert Third Party Reviews (TPR) of an annual plant condition, bi-annual fire drill audit and tri-annual fire program audit. By incorporating the results of the CNSC compliance activity findings and TPR observations and recommendations into the drill and training program, the emergency response team performance continued to improve.

UPDATE: NB Power continues to follow up on a Fire Response Type II inspection that raised two low safety significant findings related to inconsistencies in the fire program documentation and the fire drill program not meeting the intent of NFPA 600-2010: Standard on Industrial Fire Brigades and CSA N293.12. On January 24, 2022, a letter was sent to NB Power with CNSC staff requests regarding the non-compliances. NB Power is requested to ensure that drill program documentation is updated to reflect the expectations for Emergency Response Team (ERT) evaluated drills to be conducted on the nuclear power plant and structures, systems, and components within the scope of CSA N293: *Fire protection for nuclear power plants*. NB Power is expected to respond by March 24, 2022.

In 2021, CNSC staff completed a number of compliance verification activities and had 6 non-compliant findings in the fire emergency preparedness and response SpA, of which 4 were low safety significant findings and 2 were of negligible safety significance. Three (3) of the non-compliant findings have been corrected and NB Power is working to address the remaining non-compliances. CNSC staff continue to follow-up on a 2019 action item that was issued to NB Power in regards to the testing of foam concentrates used for fire protection. NB Power put in place a number of interim measures while work was being done to determine a permanent solution for their foam concentrate testing capabilities. NB Power submitted that the manufacturer of the reactor building foam concentrate does not specify testing requirements and NB Power's proposed corrective actions include performing the testing in the PLNGS Chemistry Lab. In a meeting on November 5, 2021, NB Power provided CNSC staff with concurrence from the manufacturer on the validation of the proposed testing regime (including the physical/chemical property testing specification). Based on discussions following the meeting, Based on the review of NB Powers response to the 2019 action item, CNSC staff are satisfied that NB Power's PLNGS Chemistry Lab is qualified to conduct proposed testing regime and that the requirements of Clause 11.6.2 of [National Fire Protection Association](#) (NFPA) 11 (2005) Standard for Low-, Medium-, and

High-Expansion Foam are being met. CNSC staff are satisfied with NB Power's corrective actions to address this non-compliance.

### 3.7.11 Waste Management

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Waste Management at the PLNGS in 2021.

CNSC confirmed that NB Power complied with the applicable regulatory requirements for the collection of radioactive waste as well as the minimization and segregation of conventional waste.

The PROL for PLNGS requires NB Power to submit a quarterly report on the Solid Radioactive Waste Management Facility (SRWMF). CNSC staff were satisfied with all reports and additional information submitted by NB Power for the SRWMF in 2021.

In 2021, 10 canisters (5400 spent fuel bundles) were transferred to Phase II of the SRWMF from the Point Lepreau NGS. The spent fuel inventory at the SRWMF increased to a total of 235 canisters filled (126898 bundles).

### 3.7.12 Security

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations, for the SCA Security at the PLNGS in 2021.

CNSC staff determined NB Power met their licence requirement to update their cyber security program to meet the requirements in CSA N290.7-14 *Cyber security for nuclear facilities*. Overall, NB Power performance for the specific area of cyber security met CNSC staff expectations. At the end of 2021, CNSC staff were conducting an inspection of NB Power's cyber security program regarding the implementation of new CSA N290.7-14.

Following the conduct of an inspection conducted for the specific areas of Facilities and Equipment, Security Practices, Response Arrangements and Drills and Exercises in 2021, CNSC staff concluded that NB Power was compliant with the regulatory requirements and did not find evidence of undue risk to the health and safety of persons, to the environment, to security, or to compromising Canada's international obligations.

### 3.7.13 Safeguards and Non-Proliferation

CNSC staff concluded that NB Power met applicable regulatory requirements and CNSC staff expectations for the Safeguards and Non-Proliferation SCA at the Point Lepreau NGS in 2021.

CNSC staff determined that NB Power implemented and maintained a program for accountancy and control of nuclear material at the PLNGS in a satisfactory manner to comply with the applicable regulatory requirements of [REGDOC-2.13.1, Safeguards and Nuclear Material Accountancy](#). During the reporting period of 2021, PLNGS provided the required nuclear material accountancy and

control reports to the CNSC and the IAEA for their safeguards verification activities.

NB Power granted the required access and assistance to the IAEA for safeguards activities, including inspections and for the maintenance of IAEA equipment at the PLNGS.

NB Power submitted the required annual operational programme with quarterly updates and the annual update to the Additional Protocol to the CNSC in a timely manner. The CNSC reviewed these documents and determined that they met requirements and expectations.

CNSC staff determined that NB Power met the applicable regulatory requirements for safeguards equipment, containment, and surveillance in 2021 at the PLNGS. In 2021, NB Power provided the assistance required for the IAEA's safeguards equipment, containment, and surveillance activities, including inspections at the PLNGS.

### **3.7.14 Packaging and Transport**

CNSC staff concluded that NB Power met the applicable regulatory requirements and CNSC staff expectations for the SCA Packaging and Transport at PLNGS in 2021.

The packaging and transport program was effectively implemented for PLNGS and the transport of nuclear substances to and from the facility was conducted safely in 2021.

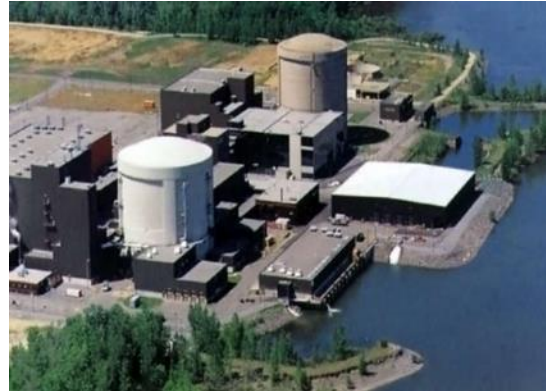
In 2021, CNSC staff conducted an inspection of packaging and transport. CNSC staff verified that all employees who were engaged in transport-related activities were adequately trained, radioactive materials to be transported were appropriately classified and packaged, and the documentation accompanying the shipments was properly completed. CNSC staff did not find any items of non-compliance during the field inspection.

There were no packaging and transport events reported in 2021.

## 3.8 Gentilly-2

### 3.8.0 Introduction

[Gentilly-2](#) est située sur la rive sud du fleuve Saint-Laurent à Bécancour (Québec), environ 15 km à l'est de la ville de Trois-Rivières. Le site de Gentilly-2 est situé sur le territoire traditionnel des Abénaquis de Wôlinak et d'Odanak ainsi que de la Nation huronne-wendat. La centrale appartient à Hydro-Québec et est gérée par celle-ci. Le réacteur CANDU de Gentilly-2 présentait une capacité nominale de 675 mégawatts électriques (MWé). Il est entré en exploitation commerciale en 1983, et a été mis à l'arrêt définitif le 28 décembre 2012.



En décembre 2020, Gentilly-2 a complété le transfert de tout son combustible irradié vers les modules de stockage à sec CANSTOR.

### Autorisation

En 2016, la Commission a [délivré](#) à Hydro-Québec un permis de déclassement d'un réacteur de puissance pour les installations de Gentilly-2. Le permis est en vigueur du 1<sup>er</sup> juillet 2016 au 30 juin 2026.

### Autorisation en vertu de la Loi sur les pêches

Hydro-Québec a réalisé une autoévaluation en vertu de la [Loi sur les pêches](#) avant la délivrance de son permis en 2016. Le personnel de la CCSN a examiné cette autoévaluation et a conclu qu'une autorisation en vertu de la *Loi sur les pêches* n'était pas requise. Pêches et Océans Canada est d'accord avec les conclusions du personnel de la CCSN.

### Programme de vérification de la conformité

Deux inspections ont été réalisées aux installations de Gentilly-2 en novembre 2021, par contre puisque le rapport d'inspection n'a pas été envoyé avant le 1 février 2022, les constats de ce rapport seront inclus dans le rapport annuel de 2022.

### 3.8.1 Système de gestion

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le des domaines de sûreté et de réglementation (DSR) Système de gestion aux installations de Gentilly-2 en 2021.

### 3.8.2 Gestion de la performance humaine

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Gestion de la performance humaine aux installations de Gentilly-2 en 2021.

Le personnel de la CCSN est satisfait du progrès accompli sur le plan de mesures correctives d'Hydro-Québec en 2021.

Hydro-Québec ne maintient plus de programmes d'examens initiaux et de tests de requalification du personnel accrédité aux installations de Gentilly-2. Les seules personnes encore accréditées à Gentilly-2 sont les personnes qui agissent comme responsable technique de la radioprotection (RTR) et celles-ci sont évaluées directement par le personnel de la CCSN.

En 2021, un examen de requalification pour le poste de RTR à Gentilly-2 a été administré par les spécialistes de la division d'accréditation du personnel de la CCSN. L'accréditation de cette personne agissant à titre de RTR a donc été renouvelée par la CCSN pour 5 ans.

Hydro-Québec a satisfait aux exigences réglementaires applicables, et son rendement a rencontré les attentes du personnel de la CCSN, pour le DSR Aptitude au travail à Gentilly-2 en 2021.

En 2021, le personnel de la CCSN a déterminé que la mise en œuvre des nouvelles exigences dans le domaine d'aptitude au travail a rencontré les attentes du personnel de la CCSN. Le rapport annuel des dépassements des heures de travail était soumis en 2021. Le personnel de la CCSN était satisfait de ce rapport.

### 3.8.3 Conduite de l'exploitation

Le personnel de la CCSN a conclu qu'Hydro-Québec respectaient les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Conduite de l'exploitation aux installations de Gentilly-2 en 2021.

Les rapports trimestriels, semestriels et annuels soumis par Hydro-Québec en 2021 qui documentent les activités réalisées ont montré une conformité aux exigences du permis. Lors de la revue de ces rapports par le personnel de la CCSN, aucune lacune ou situation qui aurait pu indiquer que les activités menées aux installations de Gentilly-2 étaient non sécuritaires ou en deçà des attentes du personnel n'a été remarquée. Hydro-Québec a fourni des réponses satisfaisantes dans un délai acceptable au personnel de la CCSN qui a réalisé l'examen de ces rapports. De plus, Hydro-Québec a signalé à la CCSN les événements survenus aux installations de Gentilly-2 en 2021 et a apporté des correctifs à la satisfaction du personnel de la CCSN.

### 3.8.4 Analyse de la sûreté

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Analyse de la sûreté aux installations de Gentilly-2 en 2021.

En 2021, Hydro-Québec a soumis la nouvelle révision de son rapport de sûreté. Ce rapport jumelle le rapport de sûreté de l'installation nucléaire ainsi que le rapport de sûreté des installations de déchets radioactifs solides et du combustible irradié de Gentilly-2. Ceci fait en sorte qu'il y a qu'un seul rapport de sûreté pour toutes les installations de Gentilly-2 dorénavant. Le personnel de la CCSN révise actuellement cette soumission.

### 3.8.5 Conception matérielle

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Conception matérielle aux installations de Gentilly-2 en 2021.

Les informations sur le rendement tirées des examens techniques, des rapports trimestriels et des rapports annuels ont répondu aux attentes du personnel de la CCSN pour les systèmes électriques.

En novembre 2021, Hydro-Québec a transmis au personnel de la CCSN la demande pour débiter la vidange du circuit de refroidissement des boucliers et du caisson. En février 2022 le personnel de la CCSN a conclu que cette demande était acceptable.

### 3.8.6 Aptitude fonctionnelle

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Aptitude fonctionnelle aux installations de Gentilly-2 en 2021.

Le personnel de la CCSN était satisfait du rapport sur la dégradation des enveloppes de pression des systèmes de sûreté pour l'année 2021.

### 3.8.7 Radioprotection

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Radioprotection aux installations de Gentilly-2 en 2021.

En 2021, il n'y a eu aucun dépassement des limites réglementaires pour les doses reçues aux travailleurs à Gentilly-2. Également, il n'y a eu aucun dépassement des seuils d'intervention réglementaires rapporté.

L'indicateur de rendement en matière de sûreté pour les événements de contamination du personnel a permis de relever quelques événements mineurs,



mais aucun événement significatif n'a été rapporté en 2021. Les indicateurs de rendement en matière de sûreté relatifs aux doses non planifiées ont tous indiqués « 0 » pour les trimestres de 2021. Des événements de contamination non fixée ont eu lieu au site de Gentilly-2 en 2021. Cependant, aucun de ces événements indiquent une perte de contrôle du programme de radioprotection. Ceci tend à indiquer qu'il n'y avait aucun problème lié à ces aspects en 2021 chez Hydro-Québec.

### **3.8.8 Santé et sécurité classiques**

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et aux attentes du personnel de la CCSN en ce qui concerne le DSR Santé et Sécurité Classique aux installations de Gentilly-2 en 2021.

Le personnel de la CCSN note qu'il n'y a eu aucun rapport déposé en 2021 faisant état d'accidents avec perte de temps de travail, d'accidents nécessitant des soins médicaux ou encore des jours de travail perdus.

### **3.8.9 Protection de l'environnement**

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Protection de l'environnement aux installations de Gentilly-2 en 2021.

Le personnel a examiné les rapports du plan de surveillance environnementale de Gentilly-2 soumis semestriellement, ainsi que le rapport annuel 2021 sur le programme de surveillance de l'environnement. Les quantités de rejets radioactifs et non radioactifs dans l'environnement sont demeurés très inférieures aux limites établies. En 2021, la dose au public à proximité du site de Gentilly-2 (0.001 mSv) était inférieure à la limite de dose réglementaire de 1 mSV/an, et demeure similaire à celle de l'année passée, démontrant que les concentrations de radionucléides dans l'environnement restent basses. Étant donné qu'Hydro Québec satisfait aux limites autorisées par sa province, il y a un risque négligeable à la santé des humains et l'environnement des rejets des substances non radiologiques venant des opérations de Gentilly-2.

Les informations sur la performance issues de l'évaluation technique de ces rapports montrent que Hydro-Québec a atteint les attentes en matière de contrôle des effluents et émissions pour en 2021.

### **3.8.10 Gestion des urgences et protection-incendie**

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Gestion des urgences et protection-incendie aux installations de Gentilly-2 en 2021.

Le personnel de la CCSN a examiné les indicateurs de rendement en matière de sûreté relatifs à l'indice de participation à l'exercice de l'organisation

d'intervention d'urgence et à l'indice de vérification des ressources d'intervention d'urgence, et s'est déclaré satisfait des résultats communiqués par Hydro-Québec en 2021.

Le personnel de la CCSN conclut qu'Hydro-Québec continue à maintenir une capacité d'intervention en cas d'incendie et un programme de protection contre les incendies conformes aux exigences réglementaires applicables. L'intervention d'urgence en cas d'incendie est maintenant assurée par les municipalités environnantes, notamment un protocole d'entente a été renouvelé en 2021 avec le Service de sécurité incendie de la ville de Bécancour (SSIB) pour officialiser et renforcer le service d'intervention en cas d'incendie et de sauvetage du SSIB au site de G2.

En avril 2021 Hydro-Québec a fait part de son intention de modifier le nombre d'exercices annuels conjoints entre les Installations de Gentilly-2 et le SSIB de 2 à 1 exercices et les visites de familiarisation est maintenue à 2 par année. Le personnel de la CCSN a conclu que cette proposition était satisfaisante.

En novembre 2021, le personnel de la CCSN a observé en personne et à distance un exercice d'intervention en cas d'incendie avec aide mutuelle mené par Hydro-Québec et le [service sécurité et incendie de Bécancour](#) (SSIB) au site de G2. Puisque le rapport d'inspection n'a pas été envoyé à HQ avant le 1 février 2022, les constats de cet inspection seront inclus dans le rapport annuel de 2022.

### 3.8.11 Gestion des déchets

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Gestion des déchets aux installations de Gentilly-2 en 2021.

Le personnel de la CCSN a examiné les deux rapports semestriels de 2021 pour la gestion des installations de déchets radioactifs solides et du combustible irradié de Gentilly-2. Les deux rapports répondaient aux exigences réglementaires et le personnel de la CCSN n'avait pas de commentaires.

En 2020, le personnel de la CCSN a fait la revue du Plan de déclassement préliminaire des Installations de Gentilly-2, des garanties financières et du Plan pour la phase de stockage sous surveillance. Ces plans n'ont pas été modifiés en 2021 et demeurent toujours valide.

En avril 2020, à la lumière de la pandémie de COVID-19, le personnel de la CCSN a demandé à ce qu'Hydro-Québec effectue une analyse de la valeur marchande courante de sa garantie financière, y compris une comparaison avec la valeur minimum nécessaire en vertu du paragraphe 12(2) du *Règlement général sur la sûreté et la réglementation nucléaires*. De plus, une mise à jour de la valeur marchande courante de sa garantie financière pour le déclassement des installations de Gentilly-2 à tous les trois mois a été demandé.

Hydro-Québec a démontré la validité de sa garantie financière au moyen des rapports trimestriels demandés. Sur cette base, le personnel de la CCSN a

considéré qu'un rapport trimestriel sur l'état de la garantie financière de Gentilly-2 n'est plus nécessaire et a fait parvenir à Hydro-Québec une communication en septembre 2021 mettant fin à cette exigence.

### 3.8.12 Sécurité

Le personnel de la CCSN a conclu qu'Hydro-Québec respectaient les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Sécurité aux installations de Gentilly-2 en 2021.

Le personnel de la CCSN a examiné les rapports de sécurité du site et de l'évaluation de la menace et du risque annuels de même que les quatre rapports de sécurité trimestriels de Gentilly-2 et a confirmé que Hydro-Québec respectait toutes les exigences réglementaires applicable au domaine particulier Installations et équipement en 2021.

Bien qu'elle ait mis en œuvre son plan de continuité des opérations (PCO), Gentilly-2 a été en mesure de maintenir un programme d'entraînement efficace. Les renseignements sur le rendement tirés des rapport trimestriels et du programme d'entraînement et d'exercice du titulaire de permis respectent les attentes réglementaires ainsi que les attentes du personnel de la CCSN.

### 3.8.13 Garanties et non-prolifération

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Garanties et non-prolifération aux installations de Gentilly-2 en 2021.

Le personnel de la CCSN a conclu que la comptabilité et le contrôle des matières nucléaires à Gentilly-2 satisfaisaient à toutes les exigences réglementaires pertinentes en 2021.

Hydro-Québec a fourni à la CCSN et à l'Agence internationale de l'énergie atomique (AIEA) les rapports de comptabilité et de contrôle des matières nucléaires requis pour les activités de garanties, y compris les inspections en 2021.

En 2021, Hydro-Québec a fourni l'accès et l'assistance nécessaires aux activités de l'AIEA, y compris les inspections et l'entretien de l'équipement de l'AIEA.

Le personnel de la CCSN a conclu que l'informations opérationnelles et renseignements descriptifs à Gentilly-2 satisfaisait à toutes les exigences réglementaires applicables en 2021. Hydro-Québec a fourni les informations opérationnelles et renseignements descriptifs requis pour faciliter les activités de Garanties et non-prolifération de l'AIEA.

Suivant la confirmation que tout le combustible a été transféré de la piscine à l'aire de stockage à sec en 2021, le personnel de la CCSN a mis à jour ses exigences au niveau des garanties pour Gentilly-2.

Hydro-Québec a fourni l'assistance nécessaire pour l'équipement de garanties, confinement et surveillance de l'AIEA, y compris les inspections.

Lors d'une activité en septembre 2021, l'AIEA a pu confirmer que tout le combustible sur le site a été transféré à l'aire de stockage à sec et a procédé à l'enlèvement de l'équipement de surveillance restant à la piscine de stockage de combustible usé.

Un incident mineur est survenu en septembre 2021 lorsqu'un scellé de l'AIEA a été endommagé en surface lors de travaux sur un module d'entreposage à sec de combustible. Hydro-Québec a coordonné le remplacement du scellé par l'AIEA lors d'une visite subséquente sur le site, à la satisfaction du personnel de la CCSN.

### 3.8.14 Emballage et transport

Le personnel de la CCSN a conclu qu'Hydro-Québec respectait les exigences réglementaires applicables et que son rendement répondait aux attentes du personnel de la CCSN en ce qui concerne le DSR Emballage et transport aux installations de Gentilly-2 en 2021.

Hydro Québec maintient un programme d'emballage et de transport à Gentilly-2 qui assure la conformité au [Règlement sur l'emballage et le transport des substances nucléaires \(2015\)](#) et au [Règlement sur le transport des marchandises dangereuses](#).

Le programme a été mis en œuvre de façon efficace, et le transport des substances nucléaires à destination et en provenance de l'installation était effectué de manière sûre. Au cours de l'année 2021, il n'y a eu aucune inspection de l'emballage et du transport à Gentilly-2 et aucun incident a été rapporté.

## 4 CONCLUSIONS FOR THE REGULATORY OVERSIGHT OF NUCLEAR POWER GENERATING SITES IN 2021

In 2021, CNSC staff continued to conduct regulatory oversight of NPPs and WMFs, using remote and in-person means, as appropriate, given the pandemic restrictions. CNSC staff concluded that the Nuclear Power Plants (NPPs) and the associated Waste Management Facilities (WMFs) on their respective sites operated safely in 2021. This conclusion was based on detailed CNSC staff assessments of findings from compliance verification activities for each facility in the context of the 14 CNSC safety and control areas. The conclusion was supported by safety performance measures and other observations.

Important performance measures and observations include the following:

- The ongoing pandemic did not lead to decreasing safety performance of the facilities, systems, structures, and components, nor affected human or organizational performance
- The NPP and WMF licensees followed approved procedures and took appropriate corrective action for all events reported to the CNSC
- NPPs and WMFs operated within the bounds of their operating policies and principles
- There were no serious process failures at the NPPs. The number of unplanned transients and trips in the reactors was low and acceptable to CNSC staff. All unplanned transients in the reactors were properly controlled and adequately managed
- Radiation doses to the public were well below the regulatory limits
- Radiation doses to workers at the NPPs and WMFs were also below the regulatory limits
- The frequency and severity of non-radiological injuries to workers were low
- Radiological releases to the environment from the NPPs and WMFs were below regulatory limits
- Licensees met the applicable requirements related to Canada's international obligations; safeguards inspection results were acceptable to the International Atomic Energy Agency

CNSC staff assessments for 2021 concluded that the licensees complied with the applicable requirements and met CNSC staff expectations for all safety and control areas at all the NPPs and WMFs, with the exception of the Security SCA for the Pickering and Darlington NPPs.

## REFERENCES

1. CMD 21-M36, Regulatory Oversight Report for Canadian Nuclear Power Generating Stations: 2020
2. CNSC Website, *General Description of Regulatory Framework for Nuclear Power Generating Sites*:  
<https://nuclearsafety.gc.ca/eng/resources/publications/reports/regulatory-oversight-reports/general-description-of-regulatory-framework-for-NPGS.cfm>
3. CMD 15-H111, Modification au permis de Gentilly-2 pour inclure REGDOC-3.1.1
4. CNSC Open Government Portal, Radionuclide Release Datasets:  
<https://open.canada.ca/data/en/dataset/6ed50cd9-0d8c-471b-a5f6-26088298870e>
5. CNSC Website, CNSC's Independent Environmental Monitoring Program:  
<http://www.nuclearsafety.gc.ca/eng/resources/maps-of-nuclear-facilities/iemp/index-iemp.cfm>

## GLOSSARY

For definitions of terms used in this document, see [REGDOC-3.6, Glossary of CNSC Terminology](#), which includes terms and definitions used in the Nuclear Safety and Control Act and the Regulations made under it, and in CNSC regulatory documents and other publications.

## A. RATING DEFINITIONS

The rating categories are defined as follows.

### Satisfactory (SA)

- Licensee meets all of the following criteria
- Performance meets CNSC staff expectations
- Licensee non-compliances or performance issues, if any, are not risk-significant
- Any non-compliances or performance issues have been, or are being, adequately corrected

### Below expectations (BE)

One or more of the following criteria apply:

- Performance does not meet CNSC staff expectations
- Licensee has risk-significant non-compliance(s) or performance issue(s)
- Non-compliances or performance issues are not being adequately corrected

### Unacceptable (UA)

One or both of the following criteria apply:

- Risk associated with a non-compliance or performance issue is unreasonable
- At least one significant non-compliance or performance issue exists with no associated corrective action



## **B. LIST OF REGULATORY REQUIREMENTS AT THE END OF 2021**

The following table lists published CNSC regulatory documents and CSA Group standards that contain compliance verification criteria used by CNSC staff for the SCAs covered in this regulatory oversight report. The information was compiled from the various facility Licence Conditions Handbooks (LCHs) as they existed in December 2021. Also, the main body of this report may include additional information related to the implementation of some of these documents, as well as more recently published documents, which were not used for compliance verification purposes in 2021.

In the table, a check mark indicates that the publication was included as compliance verification criteria for the facility at the end of 2021, a dash indicates that the publication was not included as compliance verification criteria, and a date indicates the year when the licensee indicated it plans to fully implement the requirements in the publication.

Appendix E

Regulatory documents and industry standards to be applied as requirements for all applicants (currently as CVC in LCH)

Source	Number	Title	Year	LCH	Bruce	DNCS	DWIMF	PNCS	PWMF	PLNGS	Gentilly2	WWMF
CSA	N286	Management system requirements for nuclear power plants, Update 1, 2007	2005	1	-	-	-	-	-	-	-	-
CSA	N286	Management system requirements for nuclear facilities	2012	1	V	V	V	V	V	V	V	V
CNSC	REGDOC-2.1.2	Safety Culture	2018	1	V	-	-	-	-	-	-	-
CNSC	REGDOC-2.2.2	Personnel Training	2014	2	-	V	V	V	V	V	V	V
CNSC	REGDOC-2.2.2	Personnel Training, version 2	2016	2	V	-	-	-	-	-	-	-
CNSC	REGDOC-2.2.3	Personnel Certification, Volume III: Certification of Persons Working at Nuclear Power Plants	2019	2	V	-	-	-	-	-	-	-
CNSC	RD-204	Certification of Persons Working at Nuclear Power Plants	2008	2	-	-	-	-	-	-	-	-
CNSC	EG1*	Requirements and Guidelines for Written and Oral Certification Examinations for Shift Personnel at Nuclear Power Plants	2005	2	V	V	-	-	-	-	-	-
CNSC	EG2*	Requirements and Guidelines for Simulator-Based Certification Examinations for Shift Personnel at Nuclear Power Plants	2004	2	V	V	-	-	-	-	-	-
CNSC	RD-363	Requirements for the Requalification Testing of Certified Shift Personnel at Nuclear Power Plants	2009	2	V	V	-	-	-	-	-	-
CNSC	REGDOC-2.1.2	Nuclear Security Officer Medical, Physical and Psychological Fitness	2008	2	-	V	V	V	V	V	V	V
CNSC	REGDOC-2.2.4	Safety Culture	2018	2	-	V	V <sup>1</sup>	V	V <sup>1</sup>	-	-	V <sup>1</sup>
CNSC	REGDOC-2.2.4	Fitness for Duty Volume I: Managing Worker Fatigue	2017	2	-	V	V	V	V	2022	V	V
CNSC	REGDOC-2.2.4	Fitness for Duty Volume II: Managing Alcohol and Drug	2017	2	-	V	V	V <sup>2</sup>	V <sup>2</sup>	TBD <sup>2</sup>	V	V <sup>2</sup>
CNSC	REGDOC-2.2.4	Fitness for Duty Volume III: Nuclear Security Officer Medical, Physical, Psychological Fitness	2021	2	V	-	-	-	-	-	-	-
CNSC	REGDOC-2.3.3	Periodic Safety Reviews	2018	2	-	V	V	V	V	V	V	V
CNSC	REGDOC-2.3.3	Periodic Safety Reviews	2008	3	-	-	-	-	-	-	-	-
CNSC	REGDOC-2.3.3	Periodic Safety Reviews	2015	3	-	V	-	-	-	-	-	-
CNSC	REGDOC-3.1.1	Reporting Requirements for Nuclear Power Plants	2014	3	-	-	-	-	-	-	-	-
CNSC	REGDOC-3.1.1	Reporting Requirements for Nuclear Power Plants, version 2	2016	3	V	-	-	-	-	-	-	-
CNSC	REGDOC-3.1.2	Reporting Requirements, Volume 1: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills	2018	3	-	-	-	-	-	-	-	-
CSA	N290.15	Requirements for the safe operating envelope of nuclear power plants (Update No 1, 2016)	2010	3	V	V	-	-	-	-	-	-
CNSC	REGDOC-2.3.2	Accident Management: Severe Accident Management Programs for Nuclear Reactors	2013	3	V	V	-	-	-	-	-	-
CSA	N290.11	Requirements for reactor heat removal capability during outage of nuclear power plants	2013	3	-	-	-	-	-	-	-	-
CSA	N286.7	Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear Power Plants	1999	4	-	-	-	-	-	-	-	-
CSA	N286.7	Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear Power Plants	2016	4	V	V	V	V	V	V	V	V
CNSC	S-294	Probabilistic Safety Assessment (PSA) for Nuclear Power Plants	2005	4	-	-	-	-	-	-	-	-
CNSC	REGDOC-2.4.1	Deterministic Safety Analysis	2014	4	V	V	-	-	-	-	-	-
CNSC	REGDOC-2.4.2	Probabilistic Safety Assessment (PSA) for Nuclear Power Plants	2014	4	V	V	-	-	-	-	-	-
CNSC	RD-327	Nuclear Criticality Safety	2010	4	-	-	-	-	-	-	-	-
CSA	N289.1	General requirements for seismic design and qualification of CANDU nuclear power plants	2008	5	V	V	-	-	-	-	-	-
CSA	N289.2	Ground motion determination for seismic qualification of CANDU nuclear power plants	2010	5	V	-	-	-	-	-	-	-
CSA	N289.3	Design procedures for seismic qualification of CANDU nuclear power plants	2010	5	V	-	-	-	-	-	-	-
CSA	N289.4	Testing procedures for seismic qualification of nuclear power plants structures, systems, and components	2012	5	V	-	-	-	-	-	-	-
CSA	N289.5	Seismic instrumentation requirements for nuclear power plants and nuclear facilities	2012	5	V	-	-	-	-	-	-	-
CSA	N290.13	Environmental Qualification of Equipment for CANDU Nuclear Power Plants (2005/R2015)	2005	5	V	V	-	-	-	-	-	-
CSA	N285.0	General requirements for pressure-retaining systems and components in CANDU nuclear power plants	2008	5	-	-	V	V	V	V	V	V
CSA	N285.0	General requirements for pressure-retaining systems and components in CANDU nuclear power plants (including updates 1 and 2)	2012	5	V <sup>3</sup>	-	-	V	V	V	V	V
CSA	N290.12	Human factors in design for nuclear power plants	2014	5	V	V	-	-	-	-	-	-
CSA	N290.0	General requirements for safety systems of nuclear power plants	2011	5	V	V	-	-	-	-	-	-
CSA	N290.14	Qualification of digital hardware and software for use in instrumentation and control applications for nuclear power plants	2015	5	V	-	-	-	-	-	-	-
CSA	N291	Requirements for safety related structures for CANDU nuclear power plants	2008	5	-	V	-	-	-	-	V <sup>updt.1&amp;2</sup>	V
CSA	N291	Requirements for safety related structures for CANDU nuclear power plants	2015	5	V	-	-	-	-	-	-	-
CNSC	RD/GD-98	Reliability Programs for Nuclear Power Plants	2012	6	-	V	-	-	-	-	-	-
CNSC	REGDOC-2.6.1	Reliability Programs for Nuclear Power Plants	2017	6	V	V	-	-	-	-	-	-
CNSC	RD/GD-210	Maintenance Programs for Nuclear Power Plants	2012	6	-	V	-	-	-	-	-	-
CNSC	REGDOC-2.6.2	Maintenance Programs for Nuclear Power Plants	2017	6	V	V	-	-	-	-	-	-
CSA	N285.4	Periodic inspection of CANDU nuclear power plant components	2005	6	-	-	-	-	-	-	-	-
CSA	N285.4	Periodic inspection of CANDU nuclear power plant components	2009	6	-	-	-	-	-	-	-	-
CSA	N285.4	Periodic inspection of CANDU nuclear power plant components	2014	6	V	V	-	-	-	-	-	-
CSA	N285.5	Periodic inspection of CANDU nuclear power plant components	2008	6	V	V	-	-	-	-	-	-
CSA	N285.5	Periodic inspection of CANDU nuclear power plant components	2018	6	2023	V <sup>8</sup>	-	-	-	-	-	-
CSA	N287.1	General requirements for concrete containment structures for nuclear power plants	2014	6	-	-	-	-	-	-	-	-

Legend - V = implemented ; yyyy = to be implemented by year yyyy ;  
 - = no implementation date

Appendix E

Source	Number	Title	Year	LCH	Bruce	DNCS	DWMF	PNGS	PWMP	PLNGS	GentillyZ	VWMPF
CSA	N287.2	Material requirements for concrete containment structures for CANDU nuclear power plants	2008	6	-	-	-	V	-	-	-	-
CSA	N287.7	In-service examination and testing requirements for concrete containment structures for CANDU nuclear power plants	2008	6	V	V	-	V	-	V	-	-
CSA	N285.7	Periodic inspection of CANDU nuclear power plant balance of plant systems and components	2015	6	V	-	-	-	-	-	-	-
CSA	N285.8	Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors	2015	6	V	V	-	V	-	V	-	-
CSA	N285.8	Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors	2010	6	-	-	-	-	-	-	-	-
CSA	N291	Requirements for safety related structures for CANDU nuclear power plants	2015	6	V	-	-	-	-	-	-	-
CNSC	REGDOC-2.6.3	Aging Management	2014	6	V	V	-	V	V	V	V	V
CSA	N288.1	Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities(Include update 1)	2008	9	V	V	-	V	-	V	-	V
CSA	N288.1	Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities (Includes updates 1.2 and 3)	2014	9	V	V	V	V	V	V	V	V
CSA	N288.3.4	Performance testing of nuclear air-cleaning systems at nuclear facilities	2013	9	-	V	-	V	-	-	-	V
CNSC	REGDOC-2.9.1	Environmental Policies, Programs and Procedures	2013	9	-	V	-	-	-	-	-	V
CNSC	REGDOC-2.9.1	Environmental Policies, Programs and Procedures, section 4.6	2016	9	-	-	-	-	-	-	-	V
CNSC	REGDOC-2.9.1	Environmental Principles, Assessments and Protection Measures, version 1.1	2017	9	-	-	2022	-	-	-	-	2022
CNSC	REGDOC-2.9.1	Environmental Principles, Assessments and Protection Measures, version 1.2	2020	9	V	-	-	-	-	-	-	-
CSA	N288.4	Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills	2010	9	V	V	V	V	V	V	V	4
CSA	N288.5	Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills	2011	9	V	V	V	V	V	V	V	4
CSA	N288.6	Environmental risk assessments at Class I nuclear facilities and uranium mines and mills	2012	9	V	V	V	V	V	V	V	2022
CSA	N288.8	Establishing and implementing action levels for releases to the environment from nuclear facilities	2017	9	V	-	-	-	-	-	-	-
CSA	N288.7	Groundwater protection programs at Class I nuclear facilities and uranium mines and mills	2015	9	V	2022	2022	V	V	V	-	2021
CNSC	RD-353	Testing and Implementation of Emergency Measures	2008	10	-	-	-	-	-	-	-	-
CNSC	REGDOC-2.10.1	Nuclear Emergency Preparedness and Response	2014	10	V	-	-	-	-	-	-	-
CNSC	REGDOC-2.10.1	Nuclear Emergency Preparedness and Response, version 2	2016	10	-	V	V	V	V	V	V	V
CSA	N293	Fire protection for nuclear power plants	2012	10	V	V	-	V <sup>7</sup>	-	-	-	-
CSA	N393	Fire protection for facilities that process, handle, or store nuclear substances	2013	10	-	-	-	V	-	-	-	-
CSA	N292.0	General principles for the management of radioactive waste and irradiated fuel	2014	11	-	-	-	-	-	-	-	V
CSA	N292.0	General principles for the management of radioactive waste and irradiated fuel	2019	11	-	-	-	-	-	-	-	V
CSA	N292.2	Interim dry storage of irradiated fuel	2007	11	-	-	-	-	-	-	-	-
CSA	N292.2	Interim dry storage of irradiated fuel	2013	11	-	-	-	-	-	-	-	V
CSA	N292.3	Management of low- and intermediate-level radioactive waste	2008	11	-	-	-	-	-	-	-	-
CSA	N292.3	Management of low- and intermediate-level radioactive waste	2014	11	V	-	-	-	-	-	-	V
CSA	N294	Decommissioning of facilities containing nuclear substances	2009	11	-	-	-	-	-	-	-	V
CSA	N294	Decommissioning of facilities containing nuclear substances	2019	11	V	V	V	V	V	V	V	V
CSA	N290.7	Cyber Security	2014	12	V <sup>3</sup>	V	-	V	-	V	V	-
CNSC	RD-321	Criteria for Physical Protection Systems and Devices at High-Security Sites	2010	12	-	-	-	-	-	-	-	-
CNSC	RD-361	Criteria for Explosive Substance Detection, X-ray Imaging and Metal Detection at High Security Sites	2010	12	-	-	-	-	-	-	-	-
CNSC	REGDOC-2.2.4	Fitness for Duty Volume III: Nuclear Security Officer Medical, Physical, Psychological Fitness	2018	12	V	-	-	-	-	-	-	-
CNSC	REGDOC-2.12.1	High-Security Sites: Nuclear Response Force	2013	12	-	-	-	-	-	-	-	-
CNSC	REGDOC-2.12.1	High-Security Facilities, Volume I: Nuclear Response Force, Version 2	2018	12	V	-	-	-	-	-	-	-
CNSC	REGDOC-2.12.1	High-Security Facilities, Volume I: Nuclear Response Force, Version 2	2018	12	V	-	-	-	-	-	-	-
CNSC	REGDOC-2.12.2	Site Access Security Clearance	2013	12	V	V	V	V	V	V	V	V
CNSC	REGDOC-2.12.3	Security of Nuclear Substances – Sealed Sources	2013	12	V	-	-	-	-	-	-	-
CNSC	RD-336	Accounting and Reporting of Nuclear Material	2010	13	-	-	-	-	-	-	-	-
CNSC	REGDOC-2.13.1	Safeguards and Nuclear Material Accountability	2018	13	V	V	V	V	V	V	V	V
CNSC	REGDOC-2.3.3	Periodic Safety Reviews	2015	15	V	-	-	-	-	-	-	-
CNSC	RD-327	Nuclear Criticality Safety	2010	15	V	-	-	-	-	-	-	-
CNSC	REGDOC-3.2.1	Public Information and Disclosure	2018	15	V	V	V	V	V	V	V	V

\* CNSC staff documents (not published as regulatory documents)  
<sup>1</sup>OPG has implemented REGDOC-2.1.2, with the exception of nuclear security culture.  
<sup>2</sup>With the exception of random alcohol and drug testing requirements, implementation of REGDOC-2.2.4, Fitness for Duty, Volume II: Managing Alcohol and Drug Use will be six months from the date of Commission approval and subsequent p  
<sup>3</sup>Only N285.0 - Annex L are accepted to be used as "Normative" Annexes  
<sup>4</sup>N288.4, N288.5 and N288.6 are included in REGDOC-2.9.1 version 1.1 for Gentilly-2  
<sup>5</sup>Few outstanding field works are in progress and they are not impacted on major implementation of CSA N290.7-14 by Bruce Power  
<sup>6</sup>For all requirements other than random alcohol and drug testing (Pickering has a Jan 22, 2022 date for full implementation)  
<sup>7</sup>OPG Pickering will comply with Update 1 of N293-12 by June 30, 2023  
<sup>8</sup>Compliance with the 2018 edition is only for the clauses specified under "CVC Related to CSA N285.5" in this LCH

**C. CURRENT AND PREDICTED STATUS OF KEY PARAMETERS  
AND MODELS FOR PRESSURE TUBES IN CANADIAN  
POWER REACTORS**

UNIT	Status as of January 1 <sup>st</sup> 2021			Future situation			
	EFPH	Peak Heq concentration, ppm <sup>2</sup>	Existing fracture toughness model valid? <sup>1</sup>	Key date	Anticipated EFPH	Predicted maximum Heq conc., Ppm <sup>2</sup>	Existing fracture toughness model valid? <sup>1</sup>
<b>Darlington Unit 1</b>	228,090	119	Yes	n/a – fuel channels to be replaced during refurbishment (started February 2022)			
<b>Darlington Unit 2</b>	n/a – fuel channels replaced during refurbishment			n/a – fuel channels replaced during refurbishment			
<b>Darlington Unit 3</b>	Refurbishment in progress – Started September 2020			n/a – fuel channels replaced during refurbishment			
<b>Darlington Unit 4</b>	217,759	108	Yes	Refurbishment (July 2023)	231,000	113	Yes
<b>Pickering Unit 1</b>	163,831	73	Yes	Dec 2024	192,000	86	Yes <sup>3</sup>
<b>Pickering Unit 4</b>	136,894	57	Yes	Dec 2024	167,500	65	Yes
<b>Pickering Unit 5</b>	258,038	90	Yes	Dec 2024	287,500	100	Yes
<b>Pickering Unit 6</b>	264,822	82	Yes	Dec 2024	295,000	91	Yes
<b>Pickering Unit 7</b>	256,260	84	Yes	Dec 2024	287,000	95	Yes
<b>Pickering Unit 8</b>	242,344	79	Yes	Dec 2024	274,500	88	Yes
<b>Bruce Unit 1</b>	64,228	50.9	Yes	Jan 2044 (End of Service)	234,000	<120 ppm	Yes

<b>Bruce Unit 2</b>	64,685	51.1	Yes	Jan 2044 (End of Service)	234,000	<120 ppm	Yes
<b>Unit</b>	<b>Status as of January 1<sup>st</sup> 2021</b>			<b>Future situation</b>			
	<b>EFPH</b>	<b>Peak Heq concentration, ppm<sup>2</sup></b>	<b>Existing fracture toughness model valid?<sup>1</sup></b>	<b>Key dates</b>	<b>Anticipated EFPH</b>	<b>Predicted maximum Heq conc., Ppm<sup>2</sup></b>	<b>Existing fracture toughness model valid?<sup>1</sup></b>
<b>Bruce Unit 3</b>	233,758	103.6	Yes	Jan 2023 (Refurbishment)	243,000	<120 ppm	Yes
<b>Bruce Unit 4</b>	230,355	101.9	Yes	Jan 2028 (Refurbishment)	251,000	<120 ppm	Yes
<b>Bruce Unit 5</b>	261,165	113.5	Yes	Jul 2026 (Refurbishment)	~300,000	>120 ppm	Yes <sup>4</sup>
<b>Bruce Unit 6</b>	243,773	N/A	Yes	N/A	N/A	N/A	N/A
<b>Bruce Unit 7</b>	252,708	110.9	Yes	Jul 2028 (Refurbishment)	~300,000	>120 ppm	Yes <sup>4</sup>
<b>Bruce Unit 8</b>	238,887	95.7	Yes	Jul 2030 (Refurbishment)	~300,000	>120 ppm	Yes <sup>4</sup>
<b>Point Lepreau</b>	65,173	59.3	Yes	July 2042 (210,000 EFPH) Feb 2046 (235,000 EFPH)	302,220	99	Yes

#### Notes

1. The existing fracture toughness model is valid for the entire pressure tube except for the regions within 60 mm of the outlet rolled joint burnish mark and within 20 mm from the inlet burnish mark. The validity of the model for the regions near the burnish marks (BM) is under investigation. Continued operation of pressure tubes with the potential for elevated Heq near the outlet rolled joint is based on Records of Decision DEC 21-H114, DEC 21-H11, DEC 21-H111 and DEC 21-H112. The incremental risk of

continued operation of pressure tubes with the potential for elevated [Heq] near the inlet burnish has been assessed to be low until at least 2023 and remains under investigation. This note is applied for both of the Rev. 1 and Rev. 2 models as with the exception of locations near the burnish marks, the [Heq] is bounded by model predictions

2. For pressure tubes operating beyond 210,000 EFPH, the [Heq] predictions exclude the regions of the tubes from the outlet rolled joint BM to BM+60mm and from the inlet rolled joint BM to BM+20mm. Predictions have conservatively been made at the outlet BM and bound the predicted values at BM+60 mm
3. The current Rev. 2 fracture toughness model has a validity limit of 100ppm for front end material. Pickering Unit 1 contains 50% of tubes oriented with front end material at the outlet location
4. The current Rev. 2 Fracture Toughness model is valid to 140ppm

## D. LIST OF LICENCE CONDITIONS HANDBOOK CHANGES

The following table lists the LCHs for each facility covered by the regulatory oversight report and indicates the changes made to LCHs in 2021.

For those that were revised in 2021, the details are provided below.

Facility	LCH #	Revision # as of December 31, 2021	Revised in 2021?
DNGS	LCH-PR-13.01/2025	R004	Yes (June 17, 2021)
DWMF	LCH-W4-355.01/2023	R000	No
PNGS	LCH-PR-48.00/2028	R004	Yes (April 27, 2021)
PWMF	LCH-W4-350.00/2028	R000	No
Bruce A and B	LCH-PR-18.01/2028-R002	R003	Yes (September 24, 2021)
WWMF	LCH-W4-314.00/2027	R000	No
RWOS-1	LCH-WNSL-W1-320.05/2029	R000*	No
Point Lepreau	LCH-PR-17.00/2022	R001	No
Gentilly-2	MCP-GENTILLY-2	R001	No

\*The LCH for RWOS-1 was issued on August 17, 2020. There have been no changes to the LCH since issuance



### Revisions to LCH for Darlington Nuclear Generating Station (2021)

On June 17, 2021, CNSC staff made a number of changes to clarify recommendations, guidance and the compliance verification criteria in various sections to include a new or revised CNSC regulatory documents and CSA Group standards (these developments are described in this report and are aligned with the Commission decisions) and licensee documents.

The table below summarizes the changes made in revision R004:

LC(s)	Sub-section	Change
G.6 10.1 Appendix C	CVC	Updated to reflect that RD/GD 99.3 has been superseded by REGDOC-3.2.1 – <i>Public Information and Disclosure</i>  Removed references to RD/GD 99.3 and replaced with references to REGDOC-3.2.1 throughout the document: <ul style="list-style-type: none"> <li>• LC 10.1</li> <li>• Appendix C.2</li> </ul>
1.1	CVC	Updated CVC text to reflect OPG’s statement of compliance with REGDOC-2.1.2 – <i>Safety Culture</i> . Removed text from the CVC that stated OPG was to inform CNSC staff when OPG’s governance had been updated to include security culture  Updated the effective implementation date to 2020-11-26, to coincide with OPG’s stated implementation date
2.1	CVC	Update to the implementation dates and notes to reflect the publication of REGDOC-2.2.4 – <i>Fitness for Duty, Volume II: Managing Alcohol and Drug Use, Version 3</i> , and its effective implementation date of July 22, 2021  Updated the notes for this CVC to state that OPG has implemented the requirements of the REGDOC, with exception of random drug and alcohol testing requirements  Updated references to this REGDOC to reflect Version 3 throughout the LCH.
2.1	CVC	Added REGDOC-2.2.4 – <i>Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical, Psychological Fitness</i> as CVC. Updated the CVC to state that CNSC considers the effective date of all requirements of the REGDOC to be December 31, 2020
2.1	Guidance	Removed guidance paragraph referencing publication of REGDOC-2.2.4 – <i>Fitness for Duty, Volume I: Managing Worker Fatigue</i> and OPG’s implementation of the REGDOC  Removed guidance paragraph referencing the future submission of OPG’s implementation plan for REGDOC-2.2.4 Volume III. This REGDOC has been incorporated in CVC under subsection 2.1

LC(s)	Sub-section	Change
2.1	CVC	Added OPG document N-LIST-09110-10005 – <i>Listing of Broad Population and Safety Sensitive Job Codes</i> to the LCH in support of implementation of REGDOC-2.2.4.
2.3	LC	<p>Removed references to RD-204 in this subsection, as per the Record of Decision in the matter of <i>Bruce Power, Ontario Power Generation, and New Brunswick Power Applications to Amend Four Nuclear Power Reactor Operating Licences to reference REGDOC-2.2.3, Personnel Certification, Volume III: Certification of Persons Working at Nuclear Power Plants</i></p> <p>Removed consequential references throughout the remainder of the LCH:</p> <ul style="list-style-type: none"> <li>• Subsection 2.3, CVC</li> <li>• Subsection 2.3, Guidance</li> <li>• Appendix C.2</li> </ul>
2.3	CVC	<p>Updated CVC to reflect CNSC staff approval of a pilot program to conduct written Initial General examinations using a multiple-choice question (MCQ) format.</p> <p>Changed OPG document N-INS-08920-10004 – <i>Written and Oral Initial Certification Examinations for Shift Personnel</i> from a “written notification” to a “prior written notification.”</p> <p>Added letter documenting CNSC consent to allow OPG to conduct Initial General written examinations using a MCQ format to Appendix G</p>
5.1	Preamble & Guidance	Added CSA N290.12-14 – <i>Human Factors in Design for Nuclear Power Plants Compliance Assessment Summary</i> as CVC, with an effective date of March 31, 2018, in accordance with subject matter expert recommendations and OPG’s implementation plan
5.2	CVC	<p>Updated CVC to capture CNSC acceptance of OPG’s request for variance to clauses 3 and 14.2.7 of CSA N285.0-08 and Update No. 2, to perform external weld overlay repairs based on approved OPG documentation</p> <p>Added reference to CNSC approval letter, as well as conditions required under the approval letter</p> <p>Made consequential changes to Appendix G</p>
6.1	Preamble	<p>Administrative change to combine bullet points unintentionally separated</p> <p>Moved two paragraphs discussing maintenance programs and planned outages from the Preamble into appropriate CVC sections</p>
6.1	CVC	Updated OPG implementation dates to September 15, 2021, for the following REGDOCs:

LC(s)	Sub-section	Change
		<ul style="list-style-type: none"> <li>• REGDOC-2.6.1 – <i>Reliability Programs for Nuclear Power Plants</i></li> <li>• REGDOC-2.6.2 – <i>Maintenance Programs for Nuclear Power Plants</i></li> </ul>
6.1	CVC	<p>Added CSA N285.8 – <i>Technical Requirements for In-Service Inspection Evaluation of Zirconium Alloy Pressure Tubes in CANDU Reactors to CVC/</i></p> <p>Administrative update to the version control list and notes. Made consequential changes to Appendices C and E, moving N285.8 to Appendix C, and removing obsolete entries from Appendix E</p>
6.1	CVC	<p>Updated text on the current operating limit of Darlington pressure tubes. Moved the text to the section on Aging Management, to align with the Pickering LCH</p> <p>Made consequential change to Appendix G, referencing the summary Record of Proceedings and Decision (Darlington Licence Renewal 2015)</p>
6.1	CVC	<p>Added new CVC with respect to the continued use of fracture toughness models, and the validation of the cohesive zone model</p> <p>Made consequential change to Appendix G, referencing OPG document on the uncertainty analysis to the cohesive-zone fracture toughness model</p>
6.1	CVC	<p>Added new CVC regarding CNSC expectations for the systematic inspection of pressure tubes corresponding with the highest estimated cumulative probability of through-wall cracking</p> <p>Made consequential change to Appendix G, adding CNSC response to OPG’s request to close the Probabilistic Core Assessment Flaw Removal issue</p>
6.1	CVC	<p>Administrative change to updated fuel channel periodic inspection text to align with the Pickering LCH, and to reference the currently-accepted periodic inspection program</p> <p>Made consequential change to Appendix G to add the currently-accepted PIP</p>
6.1	CVC	<p>Updated CVC to reflect CNSC conditional acceptance of revised OPG plan for the “Long-Term Use of CSA N285.8 for In-Service Evaluation of Zirconium Alloy Pressure Tubes”</p> <p>Made consequential change to Appendix G</p>
6.1	CVC	<p>Updated CVC to reflect CNSC acceptance of OPG’s use of the two-tiered approach for HROL, as well as an extension for its use until August 2022</p>

LC(s)	Sub-section	Change
		Made consequential change to Appendix G
6.1	CVC	Updated CVC to reflect the current status of OPG's procedural updates and technical justifications with respect to pressure tube material testing, to align with the Pickering LCH  Made consequential change to Appendix G
6.1	CVC	Updated CVC to reflect CNSC acceptance for use of interim acceptance criteria with respect to probabilistic leak-before-break (PLBB) assessments  Made consequential changes to Appendix G
6.1	CVC	Added new CVC to capture CNSC conditional acceptance of pressure tube acceptance criterion for CSA N285.8 Probabilistic Fracture Protection Assessments  Added new explanatory text for this CVC  Made consequential change to Appendix G
6.1	CVC	Updated CVC to reflect the most recent acceptance of continued operation of Darlington X-750 spacers and removed obsolete text referencing Review Gates 1 through 4  Made consequential change to Appendix G
6.1	CVC	Corrected a typographical mistake identified by OPG, referencing an incorrect revision of a CANDU Owners Group document, when compared to a letter approving the version of the document. Made consequential changes to Appendix D, Appendix E.1, and Appendix G  Added complementary paragraph to Steam Generator inspections and disposition process consent, which was misidentified as COG acceptance
6.1	CVC & Guidance	Deletion of legacy and obsoleted text from the LCH, updated by the changes listed above and made throughout subsection 6.1  Made consequential deletions of obsoleted documents from Appendix G
9.1	CVC	Updated with a note to indicate that CNSC staff consider OPG's implementation date for REGDOC-2.9.1, version 1.1, to be December 31, 2022
10.1	CVC	Added a note to state that OPG is to provide an implementation plan for REGDOC-2.10.1 – <i>Nuclear Emergency Preparedness and Response</i> , version 2, by September 24, 2021
10.2	CVC	Updated reference to CSA Group N293-12 (R2017) – <i>Fire</i>

LC(s)	Sub-section	Change
		<i>Protection for Nuclear Power Plants</i> standard, re-affirmed in 2017  Administrative change to add a note stating OPG is requested to provide an implementation plan by September 24, 2021
11.2	CVC	Updated CVC to reflect OPG's implementation plans and gap analysis to address requirements of CSA N294-19 – <i>Decommissioning of Facilities Containing Nuclear Substances</i>  OPG committed to implement the revision to the standard by December 31, 2021
12.1	CVC	Added REGDOC-2.12.1 – <i>High Security Facilities, Volume 1: Nuclear Response Force, Version 2</i> to CVC, with an effective date of December 31, 2020
12.1	CVC	Revised the wording of the Cyber Security section to align with the inclusion of N290.7-14 as CVC since November 2019
13.1	Preamble	Removed obsolete references to RD-336 – <i>Accounting and Reporting of Nuclear Material</i> and AECB-1049 Rev. 2 – <i>Reporting Requirements for Fissionable and Fertile Substances</i>
13.1	CVC	Removed references to RD-336 from CVC and throughout the text, replacing it with reference to REGDOC-2.13.1 – <i>Safeguards and Nuclear Material Accountancy</i> . OPG indicated full compliance with the REGDOC, with exception of aspects related to non-fuel materials accountancy, as of March 31, 2020; OPG had committed to full implementation as of April 2021 but requested a 6-month delay  Added reference accepting OPG's request to delay full compliance with the non-fuel nuclear material inventory requirements in the REGDOC due to COVID-19  Removed text referencing RD-336 reporting requirements and replaced with a statement of compliance with REGDOC-2.13.1. Made consequential changes to Appendix D and Appendix E.2
15.2 15.4	Guidance	Made various administrative changes to reflect Return to Service protocols for multiple units prior to the commencement of refurbishment activities on Unit 3
Appendix D	All	Administrative change to the title of Appendix D to be renamed to "List of Licensee Documents that Require Notification of Change," to align with the Pickering LCH

### Revisions to LCH for Pickering Nuclear Generating Station

On April 27, 2021, CNSC staff made a number of changes to clarify recommendations, guidance and the compliance verification criteria in various sections to include a new or revised CNSC regulatory documents and CSA Group standards (these developments are described in this report and are aligned with the Commission decisions) and licensee documents.

The table below summarizes the changes made in revision R004:

<b>LC(s)</b>	<b>Sub-section</b>	<b>Change</b>
G.6	CVC	Updated to reflect completed implementation of REGDOC-3.2.1
1.1	CVC	Updated to reflect completed implementation of REGDOC-2.1.2
2.1	CVC	Updated to reflect effective implementation dates for REGDOC-2.2.4 Volume II, Version 3
3.3	CVC	Added a new written notification document
4.1	CVC	Added CNSC acceptance for DAC and removed outdated text concerning next Safety Report update; added new requirement for the methodology and timeline for re-categorization of LBLOCA CSI to category 2 (CMD 20-H110)
5.2	CVC	Updated to capture acceptance for variance to CSA N285.0-08 specific clauses
6.1	CVC	Updated to reflect implementation of REGDOC-2.6.1 and REGDOC-2.6.2
6.1	CVC	Updated to reflect CNSC acceptance of the revised compliance plan N-REP-31100-10061; updated CVC for Cohesive Zone Fracture Toughness Model
6.1	CVC	Add new CVC regarding CNSC expectations for the systematic inspection of pressure tubes; Added CVC recording CNSC acceptance of OPG's "Level 2" approach for evaluation of pressure tube crevice corrosion flaws in Pickering Units 5 to 8
6.1	CVC	Updated to reflect latest leakage rate test schedule for Pickering Units 4 and 7
9.1	CVC	Updated to reflect implementation of REGDOC-2.9.1 v1.1
11.2	CVC	Update to reflect OPG implementation plans for N294:19
12.1	CVC	Added CNSC interpretation for "annual" in CSA N290.7-14

<b>LC(s)</b>	<b>Sub-section</b>	<b>Change</b>
		as it relates to annual issuing of CEA lists
13.1	CVC	Updated effective dates for REGDOC-2.13.1 implementation and removed redundant CVC
15.1	CVC	Added new CVC allowing for modification of IIP items as approved by Commission (CMD 20-H110)

### Revisions to LCH for Bruce A and B Nuclear Generating Stations

On September 28, 2021, CNSC staff made a number of changes to clarify recommendations, guidance and the compliance verification criteria in various sections to include a new or revised CNSC regulatory documents and CSA Group standards (these developments are described in this report and are aligned with the Commission decisions) and licensee documents.

**The table below summarizes the changes made in revision R003:**

LC(s)	Sub-section	Change
2.1 Human Performance Management	CVC (Administrative)	Licensing basis publication of REGDOC-2.2.4 Vol. II, rev. 2021, <i>Managing Alcohol and Drug Use, Version 3</i>
4.1 Safety Analysis Program	CVC (Administrative)	<ul style="list-style-type: none"> <li>• Delete regulatory document S-294, <i>Probabilistic Safety Assessment (PSA) for Nuclear Power Plants</i> from LCH as it has been replaced by REGDOC-2.4.2, <i>Probabilistic Safety Assessment (PSA) for Nuclear Power Plants</i>, effective 2019</li> </ul>
5.1 Physical Design Program	CVC (Administrative)	<ul style="list-style-type: none"> <li>• Implementation date for N290.12-14, <i>Human factors in design for nuclear power plants</i> added of March 31, 2021, e-Doc 6445651</li> <li>• Correct the title of CSA N2901.14-15, <i>Qualification of digital hardware and software for use in instrumentation and control applications for nuclear power plants</i></li> <li>• Updated revision year 2016 of a guidance publication for CSA N290.5, <i>Requirements for electrical power and instrument air systems of CANDU nuclear power plants</i></li> </ul>
5.3 Equipment and Structure Qualification Program	CVC (Administrative)	Removal of redundant statement on the requirements for condition monitoring of EQ components and monitoring of normal environmental conditions
6.1 Fitness for Service Program	CVC (Administrative)	<ul style="list-style-type: none"> <li>• Section 6.1 of the LCH-PR-18.01/BNGS-R003 was updated to reference the written notification documents, e-Doc 6361048</li> <li>• Updated Licensing basis publications table for the dates of CSA N285.4, <i>Periodic inspection of CANDU nuclear power plant components</i> and CSA N285.8, <i>Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors</i></li> <li>• Updated the text for Periodic Inspection and Testing With respect to CSA N285.4 Clause</li> </ul>



LC(s)	Sub-section	Change
		<p>12.2.5.1.3, CNSC staff have reviewed and accepted, e-Doc 6307648, Bruce Power's Compliance Plan, e-Doc 5936135, for the use of CSA N285.8-15 Update 1 to evaluate inspection results</p> <ul style="list-style-type: none"> <li>• Updated Guidance table in Section 6.1</li> <li>• Added the text for Periodic Inspection and Testing requirements</li> </ul> <p>Updated of Fracture Toughness Model and Periodic Inspection text in <i>Validation of the Cohesive Zone-based Fracture Toughness Model, CSA N285.8-15, Clause D13.2.3</i></p>
7.1 Radiation Protection Program	CVC (Administrative)	<ul style="list-style-type: none"> <li>• Added text to Section 7.1, Table 1 on Beta-Gamma Discrete Radioactive Particle in Public Domain as per e-Doc 6242072</li> <li>• Added text to Section 7.1, <i>Guidance on REGDOC-2.7.1, Radiation Protection and REGDOC-2.7.2, Ascertaining Occupational Dose, Volume I</i> as per Bruce Power Transition Plan, e-Doc 6511470</li> </ul>
9.1 Environmental Protection Program	CVC (Administrative)	<ul style="list-style-type: none"> <li>• Updated ERA text and included a new text on the results from review of the Lutetium-177 ERA gap analysis</li> <li>• Included CSA N288.9, <i>Guideline for Design of Fish Impingement and Entrainment Programs at Nuclear Facilities</i> as a guidance publication in Section 9.1 and Appendix C</li> <li>• Added of REGDOC-2.9.1, version 1.2, <i>Environmental Protection: Environmental Principles, Assessments and Protection Measures</i> as a licensing basis document to section 9.1 and to Appendix B. Replaced REGDOC-2.9.2 version 1.1 e-Doc 6511542</li> <li>• Added DRLs for the Central Storage Facility (CSF) to table 9.1, <i>Transition Derived Release Limits</i></li> <li>• Update Notes to Table 9.2a, <i>New Environmental Action Levels (EALs)</i></li> </ul> <p>Changed implementation date of the new DRLs as per CSA N288.1-14 Update 3 and the new EALs as per CSA N288.8-17 to December 31, 2021</p>
10.1 Emergency Preparedness	CVC (Administrative)	<ul style="list-style-type: none"> <li>• Updated text on automatic data transfer in Section 10.1</li> <li>• Added implementation plan for REGDOC-</li> </ul>

LC(s)	Sub-section	Change
Program		2.10.1, <i>Nuclear Emergency Preparedness and Response, Version 2, 2016</i> to Guidance publications table
10.2 Fire Protection Program	CVC (Administrative)	<ul style="list-style-type: none"> <li>Deleted unnecessary text from Section 10.2 Fire Protection Program due to completion of the implementation plan</li> </ul> Added implementation plan for CSA N293-12 (R2017), <i>Fire protection for nuclear power plants</i> to section 10.2 and Appendix C
11.1 Waste Management Program	CVC (Administrative)	Added definition of radioactive waste to Section 11.1 to give context to the Preamble of the Section 11.1 as per REGDOC-2.11, <i>Framework for Radioactive Waste Management and Decommissioning in Canada</i>
12.1 Nuclear Security Program	CVC (Administrative)	<ul style="list-style-type: none"> <li>Added REGDOC-2.12.3, version 2.1, <i>Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material</i> as a guidance document to section 12.1 and to Appendix C</li> <li>Updated text regarding Cyber security Program in CVC section and Appendix C</li> <li>Remove references to RD-363 as it has been replaced by REGDOC-2.2.4, <i>Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical, and Psychological Fitness</i></li> <li>Include REGDOC-2.12.1, <i>High-Security Facilities, Volume II: Criteria for Nuclear Security Systems and Devices</i> that superseded RD-321 and RD-361 and references to these regulatory documents have been removed, e-Doc 6510310</li> </ul>
13.1 Safeguards Program	CVC (Administrative)	<ul style="list-style-type: none"> <li>Revision of text introducing REGDOC-2.13.1, <i>Safeguards and Nuclear Material Accountancy</i>. Editorial change to Section 13.1. Delete requirements found in REGDOC-2.13.1 redundant information</li> </ul>
14.1 Packaging and Transport Program	CVC (Administrative)	Added REGDOC-2.14.1, <i>Packaging and Transport of Nuclear Substances Regulations, Volume I, Version 2</i> , as a Guidance document to section 14.1 and Appendix C
Licence Condition 15.3 Pressure Tube	Licence Condition (Administrative)	Update Preamble and CVC text for CSA N285.4-14 and CSA N285.8-15 Update 1 as outlined in Section 6.1.

LC(s)	Sub-section	Change
Fracture Toughness		
Licence Condition 15.5 Regulatory Hold Points for Return to Service and Continued Operation	Licence Condition (Administrative)	Added to the Guidance publications table REGDOC-2.3.1 which was already referred to in the Guidance section
Licence Condition 15.9 Criticality Program	Licence Condition (Administrative)	Added REGDOC-2.4.3, version 1.1, <i>Nuclear Criticality Safety</i> as a guidance document to section 15.9 and to Appendix C
Licence Condition 15.10 Cobalt-60 and Lutetium-177	Licence Condition (Technical)	Modification Licence Condition 15.10 from Cobalt-60 to Cobalt-60 and Lutetium-177 as per modification of Bruce Power Licence Amendment Application, e-Doc 6430874, <i>The licensee shall implement and maintain a program for the production of the nuclear substances Cobalt-60 and Lutetium-177</i>
Licence Condition G.1 Licensing Basis for the Licensed Activities	Licence Condition (Administrative)	Publication of REGDOC-3.5.3 rev. 2021, <i>Regulatory Fundamentals, Version 2</i>
Licence Condition G.5 Public Information and Disclosure	Licence Condition (Administrative)	REGDOC-3.2.1 rev. 2018, <i>Public information and disclosure</i> made a CVC document, effective Aug 5, 2020