



Canada

Report to the 10th Review Meeting of the Convention on Nuclear Safety



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du Canada

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of Canada

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**Acronyms, Abbreviations, and Definitions**

Term	Meaning, Definition
Action level	A specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee's radiation protection program and triggers a requirement for specific action to be taken
AECL	Atomic Energy of Canada Limited
AI	Artificial intelligence
ALARA	As low as reasonably achievable
AMP	Administrative monetary penalty
BDBA	Beyond design basis accident
Bq	Becquerel
CANDU	Canada Deuterium Uranium
CMD	Commission member document
CNA	Canadian Nuclear Association
CNL	Canadian Nuclear Laboratories
CNRI	Canadian Nuclear Research Initiative
CNS	<i>Convention on Nuclear Safety</i>
CNSC	Canadian Nuclear Safety Commission
COG	CANDU Owners Group
ConvEx	Convention exercise (operated under the framework of the IAEA <i>Convention on Early Notification of a Nuclear Accident</i>)
Commission	The tribunal component of the Canadian Nuclear Safety Commission
CSA	Canadian Standards Association, referred to organizationally as CSA Group
CSI	CANDU safety issue
DNNP	Darlington new nuclear project
DRL	Derived release limit
EFPH	Equivalent full power hours
EMEG	Emergency mitigating equipment guidelines
EPREV	Emergency preparedness review
EPRI	Electric Power Research Institute
ERA	Environmental risk assessment
FERP	<i>Federal Emergency Response Plan</i>
FNEP	<i>Federal Nuclear Emergency Plan</i>
G7	Group of seven nations (Canada, United States of America, France, United Kingdom, Germany, Italy, Japan and representatives of the European Union)
GEH	General Electric-Hitachi
GIF	Generation IV International Forum



Term	Meaning, Definition
HFE	Human factors engineering
IA	Impact assessment
IAA	<i>Impact Assessment Act</i>
IAAC	Impact Assessment Agency of Canada
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IEMP	Independent environmental monitoring program
IIP	integrated implementation plan
INES	International nuclear event scale
INFCIRC	Information circular (IAEA publication)
INPO	Institute of Nuclear Power Operations
INSAG	International Nuclear Safety Advisory Group
IRMIS	International Radiation Monitoring Information System
IRS	International Reporting System
IRRS	Integrated Regulatory Review Service
ISR	Integrated safety review
Joint Convention	<i>Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management</i>
KI	Potassium iodide
LBLOCA	Large break loss of coolant accident
LCH	Licence conditions handbook
MCR	Major component replacement
METER	Medical emergency treatment for exposure to radiation
MSC	Minimum staff complement
mSv	Millisievert
MW	Megawatt
Mwe	Megawatt (electrical)
NBEMO	New Brunswick Emergency Measures Organization
NB Power	New Brunswick Power
NEA	Nuclear Energy Agency (OECD)
NEW	Nuclear energy worker
NPP	Nuclear power plant
NRCan	Natural Resources Canada
NSCA	<i>Nuclear Safety and Control Act</i>
NSERC	Natural Sciences and Engineering Research Council
NSRB	Nuclear safety review board
OECD	Organization for Economic Co-operation and Development
OP&P	Operating policies and principles



Term	Meaning, Definition
OPEX	Operating experience
OPG	Ontario Power Generation
PNERP	<i>Provincial Nuclear Emergency Response Plan</i>
PSA	Probabilistic safety assessment
PSR	Periodic safety review
R&D	Research and development
RANET	Response and Assistance Network
REGDOC	Regulatory document (CNSC publication)
RPD	Regulatory program division
RPR	<i>Radiation Protection Regulations</i>
SAM	Severe accident management
SAMG	Severe accident management guidelines
SCA	Safety and control area
SSCs	Structures, systems and components
SDS	Shutdown system
TAG	(FNEP's) Technical Assessment Group
TECDOC	Technical document (IAEA publication)
UNENE	University network of excellence in nuclear engineering
VDNS	<i>Vienna Declaration on Nuclear Safety</i>
WANO	World Association of Nuclear Operators

Executive Summary

This tenth Canadian report demonstrates how Canada continued to meet its obligations under the terms of the *Convention on Nuclear Safety* (CNS) during the reporting period from April 2022 to March 2025. During this period, Canada effectively maintained and, in many cases, enhanced its measures to meet its obligations under the CNS. Enabled by a comprehensive legislative framework, these measures – which focus on the health and safety of persons and the protection of the environment – are implemented by Canada's nuclear regulator, licensees of nuclear power plants (NPPs), and other government institutions and industry stakeholders. Canada remains fully committed to the principles and implementation of the CNS by undertaking continuous improvements to maintain the highest level of safety of NPPs in Canada and around the world.

For the purposes of this report, the term “NPP” encompasses the existing operating fleet of CANDU reactors as well as any possible future power- or heat-producing reactor facilities such as small modular reactors (SMRs) or other advanced reactor concepts. Nineteen Canada Deuterium Uranium (CANDU) reactors were operating in Canada during the reporting period and three reactors were in safe storage. At the end of the reporting period, two of the operating reactors were permanently shut down and are transitioning to safe storage. Preparations continued for possible new-build projects, including those involving SMRs. Of note was the commencement of construction of an SMR at the Darlington New Nuclear Project (DNNP).

Nuclear-related activities at NPPs in Canada are governed by robust, modern legislation, with appropriate and well-defined powers to ensure the NPPs remain safe. The most important legislation is the *Nuclear Safety and Control Act* (NSCA), which is complemented by regulations and other regulatory instruments. Canada's nuclear regulator, the Canadian Nuclear Safety Commission (CNSC), is mature and well established. A system of licensing is in place to control activity related to NPPs and to protect the health and safety of persons, the environment, and national security. The CNSC has a comprehensive program to ensure compliance with the regulatory framework and monitor the safety performance of the NPPs. A comprehensive set of graduated enforcement tools are available to the CNSC to address non-compliances. The CNSC's regulatory framework and processes feature a high degree of openness and transparency.

The Canadian regulatory framework, which is largely non-prescriptive, is continuously updated and aligned with international standards. Renewals of operating licences for NPPs are used to introduce new standards and requirements that the licensees actively implement. Periodic safety reviews (PSRs) are also conducted on 10-year intervals to assess and close any gaps with modern standards and requirements. The framework is also being improved to adjust to emerging technologies, including the deployment of SMRs.

Canada's nuclear industry has an excellent safety record. During the reporting period, NPP licensees fulfilled the basic responsibilities for safety as required by the NSCA, regulations, and the NPP operating licences. The licensees also addressed any safety issues that arose, in order to keep the risk at reasonable levels – and continued to give safety a high priority at every level of their organizations.

None of the safety-significant events that occurred at Canadian NPPs during the reporting period posed a significant threat to persons or the environment. The licensees' efforts to

address operational events and other issues were effective in correcting any deficiencies and preventing recurrence.

During the reporting period, all Canadian NPPs operated with acceptable safety margins and acceptable levels of defence in depth. The maximum annual worker doses at NPPs were below annual dose limits, and all radiological releases from NPPs were very low – below 1% of derived release limits.

During the reporting period, Canada also addressed the four specific CNS challenges that were identified for Canada at the Joint 8th and 9th Review Meeting:

- 9RM C-1 *Update guidance document Generic Criteria and Operational Intervention Levels for Nuclear Emergency Planning and Response and include guidance on protection strategies and reflect guidance in provincial plans*
- 9RM C-2 *Approve and implement revision of Ontario's Provincial Nuclear Emergency Plan (PNERP)*
- 9RM C-3 *Optimize regulatory capacity and capability to effectively and efficiently assess licence applications for other nuclear technologies*
- 9RM C-4 *Ensure an effective approach between federal departments to provide proponents with certainty related to process and timelines for environmental impact assessments*

To address 9RM C-1, Health Canada is updating and expanding its guidance document on nuclear emergency planning and response, adapting IAEA recommendations as appropriate. This includes advice on developing integrated protection strategies, emphasizing the importance of anticipating, recognizing, and mitigating both radiological and non-radiological hazards. Public consultation on the revision of this document is planned to commence in the fall/winter of 2025. The provincial plans of Ontario and New Brunswick reflect the current guidance, and they are scheduled for further adjustment following the approval of the updated guidance.

To address 9RM C-2, the Province of Ontario is continuing to review the PNERP and associated Nuclear Emergency Management Program (NEMP). The NEMP enhancements were ongoing at the end of the reporting period and are expected to be implemented by 2026.

To address 9RM C-3, CNSC is enhancing and expanding its technical ability and competency in SMRs and advanced reactors. CNSC staff are involved in multiple initiatives to optimize regulatory capacity and capability to ensure that the assessment of licence applications is as effective and efficient as possible. CNSC's SMR readiness project is further expanding the existing Canadian regulatory framework to incorporate SMRs and novel technologies alike. CNSC has hired new staff and provided training on SMR and novel technologies and has worked with federal partners on programs to further research on SMRs and novel technologies. The CNSC also developed a knowledge management process for knowledge gained in the licensing of SMRs.

To address 9RM C-4, CNSC staff are currently involved in multiple initiatives to meet the challenge of ensuring an effective approach between federal departments to provide proponents with certainty related to process and timelines for environmental/impact assessments. Primarily, CNSC staff have been collaborating with the Impact Assessment Agency of Canada (IAAC) to ensure readiness for future integrated impact assessments (IAs). In addition, CNSC is conducting work as part of its SMR readiness project to ensure



CNSC's readiness to licence and regulate SMRs. This work includes more than 50 objectives to further explore areas for regulatory efficiency and optimize CNSC's regulatory framework for licensing new project proposals.



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Introduction

About This Report

Canada was one of the first signatories of the *Convention on Nuclear Safety* (CNS, also referred to as the Convention), which came into force on October 24, 1996. Canada has endeavoured to fulfill its obligations to the Convention, as demonstrated in the Canadian reports presented at the triennial review meetings of the Convention. Canada remains fully committed to the principles and implementation of the Convention by undertaking continuous improvements to maintain the highest level of safety of nuclear power plants (NPPs) in Canada and around the world.

This tenth Canadian report was produced on behalf of the Government of Canada by a team led by the Canadian Nuclear Safety Commission (CNSC). Contributions to the report were made by representatives from Bruce Power, NB Power, Ontario Power Generation (OPG), AtkinsRéalis Group, the CANDU Owners Group (COG¹), Natural Resources Canada (NRCan), Health Canada, Canadian Nuclear Association (CNA) and Global Affairs Canada.

The previous Canadian report (the ninth) was issued in August 2022 in preparation for the Joint Eighth and Ninth Review Meeting of the CNS.

A.1 Scope

As required by article 5 of the Convention, this tenth Canadian report demonstrates how Canada fulfilled its obligations under articles 6 to 19 of the Convention during the reporting period, which extended from April 2022 through March 2025. The report closely follows the form and structure established by the Contracting Parties to the Convention, pursuant to article 22 and the International Atomic Energy Agency (IAEA) document INFCIRC/572/Rev.7, *Guidelines Regarding National Reports Under the Convention on Nuclear Safety*. Further, it also follows a template for national reports that was approved for use by the Contracting Parties at the Joint Eighth and Ninth Review Meeting. This tenth Canadian report describes the basic provisions that Canada has made to fulfill the obligations of the Convention and provides details on the changes that have taken place since the publication of the ninth Canadian report.

Per Canada's [Nuclear Safety and Control Act](#) (NSCA), all reactor facilities are designated as Class IA facilities and regulated under the [Class I Nuclear Facilities Regulations](#). The nuclear installations referred to in the articles of the Convention are taken to specifically mean a single power reactor. This report uses the terms power reactor and unit interchangeably. The term 'power reactor' is generally understood to mean any power-producing reactor² that is not a research reactor. For the purposes of this report, the term 'NPP' encompasses the existing operating fleet of CANDU reactors as well as any possible future, power-producing reactor facilities, such as those with small modular reactors (SMRs) or other advanced reactor concepts. It is important to note in Canada that the majority of NPPs are multi-unit

¹ On April 2, 2025 (after the end of the reporting period), COG changed its name to Conexus Nuclear Inc.

² Power production is not restricted to electricity generation and could include other commercial uses of process heat.

NPPs. Potential new reactor concepts vary significantly in size, design features and cooling types and could be sited in places quite different from past NPP projects in Canada (e.g., in small and isolated communities). Besides potentially serving different electricity markets and enhancing grid stability, they may have uses beyond electricity generation, such as hydrogen production, desalinization and industrial or district heating.

In this report, much of the general and specific information pertains to the existing fleet of CANDU reactors. Illustrative examples often reflect the licensees of the operating NPPs, the CANDU design and its design organization. However, details and examples pertinent to other projects and vendors are also provided as appropriate.

The Canadian report does not cover nuclear research reactors. In addition, this report does not cover nuclear security and safeguards, nor does it cover spent fuel and radioactive waste, except for the discussion in sub-article 19(viii). Spent fuel and radioactive waste are addressed thoroughly in the seventh [*Canadian National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*](#), published in October 2020. The eighth National Report will be available on the [Open Government](#) website (see Annex A) when available.

A.2 Contents

This report contains three chapters. Chapter I provides important context for the rest of the report. Section A of chapter I provides a general introduction to the report while section B summarizes the outcomes of the Joint Eighth and Ninth Review Meeting for Canada, including the specific good practices, good performances and challenges that were identified for Canada. Section C describes aspects of nuclear power policy and nuclear-related activity in Canada. Section D provides a high-level description of the nuclear power industry in Canada and recent major developments (e.g., life extensions and new-build projects). Although these sections do not directly apply to any particular article of the Convention, they represent the context within which the articles are met. Section E describes the *Vienna Declaration on Nuclear Safety* (VDNS).

Chapter II provides an overview of the report's conclusions, including a summary statement of Canada's fulfillment of the articles of the Convention. It also summarizes:

- progress on addressing the challenges identified for Canada at the Joint Eighth and Ninth Review Meeting
- significant changes not directly related to the challenges identified for Canada
- notable achievements
- areas of future focus
- Canada's measures and progress related to the "major common issues" that were identified at the Joint Eighth and Ninth Review Meeting
- measures that address the VDNS

Chapter III includes detailed material that demonstrates how Canada implemented its obligations under articles 6 to 19 of the Convention during the reporting period. Chapter III is subdivided into four parts that correspond to the subdivision of the Convention articles:

- Part A General provisions (article 6)
- Part B Legislation and regulation (articles 7 to 9)
- Part C General safety considerations (articles 10 to 16)
- Part D Safety of installations (articles 17 to 19)

The sections for each article begin with the text of the relevant article of the Convention. The term “Contracting Party” in an article refers to each signatory to the Convention. For each article, the description of Canada’s provisions to fulfill the relevant obligations is organized in sub-articles that follow the structure and numbering of the obligations as presented in the article itself. Where a breakdown into finer subsections is used, lowercase letters have been appended to the article or sub-article numbering, for reference purposes (e.g., subsection 8.1(a)).

The challenges identified for Canada at the Joint Eighth and Ninth Review Meeting are highlighted near the beginning of the relevant discussion. Per the template for CNS reports, the progress toward addressing each challenge is summarized at the end of the article in which the main discussion appears. Also, in line with the template for CNS reports, at the end of articles (where applicable), there are summaries titled “Notable Achievements” and/or “Future Focus.” These summaries are intended to draw the reviewers’ attention to specific areas where Canada has either taken noteworthy, positive action or plans to take action to address a noteworthy situation where improvement or adjustment is intended.

There are two sets of annexes at the end of the report. Annexes A through E provide detailed information that is relevant to more than one article. The remaining annexes, on the other hand, provide supplementary, specific information that is directly relevant to the manner in which Canada fulfills a particular article or sub-article. The number of each of those annexes corresponds to the number of the article, sub-article, or subsection to which the annex is relevant.

The full text of previous Canadian reports, the Canadian report to the Second Extraordinary Meeting and related documents can be found on the websites of the CNSC and the IAEA. This tenth Canadian report will be available on the IAEA website upon submission in August 2025 and will be posted to the [CNSC website](#) in late 2025 or early 2026, in both of Canada’s official languages (English and French). The annual CNSC staff reports on the regulatory oversight of Canadian NPPs and other facilities, as well as the annual reports of the CNSC, can also be found on the CNSC website.

B. Outcome of the Joint Eighth and Ninth Review Meeting

Table 1 lists the challenges (C) identified for Canada at the Joint Eighth and Ninth Review Meeting. The table also lists the good practice (GP) and good performances (gp) that were identified for Canada at the Joint Eighth and Ninth Review Meeting. Cross-references to the relevant subsections of this ninth Canadian report are provided.

Table 1: Major review results for Canada from the Joint Eighth and Ninth Review Meeting

Identifier	Text	Subsection
Challenges from Joint Eighth and Ninth Review Meeting		
9RM C-1	Update guidance document Generic Criteria and Operational Intervention Levels for Nuclear Emergency Planning and Response and include guidance on protection strategies and reflect guidance in provincial plans	16.1 (a)

Identifier	Text	Subsection
9RM C-2	Approve and implement revision of Ontario's Provincial Nuclear Emergency Plans	16.1 (d)
9RM C-3	Optimize regulatory capacity and capability to effectively and efficiently assess licence applications for other nuclear technologies	8.1 (c)
9RM C-4	Ensure an effective approach between federal departments to provide proponents with certainty related to process and timelines for environmental impact assessments	17(ii)(a)
Good practice from Joint Eighth and Ninth Review Meeting		
9RM GP-1	Use of Licence Condition Handbooks and specifically the compliance verification criteria to promote consistency and objectivity of regulatory oversight	7.2(ii)(a)
9RM GP-2	CNSC engagement of Indigenous Nations and communities and the public at Commission proceedings and during all stages of regulatory initiatives	8.1(f)
Good performances from Joint Eighth and Ninth Review Meeting		
9RM gp-1	Development and ongoing execution of Canada's SMR Action Plan through funding policy development, capacity building and research and development	Introduction C.1
9RM gp-2	Publication of discussion papers to solicit early public feedback on regulatory initiatives such as the CNSC's discussion paper on the regulatory strategy, approaches and challenges associated with SMRs	7.2(i)(b)
9RM gp-3	The systematic approach for NPP-related knowledge and on the job training for NPP site inspectors in both technology and regulatory processes	8.1(c)
9RM gp-4	Development and methodology and submission to CNSC of whole-site PSA for multi-unit NPPs	14(i)(d)
9RM gp-5	CNSC readiness to regulate SMRs (Regulatory strategy; Enhancement to regulatory framework for deployment of new technology, Capacity-building, International collaboration)	7.2(i)(b), 8
9RM gp-6	Use of models to simulate and depict visual real time severe accident progression to make training and exercises more realistic	11.2(a)
9RM gp-7	Rigorous planning for safe execution of extensive refurbishments, including replacement of major components of multiple units in parallel	Introduction C.3

For the Joint Eighth and Ninth Review Meeting, Canada was part of Country Group 4, which also included Japan, Hungary, Armenia, Lithuania, Indonesia, Madagascar, Norway, Saudi

Arabia, North Macedonia, Bahrain, Denmark and Benin. During the ninth review cycle, Canada responded to 144 comments and questions from numerous countries. These comments and questions pertained to topics such as safety culture of the licensee and the regulator, design improvements at the NPPs, new build projects (especially SMRs), dose limits and CNSC inspections.

C. National nuclear framework and policy

C.1 General framework

Under Canada's constitution, the development and implementation of nuclear energy policy fall within the federal government's jurisdiction, with provinces responsible for electricity generation. The Government of Canada's role encompasses research and development (R&D), as well as the regulation of all nuclear safety and control of nuclear materials and activities in Canada. In addition, the Crown, through Atomic Energy of Canada Limited (AECL), is the holder of the intellectual property for the Canada Deuterium Uranium (CANDU) reactor, which is licensed exclusively to Candu Energy Incorporated, a private sector company based in Mississauga, Ontario and owned by AtkinsRéalis Group Incorporated based in Montreal, Quebec. Since 2015, AECL's sites have been managed and operated by Canadian Nuclear Laboratories (CNL), a private sector organization, through a government-owned, contractor-operated model.

The [Nuclear Safety and Control Act](#) (NSCA), the [Nuclear Energy Act](#), the [Nuclear Fuel Waste Act](#) and the [Nuclear Liability and Compensation Act](#) are the centrepieces of Canada's legislative and regulatory framework for nuclear matters. The NSCA establishes Canada's independent regulator and is the key piece of legislation for ensuring the safety of the nuclear industry in Canada. These acts are complemented by other legislation that provides emergency management, environmental protection and worker protection, such as the [Emergency Management Act](#), the [Impact Assessment Act](#), the [Canadian Environmental Protection Act](#) and the [Canada Labour Code](#).

Beyond its legislative and regulatory frameworks, Canada's nuclear policy framework includes the following general elements: a nuclear non-proliferation policy, transparent and independent regulation, a radioactive waste policy framework, a uranium ownership and control policy, support for nuclear science and technology, and cooperation with provincial and territorial governments and municipal jurisdictions.

Nuclear energy is an emissions-free energy source that is recognized as a reliable and cost-competitive contributor to Canada's 82% decarbonized electricity mix, supporting climate change mitigation. The Canadian nuclear energy sector is a very important component of Canada's economy.

- In 2023, Canada's 19 operating CANDU power reactors supplied about 14% of Canada's electricity.
 - In the province of Ontario, approximately 51% of electricity production came from 18 operating CANDU reactors.
 - In the province of New Brunswick, the single CANDU reactor produces nearly one third (30%) of the province's electricity.
- CANDU reactors have been built and operated in several countries besides Canada, including three in operation in South Korea, two in China, two in Romania, one in Argentina, one in Pakistan, and one in India. Two additional CANDUs are set to be constructed in Romania.

Canada is also a major supplier of medical isotopes; developments related to the production of isotopes at NPPs are described in subsection D.4.

In addition to a comprehensive nuclear energy technology ecosystem, Canada is a top producer of uranium, responsible for 15% of world production. Production for 2022 was about 7,400 tonnes of uranium metal (tU), an almost 60% increase from the roughly 4,700 tonnes produced in 2021. Approximately 85% of Canada's uranium production is exported.

According to a recent study commissioned by the Canadian Nuclear Association (CNA) in 2024, Canada's nuclear industry employs 89,000 individuals (marking a significant 17% increase since 2019), and contributes CAD\$22 billion a year to Canada's gross domestic product.

Government of Canada Support for Nuclear

The Government of Canada has funded nuclear research and supported the development and use of nuclear energy and related applications for many decades. The first NPP in Canada began operation in 1962. As of 2025, the Government of Canada provides approximately \$76 million in yearly government appropriations for nuclear-related R&D activities through the [Federal Nuclear Science and Technology \(FNST\) Work Plan](#). To ensure that CNL has the facilities and infrastructure needed to continue to be a hub for nuclear innovation in Canada, in its *Budget 2024*, the Government of Canada also provided \$3.1B over 11 years to Atomic Energy of Canada Limited (AECL) to support CNL's ongoing work. The Government of Canada has also agreed to provide nearly \$30M for R&D on SMR supply chains and waste through the [Enabling SMRs Program](#).

Nuclear energy is considered by the Government of Canada to be a clean technology, which results in the nuclear energy sector being able to access certain incentives. Since the last reporting cycle, new mechanisms have been created to encourage investment certainty and mobilize capital for clean technology projects, including nuclear energy. Between several clean-economy investment tax credits, expenditures on new large nuclear builds, SMRs, refurbishment projects, manufacturing of nuclear fuels, and recycling of heavy water are eligible under at least one tax credit. In February of 2024, Canada also issued its second 'Green Bond' under an updated framework, which makes nuclear energy activities including investments in new reactors, refurbishment work, and R&D all eligible to receive Green Bond proceeds, unlocking a new source of capital for the sector.

See annex D for a description of nuclear R&D that is funded by these and other sources, including private investment.

Federal – Provincial – Territorial Collaboration

Although the Government of Canada has important responsibilities related to nuclear energy, the decision to invest in electricity generation rests with each province. It is up to each province, in concert with the relevant provincial energy organizations and power utilities and regulatory bodies, to determine whether NPPs should be built and operated. However, the Government of Canada has provided targeted financial support to specific projects in several provinces through different programs. NRCan's Electricity Predevelopment Program and Environment and Climate Change Canada's Future Electricity Fund have provided significant funding for predevelopment work related to high profile nuclear projects since early 2022, together contributing a total of \$74M towards SaskPower's potential deployment of the

BWRX-300 SMR in the mid-2030s. The Electricity Predevelopment Program also provided \$50M for the proposed Bruce Power expansion, which aims to add 4,800MWe to its existing 6,550MWe of output, and \$7M to the planned ARC-100 SMR deployment in New Brunswick.

In December 2020, the federal government also launched [Canada's SMR Action Plan](#), in partnership with provinces and territories, Indigenous Peoples and communities, power utilities, industry, innovators, laboratories, academia, and civil society, to create sector alignment and build momentum around nuclear technologies. The SMR Action Plan stemmed from a collaborative engagement activity with industry and other levels of Government. It represented the discussions and priorities at a given point in time, which have since been overtaken by an evolving nuclear and clean energy context. This shift is further reaffirmed by observing the shift in what began as the SMR Leadership Table in 2022, having, at the request of its membership, now evolved into the Nuclear Energy Leadership Table. This group comprises representatives from the federal government, interested provincial and territorial governments, Indigenous communities, industry (nuclear and high-emitting sectors), utilities, and non-governmental organizations. Its current priorities are to review both small and large-scale nuclear progress, assess shared challenges and identify opportunities, and determine concrete actions and engagements that are required to support the advancement and anchoring of the nuclear sector and technology.

Provincial Support for Nuclear Sector

At the provincial level, four Canadian provinces (Alberta, Saskatchewan, Ontario, and New Brunswick) released a joint provincial strategic plan aimed at expanding the use of nuclear power using SMRs. It called for continued support to develop three types of SMRs, the regulatory framework, a waste management plan, opportunities for Indigenous participation and public engagement and cooperation with federal authorities. A memorandum of understanding between these four provinces was signed in March 2022 and has since expired, but discussions have started to explore renewal or expansion. In the interim, several bilateral memoranda of understanding have been pursued, and significant progress has been made on SMR projects. Saskatchewan has a preferred SMR technology and is in the site selection process, New Brunswick has submitted a registration for an environmental impact assessment and an application for a licence to prepare site for an SMR project, and OPG has received a licence to construct the first of four planned units of the first SMR deployment in the G7 at its Darlington site. Additionally, a feasibility study evaluating the possibility of adding an SMR to Alberta's electricity grid is currently underway through a partnership between OPG and Capital Power.

With anticipation of exponential electricity demand growth from electric vehicles, data centres, and electrification policies in general, focus has expanded to the potential for new large-scale deployments to meet this demand, in addition to SMRs. Ontario's CANDU refurbishment plan (see subsection D.2), which is currently on budget and ahead of schedule, has recently expanded to include four units at Pickering. Plans for multiple, large-scale projects are also under development (see subsection D.3). In 2023, AtkinsRéalis announced the newest CANDU design, the 1000 MWe MONARK reactor, modernizing Canada's homegrown CANDU technology for contemporary markets.

More information on the various developments is provided in subsection D.3.

Multilateral Engagement

Canada has signed and ratified seven other multilateral, nuclear-related treaties and conventions, including the:

- [Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management](#)
- [Convention on the Physical Protection of Nuclear Material, and its 2005 Amendment](#)
- [International Convention for the Suppression of Acts of Nuclear Terrorism](#)
- [Convention on Early Notification of a Nuclear Accident](#) (see subsection 16.2(b))
- [Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency](#) (see subsection 16.2(b))
- [Convention on Supplementary Compensation for Nuclear Damage](#)
- [Comprehensive Nuclear Test Ban Treaty](#)
- *Treaty on Fissile Material*
- *Weapons Threat Reduction Program*
- [Treaty on the Non-Proliferation of Nuclear Weapons](#)

Canada continues to enhance its international cooperation and assistance to improve nuclear safety worldwide, through cooperation with international partners. Canada is actively involved in the IAEA and fully supports IAEA peer review missions, including those of the [International Regulatory Review Service](#) (IRRS) and [Emergency Preparedness Review](#) (EPREV) service. To support continuous assessment and improvement, Canada hosted follow-up review missions for both the IRRS (in June 2024; see subsection 8.1(e)) and EPREV (in June 2023; see section 16.1(g)). Canada also contributes to the development of international standards through participation on the IAEA Commission on Safety Standards and its committees.

Canada is actively involved with a number of other international organizations and fora, including the International Nuclear Regulators Association, the IAEA's CANDU Senior Regulators Group, the Nuclear Energy Agency (NEA) of the Organization for Economic Co-operation and Development (OECD) and the G7's Nuclear Safety and Security Group. Involvement in these groups allows Canada to influence and enhance nuclear safety from an international perspective and to exchange information and experience with regulatory and other organizations. Details on the CNSC's participation in these groups are provided in subsection 8.1(g). Canada is also a participant in the Generation IV International Forum (GIF; see subsection D.6 of annex D).

During the reporting period, Canada also continued its active engagement in technical working groups and areas related to environmental protection and emergency preparedness and response, through support to the IAEA Technical Cooperation Fund.

C.2 Responsibilities for national nuclear policy and regulation

Federal Organizations

The Government of Canada places high priority on health, safety, national security and the environment in relation to nuclear activities in Canada along with the implementation of Canada's international commitments on the peaceful use of nuclear energy. The Government of Canada has established a comprehensive and robust regulatory regime implemented by Canada's independent nuclear regulator: the CNSC. The CNSC has entered

into various memoranda of understanding with other organizations involved in the nuclear industry, such as the organizations below.

While the CNSC is responsible for the regulation of Canada's nuclear sector, NRCAN serves as the lead for federal nuclear energy policy. NRCAN is responsible for establishing, developing and implementing Canadian government policy on nuclear energy, providing advice on energy policy, as well as institutional, legislative and financial frameworks for the nuclear industry in Canada and policy direction for related international activities (e.g., regulatory harmonization, export promotion, etc). In addition, it is responsible for:

- administering the [Nuclear Energy Act](#), the [Nuclear Liability and Compensation Act](#) and the [Nuclear Fuel Waste Act](#), including associated regulations
- managing historic radioactive wastes for which the Government of Canada has accepted responsibility; this includes supporting the Minister's oversight of AECL (which itself oversees the contract at CNL), fulfilling the Government's waste and decommissioning responsibilities and providing other nuclear expertise
- the NSCA, which establishes and is administered by the CNSC

AECL is a Crown corporation of the Government of Canada with a mandate to enable nuclear science and technology for the benefit of Canadians and industry, and to fulfill Canada's radioactive waste and decommissioning responsibilities. It utilizes a government-owned, contractor-operated model for its nuclear laboratories. AECL contracts CNL to provide science and technology to meet core federal needs through the FNST Work Plan (see subsection D.4 of annex D for details), and to support the nuclear industry through access to science and technology facilities and expertise on a commercial basis. In addition, AECL retains ownership of the nuclear laboratories' physical and intellectual property assets and liabilities. AECL's infrastructure and the expertise brought by CNL are strategic elements of Canada's science and technology capabilities, bringing unique abilities that benefit Canadians and the nuclear sector.

Other major federal government departments involved in the Canadian nuclear sector include:

- Global Affairs Canada, which:
 - is responsible for Canada's nuclear non-proliferation policy, including bilateral and multilateral nuclear cooperation
 - has overall responsibility for the negotiation, signing and ratification of international agreements, including those on nuclear safety
- Health Canada, which:
 - establishes radiological protection guidelines, performs research on radiation health effects and undertakes radiological health assessments
 - operates a national environmental radiation monitoring network
 - monitors occupational radiological exposures and operates the National Dose Registry for all occupationally-exposed workers in Canada
 - is responsible for the *Federal Nuclear Emergency Plan* (FNEP), an event-specific annex to the *Federal Emergency Response Plan* (FERP), and provides a radiological monitoring and assessment capability for nuclear emergency response
 - serves as competent authority for the [Convention on Early Notification of a Nuclear Accident](#) and the [Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency](#)
- Transport Canada, which:
 - is responsible for transportation policies and programs and promotes safe, secure, efficient and environmentally-responsible transportation

- develops safety standards and regulations, provides risk-based oversight and gives expert advice on dangerous goods, which include nuclear substances, to promote public safety in the transportation of dangerous goods by all modes of transport regulated by Transport Canada
- Environment and Climate Change Canada, which:
 - ensures a clean, safe, and sustainable environment for present and future generations
 - preserves, enhances, and protects the natural environment (water, air, soil, flora, and fauna, species at risk, and migratory birds)
 - reviews nuclear project proposals and technologies as an authority under the *Impact Assessment Act* and its predecessor legislation
 - provides specialist and expert information on environmental matters related to its mandate, including water and air quality, migratory birds, species at risk, ecological assessment and climate change
- Impact Assessment Agency of Canada, which:
 - is responsible for administering the [Impact Assessment Act](#) (see subsection 7.1(b))

D. Nuclear programme in Canada

Canada has a total of 22 nuclear installations as defined by the CNS; see table 2, which follows the Introduction.

D.1 Nuclear power industry in Canada

The locations of reactors and NPPs within Canada at the end of the reporting period are shown in figure D.1 (the map is partial, in that only 6 of Canada's 10 provinces are shown). The types of radioactive waste at each site are also shown. Of the 22 nuclear power reactor units in Canada, 17 were producing power at the end of the reporting period. However, at various points during the reporting period, Units 1, 3, and 4 at Darlington, and Units 3, 4, and 6 at Bruce, were shut down for refurbishment activities. More details on refurbishment can be found in subsection D.2. In addition to the 17 reactors that are considered operational, two units (Units 2 and 3) at Pickering and the one unit at Gentilly-2 are in a safe storage state. Two units (Units 1 and 4) at Pickering are shut down and in preparation for safe storage. The Gentilly-2 unit is moving toward decommissioning and is subject to the peer review conducted under the [Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management](#).

The operation and activities of the reactors within the scope of this report (17 operational, 2 in safe storage, and 2 in preparation for safe storage) are governed by four licences issued by the CNSC to three organizations:

- Ontario Power Generation Inc. (OPG), a commercial company wholly owned by the Province of Ontario
- Bruce Power Inc. (Bruce Power), a private corporation
- NB Power, a Crown corporation of the Province of New Brunswick

The 8 reactors at the Bruce site are leased by Bruce Power from the owner, OPG.

Figure D.1 also shows the location of the Darlington new nuclear project (DNNP), where the construction of an additional reactor is on-going (see subsection D.3 for details).

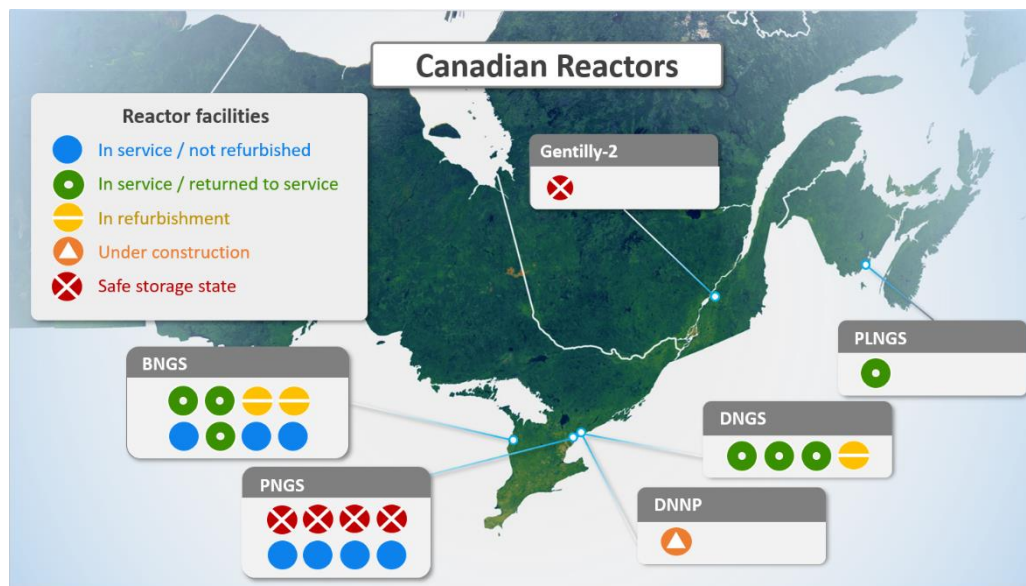


Figure D.1 Partial map of Canada showing the locations of NPPs

Figure D.2 shows the main historical periods of operation for the NPPs in Canada. Long periods of non-operation correspond to extended outages, such as for refurbishment or to accommodate a very large surplus capacity of electricity in the Province of Ontario at the time.

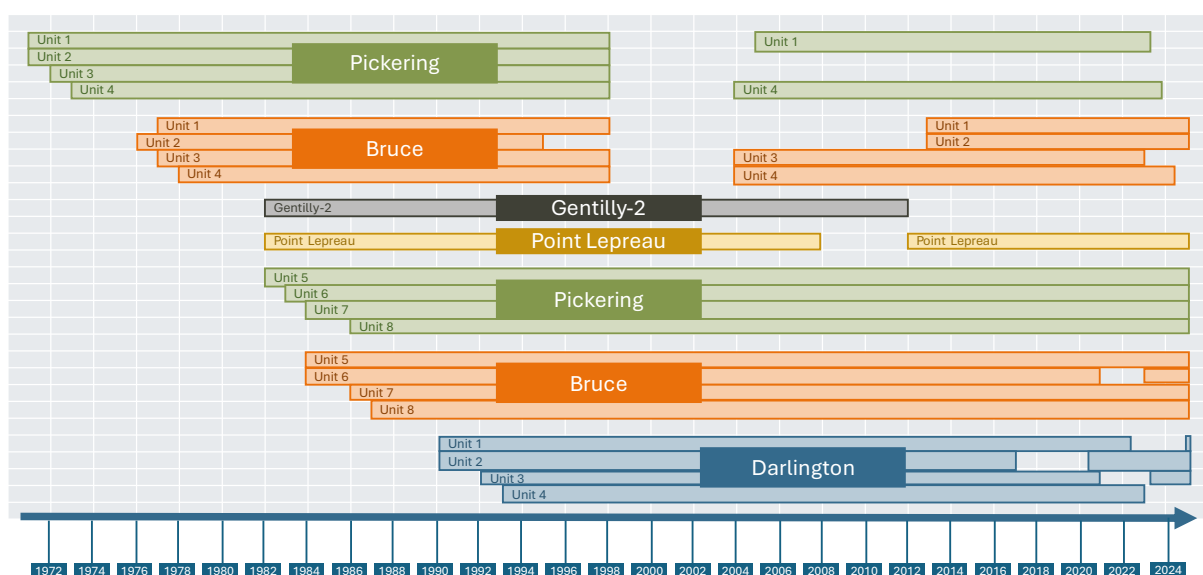


Figure D.2 Timeline of NPPs in Canada

Annex B provides additional basic information on all NPP units in Canada.

The existing NPPs in Canada use pressurized heavy-water reactors of the CANDU design (originally developed through a partnership between AECL, Ontario Hydro and General Electric Canada). Candu Energy Incorporated (Candu Energy) now acts as the original designer and vendor of the CANDU technology in Canada, holding an exclusive licence from AECL for the CANDU technology. Candu Energy and its sister company SNC-Lavalin

Nuclear, are part of AtkinsRéalis and share corporate leadership and processes. The activities of these companies are described in various parts of this report. Besides Canada, there are 6 other countries with CANDU reactors in operation. Additional information on AtkinsRéalis' CANDU reactor designs is provided in subsection D.3 of annex D. A full description of CANDU reactors was provided in the first and second Canadian reports.

All CANDU operators in the world (including licensees of operating Canadian NPPs) and CNL are members of the [CANDU Owners Group](#) (COG¹): a not-for-profit organization that provides programs for cooperation, mutual assistance and exchange of information for the successful support, development, safe operation, maintenance and economics of CANDU technology. While membership is primarily organizations owning or operating a CANDU reactor, suppliers and engineering organizations involved in the design, construction and operation of CANDU reactors are eligible for participation. COG also operates a supplier participant program that is open to all suppliers of goods and services to the Canadian nuclear industry. The program continued to expand and now includes over 45 supplier participants, which includes international suppliers. COG is described further in subsection 9(c).

Through COG, the nuclear industry provides approximately \$60 million in base R&D programs (described in subsection D.2 of annex D) and related joint projects that support operating NPPs in Canada. COG has also established the Nuclear Safety Peer Group, which meets regularly to:

- share information on regulatory interactions, strategies and approaches to resolving common issues
- identify, screen and prioritize nuclear safety and licensing issues suitable for industry collaboration
- authorize industry task teams to define unified positions and/or common approaches, and undertake technical reviews, assessments, and safety analyses
- monitor progress on issue resolution and address barriers and constraints
- coordinate industry interaction with the CNSC on industry positions, industry work programs and action item closure criteria, consistent with an agreed protocol

D.2 Life extension of existing NPPs

Several existing CANDU NPPs have undergone major life-extension projects. Currently, life extension is being pursued or considered for many of the reactors at the Canadian NPPs and abroad. Life extension includes R&D, engineering, analysis and other fitness-for-service activities to support extended operation of structures, systems and components (SSCs) beyond their assumed design life, as well as the refurbishment of components. Life extension activities are identified through a periodic safety review (PSR)³ and documented in an integrated implementation plan (IIP). CANDU refurbishment typically involves replacement of major reactor components (e.g., fuel channels), along with replacements of, or upgrades to, other safety-significant systems. Depending on the circumstances, a refurbished reactor with replaced fuel channels could operate for approximately an additional 30 or more years.

Life-extension is being carried out for Bruce A and B, Darlington and Pickering, in coordination with the Independent Electricity System Operator of the Province of Ontario.

³ In the past, these were also referred to as integrated safety reviews (ISRs), which were one-time applications of PSR for the purposes of life-extension projects.

Where refurbishment is occurring, each NPP has a condition in its licence to operate that requires the licensee to complete the IIP.

Figure D.3 shows the timing of recent, current, and planned refurbishments for the operating NPPs.

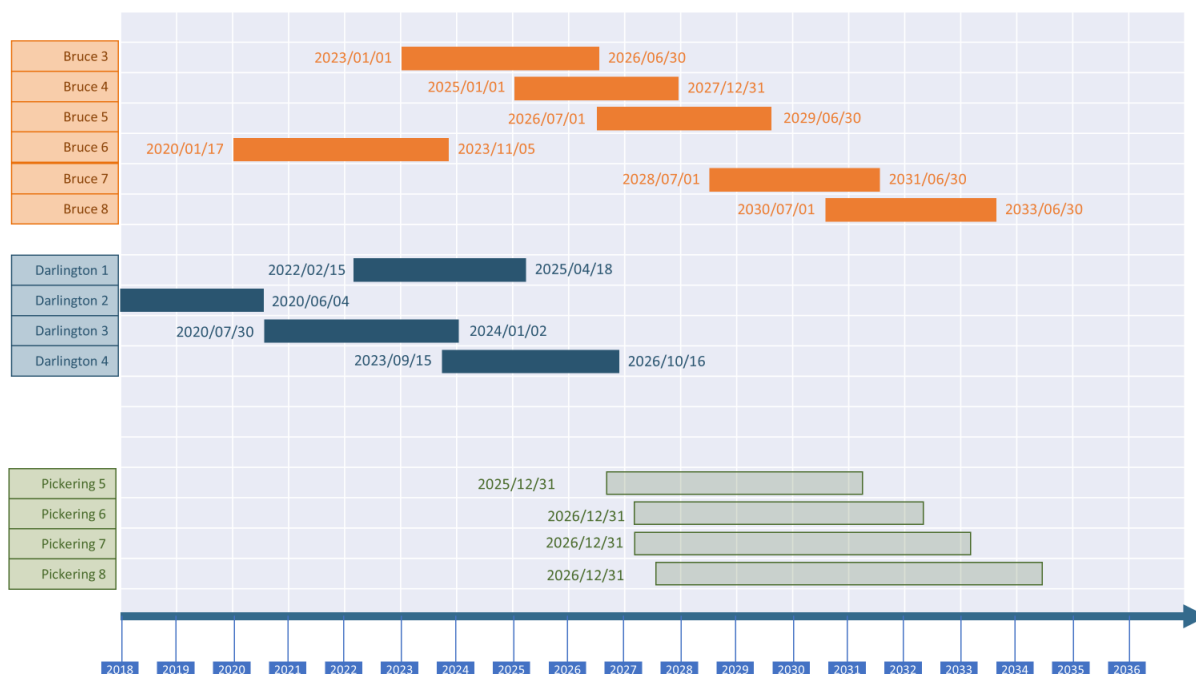


Figure D.3 Nuclear refurbishment schedule

Bruce A and B refurbishment

The Bruce Power Life Extension Program consists of two major parts. The first part is asset management, which involves the maintenance, refurbishment or replacement of equipment during regular maintenance outages to ensure that systems are in good condition until end-of-life. The second part is a set of major component replacement (MCR) outages, during which each reactor is de-fueled and drained to accommodate the replacement of major components such as fuel channels, feeder tubes and steam generators, along with other equipment that can be replaced only under such conditions. Bruce Power determined the scope of the MCR outages through a PSR conducted for Bruce A and B.

The asset management portion of life extension began on January 1, 2016 and will continue through 2053. The MCR outages began with Unit 6 in January 2020, which was followed by Unit 3 in March 2023 and Unit 4 in February 2024. Unit 6 was returned to service in September 2023. The activities carried out during these and the remaining outages will extend the lives of Units 3 to 8 over a period of 13 years. Bruce A Units 1 and 2 were fully refurbished earlier and were returned to service in 2012. Asset management and MCR outages will allow Bruce Power's units to operate safely through to 2064.

Darlington refurbishment

OPG is executing a multi-year, multi-unit refurbishment project to enable safe and reliable operation through to 2055. This project has included the replacement of fuel channel and calandria tube assemblies, feeders, feeder cabinet insulation, and instrumentation tubing

associated with the feeders (as well as other design improvements). OPG's refurbishment project at Darlington began with Unit 2 in October 2016, which continued through to June 2020. The completion assurance documents were provided to the CNSC to support the removal of each of the regulatory hold points (described in subsection 7.2(ii)(a)) for Unit 2 and demonstrated the successful and safe return to service of the reactor.

In September 2020 and February 2022, OPG commenced refurbishment activities on Unit 3 and Unit 1, respectively. The refurbishments of Unit 3 and Unit 1 were completed in July 2023 and November 2024, respectively, when the completion assurance documents were provided to the CNSC to support the removal of each of the Units' regulatory hold points and demonstrated successful and safe return to service of both units.

The refurbishment of Unit 4, which commenced in July 2023, is in the reassembly phase. OPG plans to complete the refurbishment of Unit 4 in 2026.

OPG operated the Retube Waste Processing Building, which volume-reduced radioactive wastes generated from the refurbishment of the units at Darlington (i.e., fuel channel end fittings, pressure tubes, and calandria tubes). Now that all radioactive waste from the refurbishment project has been processed, OPG is considering re-purposing the building.

Pickering refurbishment and continued operation

Pickering Units 1 to 4 were formerly known as Pickering A. Units 1 and 4 were refurbished and returned to service in 2005 and 2003, respectively. In 2010, Units 2 and 3 were each placed in a safe storage condition, which involved defueling and dewatering the reactors, isolating them from the operational part of the station (i.e., containment) and placing the units in a state that prevents start-up. Some Unit 2 and 3 systems remain operational, providing common system support to the operation of Units 1 and 4. Units 2 and 3 will be maintained in safe storage states until the entire NPP is shut down for eventual decommissioning.

OPG developed a sustainable operations plan for all operational Pickering units (1, 4 and 5 to 8) for the approach to the end of commercial operation. During the previous reporting period, as part of the renewal of the licence to operate Pickering, OPG obtained authorization from the Commission to operate up to December 31, 2024 followed by a transition to safe storage by the end of the licence period (2028). OPG was required to inform the CNSC of an intent to operate any unit beyond 2024.

Units 1 and 4 were shut down and began preparing for safe storage in September and December of 2024, respectively. However, the Province of Ontario considered the option of further life extension of Units 5 to 8 and, on September 29, 2022, requested OPG to complete the assessment of a potential refurbishment. In the interim, in June 2023, OPG requested authorization from the CNSC to operate Units 5 to 8 until December 31, 2026. A CNSC public hearing was held in June 2024, after which the Commission approved the extension.

To support the potential life extension of Pickering Units 5 to 8 beyond 2026, OPG completed a refurbishment assessment in August 2023. It included scope development, schedule development, risk assessments, economic evaluations, and regulatory strategies. It also included preliminary high-level technical assessments, progress updates, initial financial assessments, industry capacity and capability assessments and commercial strategies, community engagement and initial discussions with First Nations communities.

On January 30, 2024, the Province of Ontario approved the refurbishment of Units 5 to 8. OPG is proceeding with the project definition and planning phase, which will further define the regulatory and safety requirements. It is also conducting a PSR to support the refurbishment; see subsection 14(i)(b) for details. On October 31, 2024, OPG informed the CNSC of its intent to apply for an early renewal of the licence to operate Pickering and submit a licence renewal application in 2025. OPG plans to undergo refurbishment of Units 5 to 8 during the requested licence period.

Upon the required shutdown of Pickering Units 5 to 8, the station will be in an extended shutdown state. The units will be transitioned individually from normal operations to a defueled and de-watered state until the next phase has been determined, or when refurbishment begins.

D.3 New-build developments

This section describes projects at the planning, development, and/or licensing stages in a number of Canadian provinces. Besides SMR projects, these include possible large nuclear development to meet increasing electrical demand. In addition to the background information that follows for those projects, specific measures taken by the CNSC and licensees/applicants with respect to new-build projects are described throughout this report.

See subsection D.3.2 of annex D for additional information on reactor development projects.

Darlington new nuclear project

In 2021, the CNSC Commission renewed OPG's licence to prepare the DNNP site for power reactor construction. In December 2021, OPG announced it would be working with General Electric-Hitachi (GEH) to deploy the BWRX-300 at the site. OPG submitted an application for a licence to construct to the CNSC in October of 2022 and started site preparation activities in August of 2022. The Commission held a public hearing in January 2024 to determine the applicability of the project environmental assessment to the selected technology. In April 2024, the Commission announced its decision stating that the selected technology was not fundamentally different from those considered in the environmental impact statement and that the environmental assessment remained valid. The Commission then held a 2-part hearing for OPG's application for a licence to construct. Part 1 of the hearing took place in October 2024 and Part 2 in January 2025. At the end of the reporting period (April 4, 2025), after reviewing the application and CNSC staff's recommendation, the Commission announced its decision to grant OPG a licence to construct a GEH BWRX-300 reactor. The power reactor construction licence is valid until March 31, 2035. This is the first approval of construction of the BWRX-300 design and the first approval of SMR construction in the G7.

OPG is planning to submit a licence application amendment to CNSC in the next reporting period for the construction of three additional units at DNNP.

Point Lepreau SMR project

In 2023, NB Power submitted an application for a licence to prepare site for one ARC-100 SMR at the existing Point Lepreau site. The project is also carrying out a provincially-led environmental assessment.

Bruce C new nuclear project

Bruce Power is conducting the federal integrated impact assessment (IA) process to create the option to build up to 4,800 megawatts of nuclear capacity. The proposed Bruce C project would complement the existing 6,550MWe of output at Bruce A and Bruce B with an additional output of up to 4,800MWe. It would be located at the Bruce Power site in Ontario, which is within the Territory of the Saugeen Ojibway Nation. Bruce Power submitted the initial project description to the Impact Assessment Agency of Canada (IAAC) in August 2024, and has initiated the integrated IA. See subsection 17(ii)(a) for more information on integrated IAs and the IAAC.

Wesleyville new nuclear project

In early 2025, OPG notified the IAAC and the CNSC of its intent to begin the integrated IA process for potential new nuclear generation at OPG's Wesleyville site. Early studies indicate the site could support up to 10,000 MW of new nuclear generation. OPG is presently planning to submit the initial project description to IAAC in the fall of 2025.

For the potential Wesleyville project, OPG is committed to early, continuous, and meaningful engagement with Indigenous Nations, as rights holders and key partners. OPG's goal is to collaborate and understand the interests, rights, and perspectives of Indigenous communities in all areas of engagement. This includes identifying and respecting the interests of Indigenous Nations, supporting capacity for participation, and exploring potential procurement opportunities for Indigenous businesses as well as equity partnerships. OPG is dedicated to building long-term, respectful relationships that extend beyond the assessment process.

Alberta

In April 2025, Energy Alberta submitted its initial project description seeking to build up to 4800 MWe of nuclear power at a greenfield site. A feasibility study evaluating the possibility of adding an SMR to Alberta's electricity grid is currently underway through a partnership between OPG and Capital Power.

Saskatchewan

Saskpower has chosen a preferred technology (BWRX-300) for potential deployment and narrowed the site selection process to two remaining options in the same region. CNSC staff expect to receive an initial project description in 2025 or 2026. Also, Saskatchewan Research Council Nuclear is working with Westinghouse on a potential demonstration eVinci unit.

Micro modular reactor project at Chalk River Laboratories

In 2019, Global First Power had submitted an application for a licence to prepare site for a 15MW(th) high-temperature gas-cooled reactor on AECL's property at Chalk River Laboratories. Regulatory review of the application and an environmental assessment began in the previous reporting period. In August 2024, CNSC staff paused its work on the review and environmental assessment following non-payment of fees by the applicant. In October 2024, Global First Power's parent company, Ultra Safe Nuclear Corporation filed for bankruptcy protection.

D.4 Medical isotope production

CANDU reactor design is adaptable to the production of medical isotopes, along with electrical energy production. By producing radioisotopes, Canada's nuclear technology sector has enabled healthcare providers to improve cancer therapy and diagnostic techniques, as Canada is a major supplier to the world market for medical and industrial isotopes.

Cobalt-60 (Co-60) isotopes are currently being produced at various CANDU units. Sterilization Co-60 is the first and most widely used type of Co-60. It is employed by the healthcare industry to sterilize medical devices such as sutures, gloves and syringes. Bruce Power and OPG have produced sterilization-grade Co-60 at Bruce and Pickering, respectively, for many years.

Medical-grade Co-60 is used worldwide to treat cancer and complex brain conditions by using radiation therapy. Four units at Bruce have been producing medical-grade Co-60 since 2018.

To support the long-term production and supply of Co-60 to the medical and other industries, OPG initiated a production modifications project at Darlington in 2020. The modification involves the replacement of stainless steel adjuster rods with Co-59 adjuster rods that, during operation, activate to Co-60. OPG received a licence amendment from the Commission and installed Co-59 rods in the first unit (Unit 1) at Darlington in 2024. The first Co-60 harvest is planned in 2027, with distribution to gamma sterilization facilities worldwide. OPG plans to modify the remaining three units (Units 2, 3, and 4) at Darlington to expand Co-60 production capacity.

In 2018, OPG entered into a partnership with BWX-Technologies to produce molybdenum-99 (Mo-99) at Darlington for the medical community. Mo-99 decays to technetium-99^m (Tc-99^m), which is an important medical diagnostic isotope. Approximately 80% of nuclear medicine procedures use Tc-99^m for heart, cancer and bone diagnostic scans. Over the years, the traditional Mo-99 supply has encountered numerous challenges with unreliable production. OPG is currently producing Mo-99 at Darlington for performance and verification tests. Following successful completion of these tests, OPG will move into commercial production, which will make it the only supplier of Mo-99 in North America. The reliable production of Mo-99 by OPG will assure a stable long-term supply using neutron capture of natural molybdenum targets, while reducing concerns related to nuclear proliferation and waste. OPG plans to enhance its isotope generation during the next reporting period through installation of production systems on additional units, as well as the introduction of a broader range of isotopes, including yttrium-90 and lutetium-177 (Lu-177).

Lu-177 is used in targeted radionuclide therapy to treat neuroendocrine tumours and prostate cancer while leaving healthy cells unaffected. In 2019, Bruce Power partnered with Isogen, a joint venture between Framatome and Kinectrics, to undertake a first-of-its-kind solution to enable production of Lu-177 by irradiating the stable isotope, ytterbium-176. The isotope production system is being installed in Bruce Power's reactors through the course of the life extension program currently underway. Bruce Power began supplying the world market with Lu-177 in October 2022 from a system installed in Bruce Unit 7. In October 2024, Bruce Power commissioned a second irradiation tube in the Unit 7 isotope production system to double the production capacity. Bruce Power intends to install isotope production systems in other units in the next reporting period.

The licensing of new activities to produce medical isotopes at Darlington and Bruce is described in subsection 7.2(ii)(a). The associated design changes are described in the introduction of Article 18 using Darlington as an example.

E. *Vienna Declaration on Nuclear Safety*

The *Vienna Declaration on Nuclear Safety* (VDNS) was adopted by Contracting Parties to the CNS at a Diplomatic Conference held in Vienna on February 9, 2015. The declaration provides the following three principles for implementing the objective of the CNS (to prevent accidents and mitigate radiological consequences):

- Principle (1) New NPPs are to be designed, sited and constructed, consistent with the objective of preventing accidents in the commissioning and operation and, should an accident occur, mitigating possible releases of radionuclides causing long-term offsite contamination and avoiding early radioactive releases or radioactive releases large enough to require long-term protective measures and actions.
- Principle (2) Comprehensive and systematic safety assessments are to be carried out periodically and regularly for existing installations throughout their lifetime in order to identify safety improvements that are oriented to meet the above objective. Reasonably practicable or achievable safety improvements are to be implemented in a timely manner.
- Principle (3) National requirements and regulations for addressing this objective throughout the lifetime of NPPs are to take into account the relevant IAEA safety standards and, as appropriate, other good practices as identified *inter alia* in the Review Meetings of the CNS.

A description of how Canada fulfills the VDNS principles is provided in the Summary.

Relevant Nuclear Installations

Canada is a Category 1 Contracting Party. It has 22 power reactors, situated at 5 sites. Of the 22 reactors, 17 are operating, 3 are in safe storage, and 2 are preparing for safe storage. The term used in the Convention is nuclear installation, which, for the purposes of this report, is considered synonymous with an individual power reactor. This report does not typically use the term nuclear installation; rather, it uses “reactor” or “unit” for individual installations and the term NPP for single-unit or multi-unit stations. In Canada, 3 of the 4 NPPs are multi-unit NPPs. Table 2 provides details for the reactor sites in Canada and the reactors at each site. DNNP is excluded – it was not included in the list of reactors when Canada indicated it was a Category 1 Contracting Party, and the licence to construct was not awarded until just after the end of the reporting period.

Table 2: Relevant Nuclear Installations (and their status at the end of the reporting period)

Location	Licence Holder	Unit	Type	First Criticality	Capacity (Mwe)	Status
Bruce A and B	Bruce Power	8	PHWR	Dec. 17, 1976	836	Operating
Darlington	Ontario Power Generation	4	PHWR	Oc. 29, 1990	934	Operating
Pickering	Ontario Power Generation	8	PHWR	Feb. 25, 1971	542	2 in safe storage 2 preparing for safe storage 4 operating
Point Lepreau	New Brunswick Power	1	PHWR	July 25, 1982	705	Operating
Gentilly-2	Hydro Quebec	1	PHWR	Sept. 11, 1982	675	Safe storage

Summary

Canada is a Category 1 Contracting Party. As such, it has reported on all articles of the CNS. During the reporting period (April 2022 to March 2025), Canada effectively maintained and, in many cases, enhanced its measures to meet its obligations under the CNS.

The Canadian regulatory framework, which is largely non-prescriptive, is continuously updated and aligned with international standards. The *Nuclear Safety and Control Act* (NSCA) is complemented by regulations and other regulatory instruments. Canada's nuclear regulator, the Canadian Nuclear Safety Commission (CNSC), is mature and well established. A system of licensing is in place to control activity related to NPPs and to protect the health and safety of persons, the environment, and national security. Renewals of operating licences for NPPs are used to introduce new standards and requirements that the licensees actively implement. The framework is also being improved to adjust to emerging technologies, including the deployment of SMRs. Furthermore, the CNSC has a comprehensive program to ensure compliance with the regulatory framework and monitor the safety performance of the NPPs.

The CNSC's regulatory framework and processes feature a high degree of openness and transparency. The CNSC continued to foster openness and transparency during the reporting period – for example, through its Participant Funding Program, which facilitates the participation of eligible intervenors in the decision-making process and by issuing discussion papers and soliciting early public feedback on potential regulatory changes.

The CNSC, NPP licensees and other industry members make a strong commitment to nuclear safety and strive to continuously improve it, e.g., through regular peer reviews and other assessments.

Licensees conduct periodic safety reviews (PSRs) on 10-year intervals to assess and close any gaps with modern standards and requirements. They also update their safety analysis reports and probabilistic safety assessments (PSAs).

NPP licensees implement safety upgrades on a continual basis. They have also successfully completed, and are completing, major refurbishment projects that safely extend the operational lifetime of a reactor beyond its originally-assumed design life. These refurbishment projects are supported by PSRs and involve the replacement of major components and many other design upgrades that, to the extent practicable, bring the refurbished reactor to a level of safety comparable to that of a new facility.

During the reporting period, NPP licensees addressed any safety issues that arose in order to keep the risk at reasonable levels – and continued to give safety a high priority at every level of their organizations. None of the safety-significant events that occurred at Canadian NPPs during the reporting period posed a significant threat to persons or the environment. For example, there were no serious process failures at any NPP during the reporting period. The licensees' efforts to address operational events were effective in correcting any deficiencies and preventing recurrence.

During the reporting period, all Canadian NPPs operated with acceptable safety margins and acceptable levels of defence in depth. The maximum annual worker doses at NPPs were below annual dose limits, and all radiological releases from NPPs were very low – below 1% of derived release limits (DRLs).

Table 3 highlights important parts of the report by reproducing, from the articles, the summaries of information related to challenges on Canada from the Joint 8th & 9th Review Meeting, other significant changes, notable achievements and areas of future focus.

Table 3: Summaries of Responses to Challenges, Notable Achievements and Future Foci

Article 7	
Significant Change	CNSC and the CSA Group continued to develop and revise regulatory framework documents across all 14 CNSC SCAs, with a focus on readiness for potential new-build. CNSC worked to adapt both its practices and regulatory framework to other emerging developments, such as DIET and AI. NPP applicants, CNSC staff, and the Commission undertook various activities related to the application for, initial granting of, or renewal of licences to site, construct, and operate NPPs at various sites. CNSC revised its 5-year baseline compliance verification program to increase capacity for reactive verification activities in response to emerging issues. CNSC began conducting the identified activities, which will be scheduled during the 2023-28 fiscal year⁴ timeframe.
Notable Achievement	CNSC has established and continues to improve a large suite of customizable, comprehensive inspection guides that facilitate the consistent and effective execution of compliance verification activities at NPPs. CNSC updated REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants (Version 3), improving reporting efficiency and incorporating new requirements such as cybersecurity.
Future Focus	CNSC will continue to modernize regulatory oversight reports, with further changes planned to improve accessibility and engagement with Indigenous Nations and communities, stakeholders, and the public.
Article 8	
9RM C-3	<i>Optimize regulatory capacity and capability to effectively and efficiently assess licence applications for other nuclear technologies</i> CNSC is enhancing and expanding its technical ability and competency in SMRs and advanced reactors. CNSC staff are involved in multiple initiatives to optimize regulatory capacity and capability to ensure that the assessment of licence applications is as effective and efficient as possible. These include the development of a knowledge management process and an approach to prioritize technologies that have a higher likelihood of being implemented in Canada. CNSC's SMR readiness project is further expanding the existing Canadian regulatory framework to incorporate SMRs and novel technologies alike. CNSC has hired new staff and provided training on SMR and novel technologies. CNSC is a key stakeholder in the FNST Program, which includes valuable research in the "New Nuclear Technologies" theme area that includes SMRs and advanced reactor-driven research projects. The CNSC partnered with NSERC to fund a new community of research on SMRs and novel technologies. The CNSC also developed a knowledge management process for knowledge gained in the licensing of SMRs. In addition, NSERC and NRCan agreed to co-fund research projects that focus on SMR supply chain development, fuel supply, and waste management. Canada recommends that Challenge 9RM C-3 be closed.
Other Significant Change	The CNSC established the SMR readiness project, which spans 5 years and embodies numerous initiatives to optimize its readiness to license and regulate SMRs. The CNSC established the DIET program, which includes the DIET Working Group and the Innovation Hub that facilitate the internal and external sharing of information

⁴ The CNSC fiscal year begins on April 1.

	on innovation. The CNSC hosted an independent (IAEA) assessment of regulatory safety culture and began developing a plan to address the findings. The CNSC launched the ISCF to help Indigenous Nations and communities and interested parties gain the capacity to engage in the CNSC's regulatory processes prior to and throughout the lifecycle of nuclear facilities and activities. The CNSC signed a trilateral memorandum of cooperation with the United States Nuclear Regulatory Commission and the United Kingdom's Office for Nuclear Regulation, and bilateral memoranda of cooperation with the National Atomic Energy Agency of the Republic of Poland and the Swedish Radiation Safety Authority.
Notable Achievement	The CNSC hosted a follow-up IRRS mission that focused on the status of each of the 4 recommendations and 16 suggestions from the 2019 mission. The CNSC is significantly enhancing its capacity to assess licence applications for novel nuclear technologies.
Future Focus	CNSC will continue to focus on optimizing its workforce as the technologies and levels of interest in newbuild evolve.
Article 10	
Notable Achievement	CNSC hosted a country-specific safety culture forum for Canada (in cooperation with NEA and WANO). CNSC hosted an IAEA-led independent assessment of regulatory safety culture.
Future Focus	CNSC plans to develop a management action plan to address the suggestions and recommendations from the independent assessment of regulatory safety culture. Licensees will continue to conduct safety culture assessments, while using tools such as ongoing monitoring panels and pulse surveys to track and improve nuclear safety and security culture between assessment cycles.
Article 11	
Significant Change	NPP licensees are transitioning from traditional training approaches to more responsive approaches that are continuous, self-paced, collaborative, and more experiential. The licensees are optimizing mentoring, leveraging technology and learning systems, employing dynamic learning activities, and making greater use of simulators.
Notable Achievement	Industry organizations have developed and maintained effective processes and methods to attract and develop technical staff and leaders and retain critical knowledge. They have also enhanced their proactive, comprehensive, and collaborative efforts related to workforce planning. CNA engaged widely and assessed the future workforce needs of Canada's nuclear sector in a thorough and adaptive manner, while identifying related strategies and recommendations.
Future Focus	CNA plans to monitor the response to the recommendations stemming from its workforce assessment, use of the workforce models, and the evolution of the workforce and activities in the nuclear energy sector in order to facilitate implementation of the strategies where reasonable.
Article 12	
Significant Change	Canada's court system upheld the legality of Version 3 of REGDOC-2.2.4, Fitness for Duty, Volume II: Managing Alcohol and Drug Use. Specifically, the Federal Court (later confirmed by the Federal Court of Appeal) stated that its provisions for pre-placement and random testing for alcohol and drug use were reasonable. CNSC published REGDOC-2.2.1, Human Performance (Version 2), providing updated guidance and requirements to strengthen systemic human performance programs across the nuclear sector.
Future Focus	NPP licensees will work to implement random and pre-placement alcohol and drug testing for safety-critical positions. Licensees, licence applicants, design organizations and vendor/contractors will continue to incorporate HFE into nuclear design projects, including those related to new-build and refurbishment.

Article 13	
Significant Change	During the reporting period, OPG and GEH established formal arrangements for engineering oversight to assure that engineering, procurement, and construction activities for DNNP meet applicable safety-related and other requirements.
Notable Achievement	NPP licensees and other parts of the nuclear supply chain have strengthened supply chain oversight and contractor management, including enhanced surveillance and training of contractors.
Article 14	
Significant Change	CNSC staff assessed the licence applications for DNNP (licence to construct) and DNGS (renewal of licence to operate). Both assessments concluded that the applicant (OPG in both cases) was qualified to undertake the proposed activity and would make adequate provisions for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed. NPP licensees conducted and updated PSRs to assess ongoing safety and complete IIPs that bring their NPPs to a level of safety approaching that of modern standards. NPP licensees continued to update both deterministic safety analysis and probabilistic safety assessments, based on updated regulatory requirements.
Notable Achievement	NPP licensees have developed a series of periodic inspection programs and plans in support of aging management that expand the minimum inspection and testing program requirements to address operational and safety issues for critical components.
Future Focus	NPP licensees plan to continue enhancing and refining PSAs and deterministic safety analyses to support operational risk monitoring, design improvements, and long-term safety goals, including consideration of climate change and emerging hazards.
Article 15	
Significant Change	NPP licensees introduced new technologies, tools and methods, as well as enhanced training, to maintain doses to workers ALARA and reduce source terms.
Future Focus	CNSC will continue its review and analysis in preparation for an amendment of the RPRs in the 2030 timeframe. NPP licensees will continue to implement REGDOC-2.9.2, Controlling Releases to the Environment , which describes the role of dose constraints in the optimization of environmental protection and establishment of discharge limits.
Article 16	
9RM C-1	<i>Update guidance document Generic Criteria and Operational Intervention Levels for Nuclear Emergency Planning and Response and include guidance on protection strategies and reflect guidance in provincial plans</i> Health Canada is updating and expanding its guidance document on nuclear emergency planning and response, adapting IAEA recommendations as appropriate. This includes advice on developing integrated protection strategies, including the benefits and detriments of protective actions under different circumstances. Public consultation on the revision of this document is planned to commence in the fall/winter of 2025. The provincial plans of Ontario and New Brunswick reflect the current guidance, and they are scheduled for further adjustment following the approval of the updated guidance, which is expected in the next reporting period. Canada recommends that Challenge 9RM C-1 remain open.
9RM C-2	<i>Approve and implement revision of Ontario's Provincial Nuclear Emergency Plan (PNERP)</i> The Province of Ontario's review of the PNERP and associated NEMP enhancements were ongoing at the end of the reporting period. The NEMP enhancements are expected to be implemented by 2026. Canada recommends that Challenge 9RM C-2 remain open.

Notable Achievement	Canada hosted the IAEA EPREV follow-up mission (2023), which confirmed the closure of all recommendations and suggestions for nuclear emergency preparedness from the 2019 mission.
Future Focus	Following the update of Generic Criteria and Operational Intervention Levels for Nuclear Emergency Planning and Response, Health Canada and the provinces will reflect the guidance in provincial nuclear emergency plans. Bruce Power plans to redistribute KI pills in the vicinity of the Bruce site. The Province of Ontario plans to approve changes to its PNERP and implement the associated NEMP enhancements. CNSC plans to publish Version 3 of REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, which is being revised to ensure it will be applied to all Class I facilities, regardless of thermal output capacity and the novelty of the technology. Health Canada plans to complete the review of the FNEP by 2027. Canada will continue to complete any corrective actions identified through the emergency exercises conducted during the reporting period.
Article 17	
9RM C-4	<i>Ensure an effective approach between federal departments to provide proponents with certainty related to process and timelines for environmental impact assessments</i> CNSC staff are currently involved in multiple initiatives to meet the challenge of ensuring an effective approach between federal departments to provide proponents with certainty related to process and timelines for environmental/impact assessments. Primarily, CNSC staff have been collaborating with the Impact Assessment Agency of Canada (IAAC) to ensure readiness for future integrated impact assessments (IAs). In addition, CNSC is conducting work as part of CNSC's SMR readiness project to ensure CNSC's readiness to licence and regulate SMRs. This work includes more than 50 objectives to further explore areas for regulatory efficiency and optimize CNSC's regulatory framework for licensing new project proposals.
Notable Achievement	OPG systematically carried out historical data assessments and climate predictions for the DNNP to confirm that extreme conditions will remain within review level limits.
Future Focus	Canada plans to complete the work to ensure predictable processes and timelines for integrated IAs. CNSC will continue to optimize the regulatory framework for licensing new project proposals. Canada will continue the environmental reviews for new-build projects initiated during the reporting period (Point Lepreau SMR and Bruce C project).
Article 18	
Notable Achievement	The Commission granted OPG a licence to construct one BWRX-300 reactor for the DNNP. NPP licensees modified existing NPPs to safely produce a variety of medical isotopes, including cobalt-60, molybdenum-99, and lutetium-177. CNSC utilized pre-licensing vendor design reviews for a variety of reactor designs prior to engaging in formal licensing activities. The reviews have enhanced CNSC staff's readiness to review applications involving novel nuclear technologies and have familiarized proponents with the regulatory requirements and expectations. Canada conducted significant R&D related to design and construction of new nuclear technologies. CNSC updated REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants, to align with the latest IAEA safety standards and international best practices, while remaining technology-neutral. NPP licensees executed numerous safety upgrades that enhanced defence-in-depth, incorporated proven technology, and facilitated reliable operation.
Future Focus	Ongoing confirmation of defence-in-depth and the proof of reliable and safe technologies technology employed in existing and proposed designs.

Article 19	
Significant Change	NPP licensees furthered the implementation of AI-driven predictive maintenance and data analytics, while addressing potential hazards introduced by new technology.
Notable Achievement	NPP licensees reduced maintenance backlogs while improving reliability, safety, and operational efficiency through AI and other technological advances, data analytics, and design enhancements. NPP licensees completed the implementation of the post-Fukushima updates to SAMGs and the demonstration of SAMG effectiveness through exercises and plant drills. The industry and CNSC utilized extensive and effective mechanisms to share OPEX within Canada and internationally.

Major Common Issues

A number of common issues emerged from the CNS Country Group discussions during the Joint 8th and 9th Review Meeting. A brief description related to those issues is provided here along with the references to the applicable sections of this report where these items are addressed.

Managing extraordinary circumstances impacting the safe operation of nuclear installations

The CNSC has overarching and supporting business continuity plans; for more information, see the introduction of article 8 as well as subsection 7.2(iii)(b). The NPP licensees and other stakeholder organizations also have business continuity plans; for more information, see subsection 11.2 (a). Although the need for such plans is rare in Canada, they were activated effectively in response to the COVID-19 pandemic. More information on the Canadian response to the pandemic is provided in the ninth Canadian report in the above-noted subsections, as well as subsection 9(c).

Strengthening national regulatory capabilities taking into account new and innovative technologies

Challenge 9RM C-3 on Canada is directly related to this topic; it states that Canada should optimize its regulatory capacity and capability to effectively and efficiently assess licence applications for other nuclear technologies. In response, the CNSC is actively strengthening its capability to address new and innovative technologies. Measures include significant staffing actions and adjustments to the regulatory framework. These changes are facilitated and supported by the SMR readiness project. See subsection 8.1(c) for more information.

CNSC is also strengthening its capability through enhanced international collaboration; see below.

Fostering international collaboration

Canada promotes the goal of international harmonization with respect to licensing SMRs. CNSC has established memoranda of cooperation with other nuclear regulatory bodies, including a trilateral memorandum of cooperation with the United States Nuclear Regulatory Commission and the United Kingdom's Office for Nuclear Regulation. It also has memoranda of cooperation with National Atomic Energy Agency of the Republic of Poland and the Swedish Radiation Safety Authority. During the reporting period the CNSC and the U.S. Nuclear Regulatory Commission published three joint review reports on SMRs.

CNSC also participates in the IAEA's [SMR Regulators Forum](#) and [Nuclear Harmonization and Standardization Initiative](#); see subsection 8.1(g) for additional information.

As another example of international collaboration, OPG is working closely with General Electric-Hitachi (GEH) in support of construction activities of the BWRX reactor at the DNNP. OPG oversees engineering activities performed by GEH engineering and project teams under a technology collaboration agreement and integrated project agreement. GEH provides the software and hardware platforms for the multi-party collaboration to share documents, reports, issues and risks throughout the project phases. All parties are adhering to the US Export Controls protocols.

For additional information on the BWRX design, see the introduction of article 18. For additional information on the application of quality assurance in the context of the owner-contractor relationship for DNNP, see subsection 13(b).

Foster international peer review missions and timely addressing of findings

As described in subsection 8.1(e), CNSC and other federal agencies host international peer review missions and address the findings in a timely manner. During the reporting period, Canada hosted a follow-up [Emergency Preparedness Review](#) (EPREV). See subsection 16.1(g) for details on how all the recommendations and suggestions from the 2019 mission were closed. During the reporting period, Canada also hosted a follow-up to the 2019 Integrated Regulatory Review Service (IRRS) mission. Although many of the findings are outside of the scope of this report, the work done to address each recommendation and suggestion is provided in subsection 8.1(e).

During the reporting period, the CNSC hosted a country-specific safety culture forum for Canada, which was led by the [Nuclear Energy Agency](#) (NEA). The [summary report](#) was reviewed during a first-of-a-kind workshop between the CNSC and Canadian NPP licensees. The CNSC also hosted an independent assessment of regulatory safety culture, which was led by the IAEA. CNSC is developing an action plan to address the recommendations from both reviews; see subsection 10(e) for additional information.

Canadian licensees utilize and leverage the oversight from the World Association of Nuclear Operators (WANO) to continue to strive for excellence in station operations. As described in subsection 14(i)(e), WANO reviews have evolved from defined peer review cycles to a 'Continuum model' where licensees are constantly reviewed in all areas through the support of dedicated departmental points of contact and Continuum leads at WANO. However, formal peer reviews and are also conducted to ensure gaps to excellence are identified and appropriate actions are implemented.

Possible impact of climate changes on the safe operation of nuclear installations

As noted in subsection 17(i), applicants for a licence to prepare site consider climate change when identifying and assessing hazards and the impact of site-specific factors on them. Subsection 17(iii)(a) describes how OPG evaluated climate-related factors in the context of its application for a licence to construct DNNP.

As noted in subsection 14(i)(d), licensees take the effects of climate change into account when updating (every 5 years) their external hazard analysis.

Further, in the context of licensing activities, CNSC has requested NPP licensees to assess climate change resiliency and consider the effects of reasonably foreseeable climate change

based on localized historical observations and climate model predictions over the lifetime of the facility. For more information, see subsection 7.2(ii)(d).

Securing reliable supply chains

In Canada, licensees are required to maintain effective supply chain management and procurement quality assurance programs that discover and mitigate the intrusion of counterfeit, fraudulent and suspect items (CFSIs) into their operations. Refer to subsection 13(b) for further details.

Strategies for ageing management in support of the operation of nuclear installations

CNSC regulatory document [REGDOC-2.6.3, *Ageing Management*](#), establishes the regulatory requirements and provides guidance for integrated and component-specific aging management programs at NPPs. This regulatory document is listed in each NPP's licence conditions handbook (LCH) as compliance verification criteria.

Along with the aging management programs required by REGDOC-2.6.3, NPP licensees have developed a series of periodic inspection programs and plans that expand the minimum inspection and testing program requirements to address operational and safety issues. The most significant of these programs and plans are described in annex 14(ii)(b).

Strengthening emergency preparedness and response arrangements and fostering cross border collaboration

Challenge 9RM C-2 on Canada is directly related to this topic; it states that Ontario should approve and implement the revision of its [Provincial Nuclear Emergency Plan](#) (PNERP). Ontario has initiated the review and the associated enhancements of its Nuclear Emergency Management Program (NEMP). See subsection 16.1(d) for more information.

Challenge 9RM C-1 on Canada is directly related to this topic; it states that Canada should update its guidance document [Generic Criteria and Operational Intervention Levels for Nuclear Emergency Planning and Response](#) and include guidance on protection strategies and reflect guidance in provincial plans. Health Canada is adapting IAEA recommendations, as appropriate as part of the update. Public consultation on the revision is planned to commence in the fall/winter of 2025. See subsection 16.1(a) for more information.

During the reporting period, Canada collaborated on the planning and execution of Exercise Cobalt Magnet 2025, a U.S.-led, six-day, full-scale nuclear emergency response exercise focused on cross-border collaboration. The exercise simulated the consequences of a spent fuel pool accident on the shores of Lake Erie in Michigan. Given that the Canadian border lies within the 10-mile (16 km) automatic action zone, it was critical to ensure a coordinated response between the two countries. See annex 16.1(f) for more information.

Other issues addressed during the reporting period are discussed below in Challenges and Suggestions assigned to Canada from previous review meetings.

Summary of measures that address the *Vienna Declaration on Nuclear Safety*

Canada has demonstrated its fulfillment of the principles of the VDNS through the activities of the CNSC and licensees in all aspects of NPP operation. The following summarizes that fulfillment; details were provided in the seventh Canadian report as well as subsequent reports.

Principles (1) and (3)

Following the Fukushima accident in 2011, the CNSC changed its regulations and regulatory documents in response to lessons learned. The IAEA also revised five safety requirements. Subsequently, the Chair of the IAEA's Commission on Safety Standards determined that there was no need for further revisions because the technical objectives of the VDNS were already well reflected in the IAEA safety requirements. As explained in subsection 7.2(i)(b), CNSC regulations and regulatory documents align with the IAEA safety standards, including those used for emergency response and for siting, designing and constructing NPPs.

This report provides specific information and examples describing Canada's fulfillment of Principle (1) with respect to siting (article 17), design (article 18), accident response including mitigation (sub-article 19(iv)) and emergency response (article 16).

Principle (2)

The designs of existing Canadian NPPs, which are all CANDU reactors, include features that prevent accidents and mitigate impacts should an accident occur. In addition, actions by the CNSC and licensees have strengthened defence-in-depth and enhanced accident and emergency response. See articles 16 and 18 and sub-article 19 (iv) for details.

Licensees have implemented updated safety analyses and safety analysis reports that align with the requirements in revised CNSC regulatory documents. Also, licensees are meeting the safety goals associated with probabilistic safety assessments (PSAs). Details are provided in subsections 14 (i)(c) and 14(i)(d), respectively. Through verification of analysis, surveillance, testing and inspection, Canadian NPPs have been shown to meet design and safety requirements as well as the operational limits and conditions necessary for meeting VDNS Principle (1). Finally, considering the aging of Canada's fleet of reactors, NPP licensees have established and implemented rigorous aging programs with the objectives of preventing accidents and should one occur, mitigating possible releases of radionuclides (see subsection 14(ii)(b) for details).

The CNSC and licensees have used renewals of operating licences and periodic safety reviews (PSRs) on 10-year intervals as vehicles for the systematic adoption of safety-related improvements (see subsections 7.2(ii)(d) and 14(i)(b) for details). Refurbishment projects have been used to make significant safety improvements, while also extending the operating lives of the existing NPPs (see the introduction to article 18 for details).



PART A

GENERAL PROVISIONS

Part A consists of article 6 – Existing Nuclear Installations.

Article 6: Existing Nuclear Installations

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary, in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

Summary Statement for Article

Canada fulfills the obligations of article 6. Although the article does not necessarily apply after the initial national report has been written, Canada continues to use this article to elaborate on the ongoing safety of existing NPPs.

Introduction

There are 17 operating nuclear power reactors in Canada as well as three reactors in a safe storage state with an additional two shut-down and transitioning to safe storage. All 17 reactors are of the Canada Deuterium Uranium (CANDU) design and were in operation when the CNS came into force in Canada. They are situated at four sites, each with its own licence issued by the Canadian Nuclear Safety Commission (CNSC). See Relevant Nuclear Installations. There is also one reactor under construction. Annex B provides basic information on all the units at the Canadian nuclear power plants (NPPs).

Justification of continued operation of Canadian nuclear power plants

General safety framework and overall description of safety evaluations

Activities related to NPPs in Canada are governed by robust, modern legislation, with appropriate and well-defined powers to ensure the NPPs remain safe. The key legislation is the [Nuclear Safety and Control Act](#) (NSCA), which is complemented by a system of regulations and other elements of the regulatory framework. The CNSC continues to update its regulatory framework and align it with international standards. The transparency of the regulatory process in Canada (see article 7) helps to keep the focus of regulatory decisions on the health and safety of persons and the protection of the environment. Public participation in the development of the regulatory framework and the licensing process helps to maintain this focus and keep stakeholders informed and engaged. The regulatory compliance program provides comprehensive assessments of the operating NPPs' safety performance against the regulatory framework and helps ensure all reasonable provisions are made to maintain the risk of existing NPPs at a reasonable level.

Canada's nuclear regulator, the CNSC, is mature and well established, as described in article 8. Articles 9 and 10 describe how the NPP licensees fulfill their responsibilities to safety, giving it high priority at all levels of their organizations.

The remaining articles in this report describe the many provisions that contribute to the safe operation of NPPs in Canada. The CNSC, NPP licensees and other industry members make a strong commitment to nuclear safety and strive to continuously improve it. This is

evidenced by a willingness to engage in third-party evaluations, such as those done by the [Integrated Regulatory Review Service](#) (IRRS) of the [International Atomic Energy Agency](#) (IAEA) and the [World Association of Nuclear Operators](#) (WANO). The involvement of third-party expertise and participation in international fora and activities, such as the development of IAEA standards, strengthen these provisions.

Safety evaluations

Safety evaluations and improvements

The safety of all existing NPPs in Canada was fully reviewed during their initial licensing. The licensees' safety analyses, as described in the safety analysis reports, demonstrate acceptable safety margins for all Canadian NPPs. Both the licensees and the CNSC have continued to conduct broad and updated assessments since then, including updates to the safety analysis reports and probabilistic safety assessments (PSAs).

In addition, NPP licensees conduct periodic safety reviews (PSRs) on a 10-year cycle. These exercises include comprehensive and systematic plant condition assessments against modern codes, standards and practices (see subsection 14(i)(b)). Supplemental safety assessments have also been conducted in response to significant events and national and international OPEX. (e.g., related to lessons learned from the Fukushima accident).

NPP licensees have successfully completed, and are completing, major refurbishment projects that safely extend the operational lifetime of a reactor beyond its originally assumed design life. These refurbishment projects are supported by PSRs and involve the replacement of major components and many other design upgrades that, to the extent practicable, bring the refurbished reactor to a level of safety comparable to that of a new facility.

The licensees and the CNSC have also conducted many detailed verification activities in support of ongoing operations. The licensees limit the life of critical components (such as CANDU fuel channels) and implement aging management plans to help ensure ongoing safe operation. The licensees also perform thousands of tests of safety and safety-related systems each year to confirm their functionality and availability to meet the safety requirements. (See sub-articles 14(ii) and 19(iii) for more information on programs that verify safety and manage aging mechanisms on a continual basis.)

The CNSC oversees each NPP licensee on a regular basis throughout the lifecycle of a facility and conducts a very detailed assessment in conjunction with the renewal of the licence to operate. During the reporting period, the licence for the Point Lepreau Nuclear Generating Station was renewed for ten years. The CNSC has used operating licence renewals to introduce new requirements for NPPs – for example, new requirements for deterministic safety analysis and PSA. See subsection 14(i)(a) for information on licence renewal assessments and subsection 7.2(ii)(d), under “Licence renewals and updates to the licensing basis” for information on the implementation of new requirements.

In addition to major refurbishment projects, licensees have implemented safety upgrades on a continual basis to maintain safety margins and have incrementally enhanced safety at their sites. Licensees' PSRs identify safety improvements that are reflected in integrated implementation plans (IIPs). See subsection 14(i)(b) for the results of the licensees' PSRs.

See the introduction of article 18 for a list of examples of safety improvements that stemmed from PSR, refurbishment projects, or other initiatives.

Operational safety record

Canada has a mature nuclear industry with an excellent safety record spanning several decades. None of the operational events that occurred at Canadian NPPs during the reporting period posed a significant threat to the health and safety of persons or to the environment. There were no serious process failures⁵ at any NPP during the reporting period. Furthermore, the licensees' efforts to address operational events were effective in correcting any deficiencies and preventing their recurrence. The most safety-significant events that occurred during the reporting period and their follow-up are described in annex C.

Conclusion

Based on the many provisions described above and its overall strong safety record, Canada has confidence in the ongoing safety of the NPPs currently licensed to operate across the country.

⁵ A serious process failure is defined as a failure that leads to systematic fuel failure or a significant release from an NPP, or could lead to a systematic fuel failure or a significant release in the absence of action by any special safety system.⁵



PART B: LEGISLATION AND REGULATION

Part B consists of three articles:

- Article 7 Legislative and Regulatory Framework
- Article 8 Regulatory Body
- Article 9 Responsibility of the Licence Holder

Article 7: Legislative and Regulatory Framework

1. *Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.*
2. *The legislative and regulatory framework shall provide for:*
 - (i) *the establishment of applicable national safety requirements and regulations;*
 - (ii) *a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;*
 - (iii) *a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;*
 - (iv) *the enforcement of applicable regulations and of the terms of licences, including suspension, modification and revocation.*

Summary Statement for Article

Canada fulfills the obligations of article 7.

Introduction

A general description of Canada's nuclear policy is provided in section C of chapter I.

7.1 Establishing and Maintaining a Legislative and Regulatory Framework

Canada's legislative and regulatory framework includes laws (acts) passed by the Parliament of Canada that govern the regulation of Canada's nuclear industry, as well as regulations, licences and documents that the CNSC uses to regulate the industry.

The [Nuclear Safety and Control Act](#) (NSCA) is the enabling legislation for the regulatory framework. It establishes the powers, duties and responsibilities of the CNSC and authorizes regulations that set out additional requirements and provide guidance on requirements. Requirements are legally binding and mandatory elements that include the regulations made under the NSCA, licences and orders. CNSC regulatory documents, as well as other standards, also become legally binding requirements if they are part of the licensing basis (as defined in subsection 7.2(ii)(a)).

In keeping with federal policies on public consultation and regulatory fairness, the legislative and regulatory framework for nuclear regulation is open and transparent. The processes in place for the development of regulations and regulatory documents, along with the issuing of licences, provide for the involvement of interested parties and timely communications to stakeholders. (See subsection 8.1(f) for additional information on the CNSC's communications and commitment to openness and transparency.)

Canada continues to review and revise the legislative and regulatory framework to ensure it is both robust and sufficiently flexible to accommodate new technologies (such as SMRs) while ensuring that safety is maintained. This is enabled through, among other things, performance-based requirements, stakeholder engagement, environmental scans, regulatory research, and familiarization of potential licence applicants with elements of the framework,

such as the requirements and the licensing process. These provisions are described in more detail in the following subsections and in article 8.

7.1 (a) The Nuclear Safety and Control Act

The original legislation in Canada governing nuclear safety was the *Atomic Energy Control Act* of 1946. As regulatory practices evolved to keep pace with the subsequent growth in Canada's nuclear industry and nuclear technology – and to focus more on health, safety, national security, environmental protection and fulfilling Canada's international obligations – updated legislation was required for more explicit and effective nuclear regulation. The NSCA came into force on May 31, 2000, providing a robust framework for nuclear regulation, including the establishment of the CNSC. The CNSC comprises two components: a tribunal component (hereinafter referred to as the Commission, which is described below) and a staff organization (described in subsection 8.1(b)).

The Commission is an independent⁶, quasi-judicial administrative tribunal. It is a court of record with powers to hear witnesses, receive evidence and control its proceedings as long as those proceedings are dealt with as informally and expeditiously as the circumstances and considerations of fairness permit.

The Commission consists of up to seven permanent members appointed by the Governor in Council and hold office during good behaviour for a term of up to five years. One of those permanent members is designated by the Governor in Council to hold office as President. Each member is eligible to be re-appointed. Members generally have a range of experience that can include science, nuclear medicine, engineering, geology and business leadership. They are not necessarily nuclear specialists but bring strong reputations and broad transferrable skills to Commission proceedings.

Section 9 of the NSCA sets out the Commission's objects (or mandate) as follows:

- to regulate the development, production and use of nuclear energy and the production, possession and use of nuclear substances, prescribed equipment and prescribed information in order to:
 - o prevent unreasonable risk to the environment and to the health and safety of persons associated with that development, production, possession or use
 - o prevent unreasonable risk to national security associated with that development, production, possession or use
 - o achieve conformity with measures of control and international obligations to which Canada has agreed
- to disseminate objective, scientific, technical and regulatory information to the public concerning the activities of the Commission and the effects, on the environment and on the health and safety of persons, of the development, production, possession and use of nuclear substances, prescribed equipment and prescribed information

The CNSC regulates all nuclear facilities and nuclear activities in Canada, including:

- the site preparation, design, construction, operation, decommissioning and abandonment of:
 - o NPPs
 - o non-power reactors
 - o nuclear research and test facilities
 - o uranium mines and mills
 - o uranium refining and conversion facilities

⁶ The independence of the Commission is described in subsection 8.2(a).

- o nuclear fuel fabrication facilities
- o waste management facilities
- o high-power particle accelerators
- o heavy-water plants
- the certification and use of prescribed equipment and nuclear substances used in:
 - o nuclear medicine (e.g., teletherapy machines and brachytherapy used in cancer treatment and diagnostic medicine)
 - o industry (e.g., industrial radiography, oil and gas well logging, density gauges)
 - o research
- the certification of persons requiring certain qualifications to carry out duties under the NSCA

The NSCA enables the regulation of facilities (such as NPPs) by establishing a system of licensing and certification and by assigning to the Commission the power to make regulations (with the approval of the Governor in Council) that govern those facilities and to issue, amend, suspend and revoke licences, which set out the specific requirements that control licensed activities.

In addition, the NSCA provides the CNSC with other powers appropriate for a modern regulatory agency, including:

- clearly defined powers for inspectors, with powers in line with legislative practices
- a system of penalties and enforcement options for non-compliance
- clear appeal provisions for orders of inspectors and officers designated by the Commission
- provision for the Commission to redetermine decisions
- the authority to order remedial actions in hazardous situations and to require parties to bear the costs of decontamination and other remedial measures
- the authority to include licence conditions (including the power to require financial guarantees for licensed activities, such as operation, decommissioning and waste management)
- recovery of the costs of regulation from entities licensed under the NSCA
- operation of the [Participant Funding Program](#) which gives the public, Indigenous Nations and communities and other stakeholders the opportunity to request funding from the CNSC to participate in its regulatory process

The CNSC is also responsible for administering and implementing many of Canada's international obligations pursuant to existing bilateral and multilateral nuclear cooperation agreements, conventions and undertakings, including nuclear safeguards and the import and export of controlled nuclear equipment, material and information. The CNSC administers and implements the above obligations in collaboration with other government departments, including

- Global Affairs Canada, which has overall responsibility for international agreements and conventions, as well as Canada's bilateral and multilateral relationships
- NRCan, which leads on some international files involving policy direction (see section C.2 of the Introduction for details)

7.1 (b) Other legislation

Nuclear regulation is under federal jurisdiction, although certain areas are subject to provincial authority, as described below.

Subsection C.2 of chapter I describes all federal organizations in addition to the CNSC that are involved in regulating or in forming policy that may impact the Canadian nuclear industry.

The following legislation enacted by Parliament also applies to the nuclear industry in Canada:

- [Nuclear Energy Act](#)
- [Nuclear Liability and Compensation Act](#)
- [Nuclear Fuel Waste Act](#)
- [Radiation Emitting Devices Act](#)
- [Canadian Environmental Assessment Act, 2012](#)
- [Canadian Environmental Protection Act, 1999](#)
- [Impact Assessment Act](#)
- [Canada Labour Code](#)
- [Fisheries Act](#)
- [Species at Risk Act](#)
- [Migratory Bird Convention Act, 1994](#)
- [Canada Water Act](#)
- [Canadian Navigable Waters Act](#)
- [Transport of Dangerous Goods Act, 1992](#)
- [Explosives Act](#)
- [Emergencies Act](#)
- [Emergency Management Act](#)
- [Nuclear Terrorism Act](#)

The [Impact Assessment Act](#) (IAA) replaced the *Canadian Environmental Assessment Act, 2012* in August 2019. It focuses on sustainability and considers environmental, health, social and economic effects of projects, both positive and negative. See subsection 7.2(ii)(a) for more information.

The [Nuclear Liability and Compensation Act](#) holds the operator of an NPP responsible to pay up to \$1 billion for civil damages resulting from an accident at that NPP. It also provides the Government of Canada the right to establish a tribunal if required in order to accelerate and provide efficient and equitable claim settlements.

Under the Canadian Constitution, provincial laws may also apply to nuclear facilities and activities in areas that do not relate directly to nuclear regulation and that do not conflict with federal law. Where both federal and provincial laws may apply, the CNSC tries to avoid duplicate effort by seeking cooperative arrangements with federal and provincial bodies that have regulatory responsibilities or expertise in these areas. Such arrangements are authorized by the NSCA, in order to avoid regulatory overlap.

For example, conventional health and safety is overseen at the federal and provincial levels of government. In Quebec and New Brunswick, the CNSC shares the regulation of conventional health and safety for NPPs with [Employment and Social Development Canada](#), in accordance with Part II of the [Canada Labour Code](#). In Ontario, under an exclusion to the [Canada Labour Code](#), provincial legislation is substituted for federal legislation to protect workers at designated nuclear facilities. A memorandum of understanding exists between the CNSC and the Ontario Ministry of Labour, Immigration, Training and Skills Development to enable cooperation and the exchange of information/data and technical expertise related to the exercise of their respective areas of jurisdiction at designated NPPs in Ontario.

As another example, environmental protection for NPPs is regulated through the CNSC, Environment and Climate Change Canada and provincial level bodies. That is, provincial environmental legislation applies to nuclear facilities and the CNSC also shares the federal

regulation of environmental protection with Environment and Climate Change Canada, in accordance with the [Canadian Environmental Protection Act, 1999](#).

7.2 Provisions of the Legislative and Regulatory Framework

In addition to the NSCA and other acts, the Canadian legislative and regulatory framework includes the regulations under the NSCA, CNSC regulatory documents and industry codes and standards, systems of licensing, inspection, and assessment, and powers to enforce compliance with the requirements. These elements are administered in a risk-informed, performance-based regulatory approach that provides the foundation for the safety of NPPs, while remaining flexible to accommodate changing circumstances and innovation.

7.2 (i) National Safety Requirements and Regulations

The Canadian legislation and regulations for nuclear safety are a mix of prescriptive and performance-based requirements. Each regulation in Canada will typically have a document that will provide guidance in how to meet the regulatory requirements. Overall, the Canadian approach to establishing regulations and regulatory framework documents is non-prescriptive; that is, the CNSC sets general, objective, performance-based regulatory requirements and NPP applicants and licensees develop specific measures to meet the requirements.

The CNSC uses a regulatory framework plan to facilitate the creation, review, amendment, removal/repeal and general management of regulations and regulatory documents. The most recent update to the CNSC's long-term regulatory framework plan covers the period from 2025 to 2029 and outlines the regulations and regulatory documents that the CNSC will be reviewing, developing or amending during that time. This plan allows for effective planning of resources and better scheduling of projects within the regulatory framework. The CNSC updates the regulatory framework plan to take into account the CNSC's priorities, ongoing changes in the nuclear industry or changes in project plans. The updated plan is posted to the CNSC's external website annually.

7.2 (i) (a) Regulations under the NSCA

Under section 44 of the NSCA, the CNSC has implemented regulations with the approval of the Governor in Council. The regulations set general and specific regulatory requirements that must be met in order to comply with the NSCA. They apply to all types of licensees and licence applications. CNSC also has by-laws. These by-laws are in place to govern the management and conduct of the Commissions affairs.

The following regulations and by-laws are issued under the NSCA:

- [General Nuclear Safety and Control Regulations](#)
- [Radiation Protection Regulations](#)
- [Class I Nuclear Facilities Regulations](#)
- [Class II Nuclear Facilities and Prescribed Equipment Regulations](#)
- [Nuclear Substances and Radiation Devices Regulations](#)
- [Packaging and Transport of Nuclear Substances Regulations, 2015](#)
- [Uranium Mines and Mills Regulations](#)
- [Nuclear Security Regulations](#)
- [Nuclear Non-proliferation Import and Export Control Regulations](#)
- [Canadian Nuclear Safety Commission Cost Recovery Fees Regulations](#)

- [Administrative Monetary Penalties Regulations \(Canadian Nuclear Safety Commission\)](#)
- [Canadian Nuclear Safety Commission Rules of Procedure](#)
- [Canadian Nuclear Safety Commission By-laws](#)

All reactor facilities are defined as Class IA nuclear facilities under the [Class I Nuclear Facilities Regulations](#). This includes small modular reactors (SMRs) and research reactors.

The [Canadian Nuclear Safety Commission Rules of Procedure](#) set out rules of procedure for public hearings held by the Commission and for certain proceedings that have been delegated to officers designated by the Commission.

The CNSC's regulation-making process

When developing regulations, the CNSC follows the Government of Canada's [Cabinet Directive on Regulation](#) (described in annex 7.2(i)(a)) and follows the federal government's policies and procedures. This ensures that the potential impacts of each regulatory proposal on health, safety, security, the environment, and Canada's obligations under modern treaties and self-government agreements, as well as the costs or savings to government or business and the level of support of the proposed regulations, are systematically considered before they are made.

The regulation-making process includes extensive consultation with both internal and external interested parties. In developing its consultation plan, the CNSC recognizes the multiplicity of interested parties with different levels of interest, points of view and expectations concerning the nature and content of a proposed regulatory regime. Interested parties are consulted early through discussion papers (see subsection 7.2(i)(b)), workshops or other means to seek feedback. The regulation-making process is described in more detail in annex 7.2(i)(a).

7.2 (i) (b) Regulatory framework documents

Regulatory framework documents include regulatory documents published by the CNSC and standards published by the [CSA Group](#) (formerly the Canadian Standards Association). CNSC regulatory documents (called REGDOCs) and CSA Group standards are discussed in the following subsections. The expectations and guidance provided in these documents are generally articulated to be technology-neutral and, where possible, to permit the use of the graded approach by licensees and licence applicants. See annex 7.2(i)(b) for additional details and a discussion of the graded approach and regulatory framework developments related to new technologies, such as SMRs.

CNSC regulatory documents

The CNSC uses regulatory documents to support its regulatory framework by explaining and providing guidance to licensees, non-licensees and applicants on how to meet the requirements set out in Canadian legislation, including the NSCA, and its regulations. Regulatory documents also provide general information on the CNSC's practices and processes.

The CNSC's suite of regulatory documents (REGDOCs) cover its framework of safety and control areas (SCAs). The 14 SCAs cover all technical areas of regulatory oversight. The SCA's are grouped into three primary functional areas: management, facility and equipment and core processes. Each SCA addresses an aspect of the overall safety profile of a

proposed set of activities, and is then sub-divided into Specific Areas (SpA) that define the key components of each SCA. See Annex E for the list of SCAs and the SpAs. The SCA framework provides a common set of safety and control terms to ensure consistent reviews, assessments, recommendations and reporting to the Commission. This in turn facilitates better communication among CNSC staff, licensees, the Commission and members of the public.

The CNSC's ongoing enhancement and development of regulatory documents is based on a prioritized plan. The CNSC uses 3 criteria (importance, urgency and effort) to schedule and revise its regulatory framework projects.

During the reporting period (as part of its Disruptive, Innovating, Emerging Technologies (DIET) program; see section 8.1 (e)), CNSC developed a white paper on artificial intelligence (AI) for internal use. In conjunction with United Kingdom Office of Nuclear Regulation and the United States Nuclear Regulatory Commission, CNSC published the "Trilateral Principles Paper on AI." CNSC also began a project to document CNSC's position on the use of AI and machine learning during the lifecycle of SMRs, with an aim to recommend any needed changes to the regulatory framework to facilitate its regulatory oversight.

The CNSC development process for REGDOCs includes significant consultation with external interested parties. See annex 7.2(i)(b) for an outline of this process.

The CNSC conducts cyclical reviews of regulatory documents. Documents are reviewed to determine which ones should be withdrawn and archived, retained "as is" for continued use or scheduled for revision. This process ensures that the CNSC's full regulatory framework continues to be current and reflects the latest developments in domestic and international OPEX and guidance.

A table listing the key CNSC regulatory documents that apply to existing NPP licensees and new-build, in the context of the scope of the CNS, is provided in annex 7.2(i)(b). The status of the REGDOCs in the licence conditions handbooks (LCHs; see subsection 7.2(ii)(a)) of the NPPs is also provided.

IAEA standards continue to serve as references and benchmarks for the Canadian approach to nuclear safety. IAEA standards set out high-level objectives and requirements that can be mapped to the safety and control area framework used by the CNSC to establish regulatory requirements for NPPs. The IAEA standards set out best practices and expectations that are adapted to domestic circumstances by national regulators. IAEA standards apply to all reactor designs; that is, they are technology-neutral.

During the reporting period, the Canadian regulatory framework related to NPPs continued to move toward stronger alignment with international standards. The Canadian approach recognizes that international standards may only represent minimum requirements, which may need to be augmented to suit the Canadian technology, practices and regulatory approach. The first table in Annex 7.2(i)(b) provides numerous examples of where IAEA standards have been referenced in CNSC documents (and CSA Group standards, which are discussed below).

The CNSC and Health Canada actively contribute to the development of the IAEA's safety standards and security guidelines, as well as the supporting technical documents that provide more specific technical requirements and best practices for NPP siting, design, construction, operation and decommissioning. CNSC staff participate in the working groups

to draft these standards and guidelines. CNSC representatives also sit on the IAEA Commission on Safety Standards and the five supporting safety standards committees. Health Canada also sits on one of the supporting safety standards committees.

CNSC Discussion papers

Discussion papers are commonly used to solicit early public feedback on CNSC proposed policies or approaches. The CNSC considers feedback so that it can determine the type and nature of requirements and guidance to issue, as well as the appropriate regulatory instrument. The use of discussion papers early in the regulatory process underlines the CNSC's commitment to a transparent consultation process, giving interested parties an early opportunity to present their positions on regulatory initiatives. The four key stages for the development of discussion papers are:

- analyze the issue
- develop the discussion paper
- consult with interested parties
- decide on a recommended regulatory approach

The following discussion papers were published during the reporting period:

- [DIS-22-01, Proposal to Amend the Class II Nuclear Facilities and Prescribed Equipment Regulations](#)
- [DIS-22-02, Proposals to Amend the REGDOC 2.12 Nuclear Security Series](#)
- [DIS-24-01, Proposals to Amend the Packaging and Transport of Nuclear Substances Regulations, 2015 and the Nuclear Substances and Radiation Devices Regulations](#)
- [DIS-24-02, Proposal to amend REGDOC-2.13.2, Import and Export](#)
- [DIS-24-03, Proposal to amend REGDOC-2.13.1, Safeguards and Nuclear Material Accountancy](#)
- [DIS-24-04, Future Amendments the Nuclear Security Regulations: Granting Peace Officer Powers, Initiating a Complaints Investigation Mechanism, and Transferring of Firearm Ownership to Licensees](#)
- [DIS-24-05, Proposals to amend REGDOC-3.2.1, Public Information and Disclosure](#)

CSA Group standards

The CSA Group is Canada's largest, member-based standards development organization. Accredited by the Standards Council of Canada (SCC), the CSA Group uses a balanced matric approach to developing its consensus-based standards. This approach ensures that the perspectives of a diversity of interests are considered – producer, user, general interest and regulatory authorities - without any one group dominating the final product. SCC accreditation also requires that the general public be consulted about draft standards and that standards be reviewed at least every five years to ensure they remain up to date.

As many CSA Group standards are related to NPP design and operation, they are referenced in CNSC REGDOCs. Similar to REGDOCs, CSA Group standards may also be referenced in other regulatory instruments, such as licences.

During the reporting period, the nuclear industry, the CNSC and CSA Group continued to collaborate to strengthen Canada's program for nuclear standards. A representative of CNSC senior management is a member of the CSA Nuclear Strategic Steering Committee and its Executive Committee, which are responsible for guiding the development of nuclear standards. Additionally, CNSC managers and technical staff contribute to the technical committees, subcommittees and working groups developing the CSA Group standards.

CSA Group standards that are relevant to NPPs, in the context of the scope of the CNS, are shown in the first table in annex 7.2(i)(b). The table provides numerous examples of where IAEA standards have been referenced in the CSA Group standards.

7.2 (ii) System of Licensing

Section 26 of the NSCA prohibits any person from preparing a site for, or constructing, operating, decommissioning or abandoning, a nuclear facility, without a licence granted by the Commission. Subsection 24(4) of the NSCA states the following:

No licence may be issued, renewed, amended or replaced – and no authorization to transfer one given – unless, in the opinion of the Commission, the applicant or, in the case of an application for an authorization to transfer the licence, the transferee

- a) is qualified to carry on the activity that the licence will authorize the licensee to carry on; and
- b) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

Subsection 24(1) of the NSCA gives the Commission the authority to establish classes of licences for regulated activities and set the duration in each licence. Subsection 24(2) gives the Commission the authority to issue, renew, suspend, amend, revoke or replace licences. Subsection 24(5) gives the Commission the authority to include in licences any term or condition that it deems necessary for the purposes of the NSCA, including the requirement for a financial guarantee. Those terms and conditions can include references to regulatory documents or standards in whole or in part.

The CNSC's licensing system is administered in cooperation with federal and provincial/territorial government departments and agencies in such areas as health and safety, environment, emergency preparedness, Indigenous consultation, transportation and labour. The CNSC maintains memoranda of understanding with these departments and agencies as needed. Before the Commission issues a licence, the concerns and responsibilities of these departments and agencies are taken into account, to ensure that no conflicts exist with the provisions of the NSCA and its regulations.

The Commission is obligated to comply with any federal legislation and therefore may make its licensing decisions in consultation with any department or agency government bodies at the federal level having independent but related responsibilities with the CNSC.

The [Class I Nuclear Facilities Regulations](#), which apply to NPPs, require licences for each of the five types of activities in the lifecycle of a Class IA nuclear facility:

- licence to prepare a site
- licence to construct
- licence to operate
- licence to decommission
- licence to abandon

If the necessary applications are filed with the required information, the Commission may, at its discretion, and in accordance with section 24(4) of the NSCA, issue a licence that includes multiple classes of licences (e.g., a licence to prepare a site and construct, or a licence to construct and operate). A single licence may also be issued for multiple facilities, each at a different stage in their lifecycle.

The [Class I Nuclear Facilities Regulations](#) and the [Uranium Mines and Mills Regulations](#) establish a 24-month timeline for projects requiring the CNSC's regulatory review and decision on new applications for a licence to prepare a site for a Class I nuclear facility and a licence to prepare a site and construct a uranium mine and mill. This 24-month timeline does not include the time required by proponents to respond to information requests nor the time required to conduct, and render a decision on, an environmental assessment.

These timelines (based on experience from around the world) are affected by:

- completeness of the licence application
- stakeholder support (communities, Indigenous and public consultations, provincial/territorial agencies)
- state of completeness of design
- resolution of outstanding safety issues
- novel features or approaches
- state of completion of supporting R&D
- quality and timeliness of construction and commissioning

The operating reactors covered by this report are spread across four sites, each with a CNSC licence. Bruce, Darlington, and Pickering each have a single facility licence to operate multiple reactors. Point Lepreau has a licence to operate a single reactor. The Darlington New Nuclear Project (DNNP) is adjacent to the existing four-unit Darlington site and is licensed under a licence to construct.

7.2 (ii) (a) Licences and licensing process

CNSC regulatory document [REGDOC-3.5.1, Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills](#), outlines the current licensing process in the context of the NSCA. The CNSC licensing process is one of the core processes in the CNSC management system, which is described in subsection 8.1(d). Figure 7.2 depicts the CNSC licensing process and the key activities to be carried out by the licence applicant, CNSC staff and the Commission.

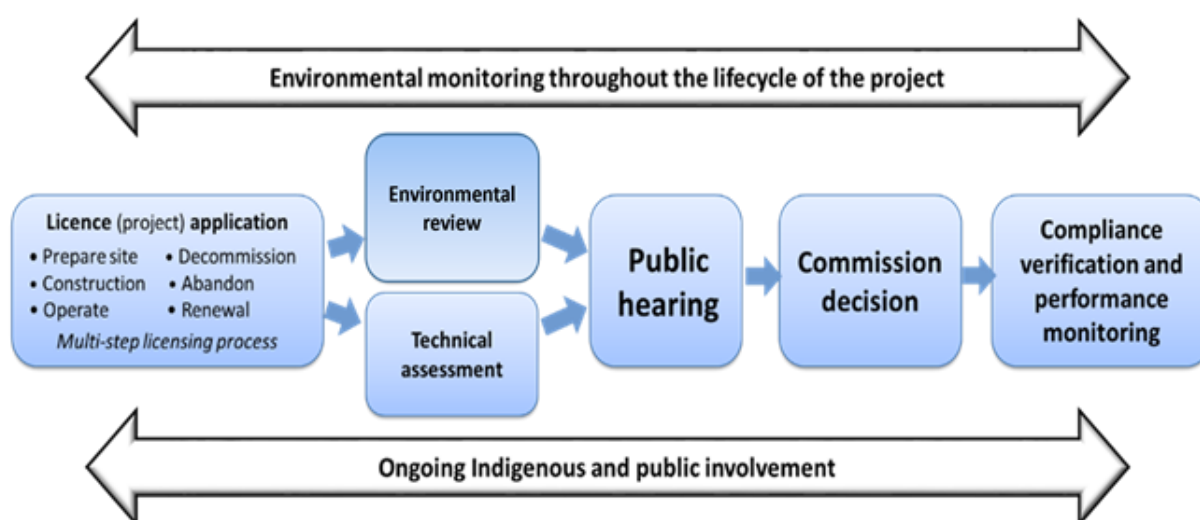


Figure 7.2 Process for obtaining an NPP licence under the NSCA

*environmental monitoring may include effluent, environmental and groundwater monitoring

The licensing process is initiated when the proponent sends an application to the CNSC. The regulations under the NSCA indicate the topics that must be addressed in the submission to the CNSC as part of the application process. Table 4 highlights some of the

more important information requirements identified in the [General Nuclear Safety and Control Regulations](#) and the [Class I Nuclear Facilities Regulations](#).

Table 4: Licence type in regulations

Licence type	General regulations	Class I regulations
Licence to prepare a site	Section 3	Sections 3 and 4
Licence to construct	Section 3	Sections 3 and 5
Licence to operate	Section 3	Sections 3 and 6

To enhance clarity, the CNSC has published, or plans to publish, supporting regulatory documents for each licence type, as shown in table 5. These REGDOCs provide additional details and criteria (such as references to other CNSC regulatory documents, national codes and standards, or the IAEA safety standards) so that applicants understand what would likely satisfy the requirements of the applicable regulations under the NSCA.

Table 5: REGDOCs providing guidance on licence applications

Document #	Title	Published
REGDOC-1.1.1	Site Evaluation and Site Preparation for New Reactor Facilities, version 1.2	February 2022
REGDOC-1.1.2	Licence Application Guide: Licence to Construct a Nuclear Power Plant, version 2	August 2019
REGDOC-1.1.3	Licence Application Guide: Licence to Operate a Nuclear Power Plant, version 1.2	September 2017
REGDOC-1.1.4	<i>Licence Application Guide: Licence to Decommission Reactor Facilities</i>	Under Development
REGDOC-1.1.5	Licence Application Guide: Supplemental Information for Small Modular Reactor Proponents	August 2019

REGDOC-1.1.1 and REGDOC-1.1.3 are described in more detail in subsections 7.2(ii)(b) and 7.2(ii)(d), respectively. CNSC's assessments of licence applications during the reporting period against the guidance in those two documents is described in subsection 14(i)(a). REGDOC-1.1.2 is described in subsection 7.2(ii)(c). REGDOC-1.1.5 provides information in addition to REGDOC-1.1.1, REGDOC-1.1.2 and REGDOC-1.1.3; it sets out expectations and guidance for an applicant to consider prior to submitting a licence application to the CNSC for an SMR.

For new NPPs, information on decommissioning plans and financial guarantees is required early in the licensing process. The [Class I Nuclear Facilities Regulations](#) require an applicant to provide information on its proposed plan for decommissioning a nuclear facility or site, while the [General Nuclear Safety and Control Regulations](#) require information on financial guarantees to accompany a licence application. Information on proposed financial guarantees should include any obligations for funding the decommissioning and long-term management of nuclear fuel waste, pursuant to the [Nuclear Fuel Waste Act](#). Financial guarantees for decommissioning are discussed in subsection 11.1(b).

As part of the licensing of new reactor projects, the environmental review would be conducted under the [Impact Assessment Act](#) (IAA). When a proposed NPP meets the thresholds in the IAA's [Physical Activities Regulations](#), known as the "project list", an integrated impact assessment (IA) is conducted by an independent review panel (which includes Commission members) that considers the requirements of both the IAA and the

NSCA in a public hearing. Their recommendation goes to the Governor in Council, who determines whether the project is in the public interest. If it is, the integrated review panel – acting as the Commission – makes the licensing decision. An IA addresses all the phases of the project lifecycle, from site preparation through to abandonment, while the applicant determines the licence(s) for which it is applying. IAs are described in more detail in subsection 17(ii)(a).

New NPP designs, such as SMRs, may employ a number of novel approaches. The Canadian regulatory approach to licensing novel designs is built on the foundation of risk-informed regulation that has been applied to traditional reactor facilities. Regulatory tools and decision-making processes are structured to enable a graded approach where a licence applicant for a reactor facility can propose alternative or novel ways to meet regulatory objectives. Where standards either do not apply or do not exist, the CNSC will consider information that is relevant to the specific application and demonstrates that the proposed safety and control measures will meet or exceed CNSC requirements. This is in line with the Government of Canada's [Cabinet Directive on Regulation](#) and is consistent with the CNSC's vision of regulatory excellence. The CNSC approach to licensing novel technologies also relies on early and frequent engagement of stakeholders and on transparency in decision making.

The CNSC has established processes for the licensing of SMR projects that utilize a graded approach. REGDOC-1.1.5 and [REGDOC-3.5.3, Regulatory Fundamentals](#), expand upon graded approach principles as they would be applied to all CNSC SCAs. The graded approach in the context of SMRs is discussed further in annex 7.2(i)(b).

The CNSC also conducted (or is in the process of conducting) pre-licensing vendor design reviews on several different reactor designs. One of their goals is to provide early identification and resolution of potential regulatory or technical issues in the design process. The pre-licensing vendor design review process has helped demonstrate that the Canadian regulatory framework is largely fit for purpose when applied in a graded manner to novel and diverse reactor designs. These initiatives, in turn, have enhanced CNSC staff's readiness to review applications involving novel nuclear technologies. During the next reporting period, the CNSC plans to continue measures to ensure effective and efficient licensing activities for new-build projects that are brought to the Commission for decision. See the description of Canada's response to Challenge 9RM C-3 in subsection 8.1(c) for more information on how CNSC is optimizing its capacity and capability to assess licence applications for novel technologies.

Canada has also promoted the goal of international harmonization with respect to licensing SMRs. CNSC has established numerous memoranda of understanding with other nuclear regulatory bodies. During the reporting period, CNSC entered into a trilateral memorandum of cooperation with the United States Nuclear Regulatory Commission and the United Kingdom's Office for Nuclear Regulation that focuses on advanced reactor SMR technologies. In addition, CNSC signed two separate bilateral memoranda of cooperation with the National Atomic Energy Agency of the Republic of Poland in June 2023 and the Swedish Radiation Safety Authority in May 2024. See subsection 8.1 (g) for additional discussion of CNSC's participation in international efforts to harmonize the regulation of new reactor technologies.

Licensing recommendations, decisions and related approvals

The CNSC staff assessment of an applicant's information is augmented by input from other federal and provincial government departments and agencies as noted above. When an NPP is not subject to an IA involving an integrated review panel, CNSC staff document the conclusions and recommendations from their reviews in Commission member documents (CMDs), submitting them to the Commission for a public hearing. The NSCA requires that members of the public be invited to participate in licensing hearings of Class I facilities (NPPs, conversion facilities, research reactors) and uranium mines and mills. The Commission may choose to hold a public hearing in one or two parts. The [Canadian Nuclear Safety Commission Rules of Procedure](#) set out the requirements for one-part and two-part public hearings. For the more conventional two-part hearing the Commission considers the documentary information, written submissions and presentations of CNSC staff and the applicant/licensee during Part 1. For Part 2 of the public hearing, the Commission focuses on the presentations and submissions of intervenors (e.g., members of the public, non-government organizations, Indigenous Nations and communities, labour unions, municipalities, other government departments, industry) as well as all information submitted by the parties who participated in Part 1 of the hearing.

For the licensing of NPPs, intervenors are typically allotted significant periods of time at the Part 2 hearing to present their information and engage the Commission. (This usually involves a 10-minute oral presentation to summarize the key points of their written submission, followed by questions from the Commission members for which no time limit is ascribed.) CNSC staff and applicants may also present supplementary or revised information at the Part 2 hearing as follow-up to discussion at Part 1. The hearings are webcast live and the video is available online for a minimum of three months following the hearing. In addition, a verbatim transcript is prepared for these proceedings and available to the public within one week of the day of the proceedings.

During and after public hearings, the Commission deliberates upon the information provided and makes the final decision on the granting of the licence. The CNSC issues news releases to inform the public of the decisions made. The records of proceedings from the hearings, along with the reasons for the Commission's decisions, are available in both of Canada's official languages, posted on the CNSC website and sent to all participants.

Subsection 37(1) of the NSCA authorizes the Commission to designate any person whom the Commission considers qualified to be a designated officer. The Commission may then authorize a designated officer to carry out any of the activities enumerated in subsection 37(2) of the NSCA, including licensing actions for certain classes of licence identified by the Commission. However, this designation by the Commission does not extend to NPP licences.

Content of licences - general

CNSC licences for NPPs contain a general requirement to conduct the licensed activities in accordance with the licensing basis. The licensing basis is defined as:

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

Thus, the information and commitments submitted with a licence application become a legal requirement for the licensee (specifically, part (iii) of the licensing basis). The documents needed to support the licence application are detailed documents supporting the design, safety analyses and aspects of operation to which the licensee refers, such as those related to conduct of operations and conduct of maintenance.

The CNSC's compliance program (see sub-article 7.2(iii)) is designed to ensure licensees continue to meet requirements and conduct the licensed activity in accordance with the licensing basis during the licence period. The licensee can improve its provisions, operations or facility design during the licence period as long as the improvements are within the licensing basis. To make a change to the licensing basis, the licensee must obtain the written approval of the Commission.

CNSC facility licences also contain a general condition requiring the licensee to notify the CNSC in writing when it changes its safety and control measures. This allows CNSC staff to confirm that operations remain in accordance with the licensing basis. Licences typically contain other terms and conditions; subsection 24(5) of the NSCA authorizes the Commission to include any licence term or condition that the Commission considers necessary for the purposes of the NSCA.

NPP licences contain relatively general requirements that are common to all NPPs in Canada; they are organized per the CNSC SCAs. They may cite CNSC regulatory documents or CSA Group standards, if needed. NPP licences may also include specific control provisions that require approval or consent to proceed for situations or changes where the licensee could be outside the licensing basis.

Also, a common type of approval included in an NPP licensee is a “regulatory hold point,” which provides a measure of additional regulatory control that is commensurate with the novelty or uncertainty associated with some aspect of licensed activity. Regulatory hold points typically involve a specific milestone that is established in a licence to separate critical phases of a work plan and allows for regulatory review before the licensee is authorized to proceed. The licensee seeks approval of the Commission or consent of a person authorized by the Commission prior to the removal of a regulatory hold point. See subsection 7(ii)(d) for examples of regulatory hold points.

Licence amendments

As noted, the NSCA gives the Commission the authority to amend licences (e.g., to modify existing licence conditions or to add new licensing requirements). The general nature of NPP licences greatly reduces the need for the Commission to amend the licence during the licence period. Nevertheless, licence amendments can be initiated by the Commission or through an application by the licensee, and can be executed relatively quickly if necessary. This ability enables the CNSC to effectively address safety-related and other issues at the licensing level. During the reporting period, the Commission amended the following licences:

- Bruce operating licence amended in October 2023 to remove licence conditions related to fitness for service programs for fuel channels in extended service
- Darlington operating licence amended in June 2024 to allow the production of cobalt-60
- Pickering operating licence amended in November 2024 to permit operation of Units 5-8 until 2026

- The licences for all operating NPPs amended in February 2025 for the implementation of [REGDOC-2.2.3, Personnel Certification, Volume III: Certification of Reactor Facility Workers, Version 2](#)

It is also worth noting that the Darlington operating licence was amended in May 2025 (just after the reporting period) to allow the production of Lutetium-177 and Yttrium-90. This, the amendment noted above that permitted the production of cobalt-60 at Darlington, and similar licence conditions related to isotope production that were established in previous reporting periods, highlight the flexibility of the licensing framework to accommodate changes to activities at operating NPPs. (It also highlights the flexibility of the CANDU design, discussed in article 18, to accommodate, with modification, safe isotope production).

Licence conditions handbooks

Each NPP site with a licence has an associated licence conditions handbook (LCH), the contents of which are under the responsibility of CNSC staff. Intended to inform both the licensee and CNSC staff, the LCH gathers in a single document all the regulatory details, explanations, expectations and associated processes for definitions, interpretations and administrative control of the licence conditions. The LCH is read in conjunction with the licence. It is organized by the licence conditions, associating each one with compliance verification criteria (CVC) that are used by CNSC staff to confirm the licensee's compliance with the licence condition. The CVC are aligned with the licensing basis and document the implementation plans, action items and transition dates required to meet the licence condition. They provide the latest revisions and effective dates of the CNSC regulatory documents and industry standards that form part of the licensing basis. They also detail the process by which the licensee notifies the CNSC of changes to its documentation that comprises part (iii) of the licensing basis. Finally, the CVC provide information on obtaining Commission approval or CNSC staff consent of specified changes (e.g., regulatory hold points), as discussed above.

In addition, the LCH provides guidance for each licence condition, which include non-mandatory suggestions or advice on how the licensee can comply with the licence condition.

A licensing hearing before the Commission includes a proposed LCH for the Commission to review. CNSC staff also inform the Commission of significant changes to LCHs (in the Regulatory Oversight Report, described in subsection 7.2(iii)(b)) to provide assurance that it continues to be an appropriate tool to facilitate the verification that the licensee remains in compliance with the licensing basis.

During the Joint 8th and 9th Review Meeting, Canada was issued a Good Practice for the “use of licence conditions handbooks and specifically the compliance verification criteria to promote consistency and objectivity of regulatory oversight”.

7.2 (ii) (b) Licence to prepare a site

The selection of a site for the long-term development of a new NPP is not, in itself, a regulated activity in Canada (although the activities of site characterization and evaluation, which support site selection, are regulated). The choice of site is largely a matter between the project proponent and the municipalities and provinces/territories involved. The only exception to this practice is when the Government of Canada, through NRCAN, assumes the role of proponent if it directly sponsors a federal NPP project (i.e., an NPP project run by the federal government). In either event, the CNSC is not involved in the site-selection process.

When applying for a licence to prepare a site, it is the applicant's responsibility to demonstrate to the CNSC that the proposed site is suitable for future development and that the activities encompassed by the licence will not pose unreasonable risks to health, safety, security and the environment for the site and its surrounding region. In addition to addressing the activities pertaining to site evaluation and site preparation, submissions for selected topics for the licence to prepare a site are expected to consider the entire lifecycle of the proposed facility. The applicant must also demonstrate that the proposed licensed activity meets all applicable regulatory requirements.

The CNSC regulatory document [REGDOC-1.1.1, Site Evaluation and Site Preparation for New Reactor Facilities](#), describes the general process for evaluating an NPP site in Canada. It supplements the related application requirements contained in the regulations and codifies experience from recent assessments for potential new NPPs and addresses lessons learned. Specifically, it:

- provides site evaluation criteria (e.g., to address the impact of the site on the environment, emergency planning and natural and human-induced external hazards)
- sets expectations for collecting site-related data
- sets expectations for quality assurance as well as public and Indigenous consultation

Additional information on the site evaluation criteria in REGDOC-1.1.1 is provided in article 17.

Regulatory efficiencies can be maximized if the applicant thoroughly evaluates the proposed site for the project and fully documents the site selection case before initiating the licensing (and, where applicable, IA) process. REGDOC-1.1.1 includes criteria for the level of facility design information needed to support the site selection case.

As part of the site evaluation process, the CNSC expects the applicant to publicly announce its intention to construct the facility and initiate a robust public communication program that will continue for the life of the project. This includes public meetings, held by the applicant, where members of the public can express their views and question the applicant.

During the reporting period, NB Power submitted an application for a licence to prepare site for one ARC-100 SMR at the existing Point Lepreau site.

7.2 (ii) (c) Licence to construct

When applying for a licence to construct a new NPP, it is the applicant's responsibility to demonstrate to the CNSC that the proposed NPP design conforms to regulatory requirements and will provide for safe operation on the designated site over the proposed plant life. The information required in support of the application to construct an NPP is referred to as the "safety case" and includes, for example, the following:

- a description of the proposed design for the new NPP, taking into consideration physical and environmental characteristics of the site
- environmental baseline data on the site and surrounding area
- a preliminary safety analysis report demonstrating the adequacy of the design
- measures to mitigate the effects on the environment and health and safety of persons that may arise from the construction, operation or decommissioning of the facility
- information on the potential releases of nuclear substances and hazardous materials and proposed measures to control them
- programs and schedules for recruiting and training staff for the construction, commissioning, and operation phases of the project

- programs and activities that will be undertaken by the applicant to perform the oversight of design, procurement, construction, commissioning and operation activities, in order to provide assurance that the plant will conform to regulatory requirements and the design and safety analysis, as presented in the application

[REGDOC-1.1.2, Licence Application Guide: Licence to Construct a Nuclear Power Plant](#)

provides guidance to applicants on the information to submit in an application for a licence to construct an NPP. A recent revision ensures it is readily applicable for SMR licence applications and the use of a graded approach.

CNSC staff use [REGDOC-2.3.1, Conduct of Licensed Activities: Construction and Commissioning Programs](#) to assess new applications for licences to construct reactor facilities. REGDOC-2.3.1 provides assurance to the applicant and the CNSC that reactor facilities will be constructed per design, meet their safety requirements and operate safely. In order for the applicant to demonstrate that the reactor facility can operate safely in the modes for which it has been designed, it is necessary for the design of the facility and the safety analysis to be well advanced and supported by appropriate and adequate research, including experimental tests and analysis.

The goal of CNSC's review of an application for a licence to construct is to obtain reasonable assurance that the facility design meets all regulatory requirements and can be constructed, commissioned and operated safely as designed and that no new safety issues will be identified prior to reactor operation. Upon receipt of the application, the CNSC performs a comprehensive assessment of the design documentation, preliminary safety analysis report, construction program and all other information required by the regulations. The evaluation involves rigorous engineering and scientific analysis, as well as engineering judgment, taking into consideration the CNSC's experience and knowledge of best practices in NPP design and operation gained from existing NPPs in Canada and around the world.

During the construction stage, the CNSC carries out compliance activities to verify the licensee's compliance with the NSCA, associated regulations and the licence. Compliance activities focus on confirming that the NPP construction is consistent with the design and that the licensee is demonstrating adequate project oversight and meeting quality assurance requirements.

The scope of a licence to construct covers all facility construction and Phase A commissioning as described in REGDOC-1.1.2 and in REGDOC-2.3.1 (i.e., the commissioning of all structures, systems and components (SSCs) done without fuel loaded). The purpose of Phase A commissioning is to verify, to the extent practicable (without fuel loaded), that all SSCs have been installed correctly and are performing according to the design intent (which includes their response to abnormal conditions, as credited in the safety analysis). Details on commissioning activities are provided in sub-article 19(i).

The licensee must also build a significant portion of the operating organization such that facility operations, processes and procedures will be in place in anticipation of the licence to operate. This approach is part of an overall philosophy to facilitate the transition from construction to commissioning to commercial operation. In addition, the approach may increase regulatory certainty for an operating licence if the licensee demonstrates good regulatory performance regarding facility construction.

Regulatory oversight activities include, but are not limited to:

- inspections, surveillance, reviews, witnessing of commissioning tests and evaluations of commissioning test results
- inspections at manufacturing facilities
- assessment of the effectiveness of the applicant's oversight of construction and commissioning activities
- granting of Commission approval or CNSC staff consent pertaining to regulatory hold points for commissioning
- oversight of the licensee's progress on its organizational development in preparation for the anticipated application for a licence to operate

During the reporting period, OPG applied for a licence to construct one BWRX-300 reactor for the DNNP. CNSC staff were guided by REGDOC-1.1.2, along with regulatory expectations outlined in applicable REGDOCs and CSA standards, as the primary criteria set for this licensing assessment when reviewing the OPG application. For certain technical areas, international standards and guidance were also used to form the basis of CNSC staff recommendations. CNSC staff concluded that the OPG application met the regulations and that OPG has the necessary programs to safely conduct the proposed construction licensed activities. The licence also includes site preparation activities for up to four nuclear reactors at the DNNP.

After reviewing the application and CNSC staff's recommendations, on April 4, 2025 the Commission issued the licence to construct for 10 years. The following regulatory hold points were imposed for DNNP:

- RHP-1: Installation of the Reactor Building (RB) Foundation – allowing for the installation of the foundation and subsequent Reactor Building construction,
- RHP-2: Installation of the Reactor Pressure Vessel (RPV) – allowing for the installation of the RPV and the connection of the RPV to associated systems and components,
- RHP-3: Fuel-Out Commissioning: allowing for the commencement of full-scale testing or commissioning activities of systems or components important to safety, but not with nuclear fuel.

7.2 (ii) (d) Licence to operate

Initial licence to operate and licence renewal - General

For a licence to operate a new NPP, the application must demonstrate that all Phase A commissioning has been successfully completed and all the systems important to safety are ready for the reactor core to accept first fuel. In addition to assessing the information included in the initial application, the CNSC verifies that any outstanding issues from the construction licensing stage have been resolved.

The initial operating licence will enable the operator to load nuclear fuel and begin fuel-in commissioning:

- Phase B starts before the end of the reactor guaranteed shutdown state
- Phase C involves the approach to critical and low-power tests
- Phase D involves high-power tests

These activities complete the overall commissioning program of all SSCs to confirm that:

- the key operational safety characteristics match those used in the safety analyses
- the NPP has been constructed in accordance with the design
- the SSCs important to safety are functioning reliably

Commissioning is discussed in more detail in sub-article 19(i).

When applying for a licence to operate (new or renewal), it is the applicant's responsibility to demonstrate to the CNSC that it has established appropriate safety management systems, plans and programs for safe and secure operation. The information required in a successful application for a licence to operate an NPP, in order to satisfy the regulations and CNSC regulatory documents, is specified in [REGDOC-1.1.3, Licence Application Guide: Licence to Operate a Nuclear Power Plant](#). It includes:

- a description of the SSCs, including their design and operating conditions
- the final safety analysis report
- proposed measures, programs, policies, methods and procedures for:
 - o conducting Phase B, C and D commissioning
 - o operating and maintaining the NPP
 - o handling nuclear substances and hazardous materials
 - o controlling releases of nuclear substances and hazardous materials into the environment
 - o preventing and mitigating the effects on the environment and health and safety of persons resulting from plant operation and decommissioning
 - o assisting offsite authorities in emergency preparedness activities, including procedures to deal with an accidental, offsite release
 - o developing and maintaining nuclear security
- the public information and disclosure program to keep the public and target audiences informed of the anticipated effects of the NPP's operation on their health and safety and on the environment
- the updated preliminary decommissioning plan
- the proposed financial guarantee for the activities to be licensed

CNSC staff conduct a balanced assessment of the proposed programs and activities against the expectations in REGDOC-1.1.3. CNSC staff's assessment guides the regulatory activities that are planned in the anticipated licence period. See subsection 14(i)(a) for the results of CNSC staff's assessment during the reporting period of NB Power's application to renew its licence to operate Point Lepreau. The pending renewal of the Point Lepreau licence is discussed further at the end of subsection 7.2(ii)(d).

Regulatory hold points are relatively common in licences to operate NPPs.

For example, the licence to operate Bruce A and B includes a condition requiring Bruce Power to obtain the approval of the Commission, or the consent of a person authorized by the Commission, before proceeding with specific phases of the major component replacement (MCR) project. The four applicable hold points, which are identified in the LCH, are:

- Phase A Prior to fuel load
- Phase B Prior to removal of guaranteed shutdown state
- Phase C Prior to exceeding 1% full power
- Phase D Prior to exceeding 35% full power

For each phase, the Commission delegated the authority for the removal of regulatory hold points for the return to service to the Chief Regulatory Operations Officer of the CNSC.

The licence to operate the Darlington NPP and the associated LCH have similar provisions for the facility's regulatory hold points related to refurbishment.

Licence renewal and updates to the licensing basis

For the renewal of a licence to operate, the licensee must indicate any changes in information that was submitted in the previous application. (See annex C of the seventh

Canadian report for a summary of information typically submitted with an application to renew an NPP operating licence.) CNSC staff conduct a comprehensive review of the facility and of the licensee's past activities and performance and future plans.

Licence renewal is a mechanism for implementing new requirements from recently published CNSC REGDOCs or CSA Group standards, thus contributing to the continuous safety improvement of NPPs. Before implementation, the CNSC consults with licensees on the need for a transition period or implementation plan. The implementation of REGDOCs or standards frequently involves a series of consultations, such as CNSC–industry workshops and CNSC staff visits to NPPs. The Commission may provide direction on the planned implementation of new REGDOCs and standards during the licence renewal process. Following the licence renewal, the implementation details of these REGDOCs and standards are recorded in the LCH. For example, the LCH may contain an anticipated implementation date of the new REGDOC or standard, that is projected to occur after the start of the licence period.

As part of continuous improvement during their licence periods, NPP licensees also implement new regulatory documents and standards (and new versions thereof) that were not considered at the time of the renewal of their licences to operate. This is done on a risk-informed basis, which considers the most effective and efficient time to adjust programs to meet evolving expectations. The LCH is used to document, on an ongoing basis, the implementation status of new regulatory documents and standards.

The licensees of operating NPPs also conduct periodic safety reviews (PSRs) in support of ongoing operation, which also account for the possible implementation of new requirements associated with modern codes, standards and practices. Refer to the second table in annex 7.2(i)(b), which illustrates through various examples the ongoing nature of implementation of individual REGDOCs and standards at the NPPs.

Evolution of licensing periods and periodic safety review within the licensing framework

The CNSC uses flexible licence periods that enable it to regulate NPPs in a more risk-informed manner (particularly through adjusting the licence period according to the licensee's previous performance and the findings resulting from CNSC compliance verification activities). The licensee may also request a specific licence period to match its planned activities or anticipated change in status (such as the beginning or end of refurbishment).

CNSC Commission member document CMD 02-M12, *New Staff Approach to Recommending Licence Periods*, compiles the factors CNSC staff need to consider when making recommendations to the Commission on licence periods. These factors include:

- facility-related hazards
- implementation of the licensee's quality management programs
- implementation of a compliance program by both the licensee and the CNSC
- licensee experience
- CNSC ratings of licensee performance under the CNSC SCAs
- the requirements of the *Canadian Nuclear Safety Commission Cost Recovery Fees Regulations*
- the facility's planning cycle

There is no explicit limit on licence periods in Canada. The imposition of a relatively short licence period by the Commission is an option when overall licensee performance, or one of the other factors listed above, is unsatisfactory.

In the mid-2010's, CNSC staff began recommending 10-year operating licences for NPPs, with a PSR performed every 10 years to synchronize with licence renewal. In 2017, the CNSC amended the Class I Nuclear Facilities Regulations to require operating NPPs to conduct a PSR at an interval specified in the licence. The requirements for PSR are found in CNSC regulatory document [REGDOC-2.3.3, Periodic Safety Reviews](#), which is consistent with the IAEA's Specific Safety Guide No. SSG-25, Periodic Safety Review for Nuclear Power Plants. The CNSC SCAs that provide the framework for the licence renewal safety assessment (and PSR) cover the IAEA PSR safety factors. The PSR results in an integrated implementation plan (IIP), which is submitted to CNSC staff for acceptance per REGDOC-2.3.3. REGDOC-2.3.3 establishes 10 years as the appropriate interval, but allows shorter intervals, or slightly longer than 10 years, to accommodate operational plans. PSRs typically support, but are not formally part of, the application to renew the licence to operate for the subsequent licence period.

Refer to subsection 14(i)(b) for the results of the most recent PSRs for operating NPPs in Canada. The Commission considered the results of those PSRs and the proposed IIPs when granting the respective operating licences. As of the end of the reporting period, the licences to operate Bruce, Darlington, Pickering and Point Lepreau each had a period of 10 years⁷.

Licence renewal applications are not needed as a mechanism to drive the resolution of safety issues. Multiple avenues are available, besides licensing hearings, for engaging stakeholders in issues that interest them. These include regulatory oversight reports and environmental protection review reports (discussed in subsections 7.2(iii)(b) and 15(b), respectively). The maturation of the regulatory framework, including the implementation of PSR and CNSC's compliance program, also support the implementation of longer licences.

During the previous reporting period, NB Power applied for a renewal of its licence to operate Point Lepreau for a period of 25 years. CNSC staff recommended to the Commission a licence period of 20 years, noting that a 25-year licence would extend past the current prediction for the end of safe operating life (2042).

The Commission took into consideration interventions from various interested parties, and noted in their record of decision that "providing opportunities for intervenors to voice their views and for the Commission to hear them is necessary to sustain a dialogue with members of the public and Indigenous Nations and communities". This led the Commission to approve a 10-year licence for the Point Lepreau NGS, with a public proceeding at the mid-point in order to provide such opportunities.

During the reporting period, OPG applied for a renewal of its licence to operate DNGS for a period of 30 years. CNSC staff also recommended to the Commission a licence period of 30 years. Part 1 of the relicensing hearing took place in February of 2025, with part 2 scheduled to take place in June 2025.

As part of the application process for renewal of the licence to operate DNGS, CNSC requested OPG to assess climate change resiliency and consider the effects of reasonably foreseeable climate change based on localized historical observations and climate model

⁷ The period for the Darlington licence is slightly less than 10 years.

predictions over the lifetime of the facility. OPG utilized the [Electric Power Research Institute Climate Vulnerability Assessment Guidance for Nuclear Power Plants](#) in order to conduct this assessment and their results will be submitted to CNSC staff in the next reporting period. A similar assessment is underway for Pickering, and Bruce Power will also undertake similar work for its next licence renewal.

7.2 (ii) (e) Licence to decommission

Specific requirements for an application for a licence to decommission a Class I nuclear facility are listed in section 7 of the [Class I Nuclear Facilities Regulations](#). Information listed in section 3 of the [General Nuclear Safety and Control Regulations](#) and the general requirements section of the [Class I Nuclear Facilities Regulations](#) is also required. Examples of the information required in an application for a licence to decommission a Class I nuclear facility include:

- effects on the environment and the health and safety of persons that may result from the decommissioning, and the measures that will be taken to prevent or mitigate those effects
- proposed measures to control releases of nuclear substances and hazardous substances into the environment
- proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons; and to maintain national security, including an emergency response plan

The [Class I Nuclear Facilities Regulations](#) require an applicant for a licence to prepare site, licence to construct, or licence to operate a Class I facility to provide information on the proposed plan for decommissioning. The CNSC requires that planning for decommissioning take place throughout a licensed activity's life-cycle, and that both a preliminary decommissioning plan and a detailed decommissioning plan be prepared for approval by the CNSC. [REGDOC-2.11.2, Decommissioning](#), stipulates regulatory expectations to licensees regarding the preparation and content of preliminary and detailed decommissioning plans for activities licensed by the CNSC. NPP licensees are in the process of implementing REGDOC-2.11.2, which also contains expectations for the preparation for decommissioning, including the transition to the end of commercial operation and decommissioning strategy.

Furthermore, CSA Group standard N294, *Decommissioning of facilities containing nuclear substances* sets out additional expectations on decommissioning of nuclear facilities and other locations where nuclear substances are managed, possessed, or stored.

As a condition of their licences, the Commission routinely requires licensees to maintain a decommissioning plan and a financial guarantee for decommissioning.

During operation, a licensee identifies a target date for end of commercial operation of the facility (normally, several years in advance). The expected regulatory process for end of commercial operation is set out in CNSC regulatory document [REGDOC-3.5.1, Information Dissemination: Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills](#), which allows appropriate plans to be developed. Per REGDOC-3.5.1, the CNSC requests the licensee to develop a broad plan that comprises steps for approaching permanent shutdown and the facility's smooth transition from shutdown to a stable state (i.e., stabilization activities). REGDOC-3.5.1 provides for two basic approaches – immediate decommissioning following the end of commercial operation and deferred decommissioning, which would

include an extended period of safe storage with surveillance prior to commencing dismantlement and site restoration.

In Canada, Gentilly-2 is in safe storage and proceeding towards decommissioning. At Pickering, Units 2 and 3 are in safe storage and Units 1 and 4 are proceeding toward safe storage. See Section D in the Introduction for more details. Gentilly-1 (a predecessor of Gentilly-2) and Douglas Point (first full-scale NPP in Canada, located near the Bruce site) are in decommissioning.

7.2 (iii) System of Regulatory Inspection and Assessment

Section 30 of the NSCA authorizes CNSC inspectors to carry out inspections to verify licensee compliance with regulatory requirements, including any licence conditions. Per paragraph 24(4)(b) of the NSCA, these inspections are intended to confirm that the licensee has sufficient provisions to adequately protect the environment and the health and safety of persons, maintain national security and implement Canada's international obligations.

The CNSC designs and executes a compliance verification program that:

- is informed by risk (to health, safety, the environment and national security)
- considers the effective implementation of international agreements to which Canada has agreed
- accounts for the compliance record of the regulated person or organization

The CNSC implements a corporate-wide compliance verification process (one of the core processes in the CNSC management system; see subsection 8.1(d)) that integrates the following elements:

- promotion to encourage compliance (subsection 7.2(iii)(a))
- verification activities to confirm licensees are complying with requirements and expectations (subsection 7.2(iii)(b))
- reactive control measures to enforce compliance (sub-article 7.2(iv))
- consistency in the method and conduct of compliance activities

The compliance verification process may provide input to the initial issuance of licences and provides input to the operating licence renewal process described in sub-article 7.2(ii).

7.2 (iii) (a) Promotion of compliance

Promotion of compliance refers to all activities related to fostering conformity with requirements. The goal is to maximize compliance by strengthening those factors that encourage it and mitigating those that hinder it. Compliance promotion can take the form of consultation, acknowledgement of good performance, collaboration with other regulatory bodies, and dissemination of information to the regulated community about regulatory requirements/standards and the rationale behind them. Specific compliance promotion activities include, but may not be limited to, training, seminars, workshops and conferences.

7.2 (iii) (b) Verification of compliance

General

Compliance verification includes all the activities related to determining and documenting whether a licensee's programs and performance comply with requirements and conform to acceptance criteria. Verification activities include:

- Type I inspections, which consist of audits of licensee programs or processes and their implementation
- Type II inspections, which focus on the performance or output of the programs or processes, as well as walkdowns (or rounds) and routine system inspections
- field inspections, which focus primarily on observations made within the nuclear power plant and can be completed within a short time frame
- desktop inspections, which focus on the performance or output of the programs or processes through document review
- compliance assessments, which involve reviews of documentation submitted to the CNSC by licensees (or applicants)
- surveillance and monitoring activities, which collect real-time information about licensee performance and possible emerging issues; these include the review of NPP records and attendance at meetings related to production, return to service and outage planning
- independent environmental monitoring program, which complements and informs the CNSC compliance program by verifying environmental monitoring results submitted by the licensees (thus confirming details needed to demonstrate compliance)

In compliance assessments, which were implemented within the reporting period, CNSC staff assess licensee documents, such as the safety analysis reports, quarterly reports, design documents and event reports, for compliance with regulatory requirements. Compliance assessments may result in a recommendation for further regulatory action, such as those detailed in subsection 7.2 (iv). Compliance assessments are also conducted when licensees propose certain changes to their operations, documentation, etc. As indicated in subsection 7.2(ii)(a), licences require the licensees to notify the CNSC of such changes. CNSC staff perform compliance assessments to confirm that the change, if it were to proceed, would remain in accordance with the licensing basis for the facility.

In general, acceptance criteria that can be used to assess compliance during these activities may be derived from CVC in the LCH (e.g., licensee documents, CNSC regulatory documents and standards cited in the LCH), and criteria that are not in the LCH such as the following:

- CNSC documents not listed in the LCH that clarify how the Commission intends to apply the legal requirements
- additional information supplied by licensees defining how they intend to meet legal requirements in performing the licensed activity
- CNSC staff's expert judgment, including knowledge of industry best practices

Inspections

Inspections typically include interviews with responsible licensee staff; reviews of documentation, data, logs and event reports; observation, and field component line-up checks. Some inspections monitor licensee activities as they unfold (e.g., exercises, outages).

See annex 7.2(iii)(b) for a listing of systems and areas that are typically inspected at NPPs.

The CNSC has in place a comprehensive process for conducting inspections for all regulated activities concerning NPPs. This process has been responsible for the development of procedures, templates and guides used by CNSC staff to improve the consistency and efficiency of inspections for all regulated facilities and activities. A feedback mechanism is also in place for CNSC staff to recommend revisions to inspection documents.

CNSC staff who conduct the inspection are chosen based on the area being assessed and typically include specialists from the head office and inspectors from the site office. The site office inspectors are designated per section 29 of the NSCA and have various powers and limitations described in sections 30 to 35 of the NSCA. A site office inspector generally leads the inspection team, with support from the technical specialist staff. The licensee is notified in advance of the inspection and its subject area. Entrance meetings, daily briefings of results and exit meetings are included in the inspection plans for Type I and Type II inspections. The results are recorded in a CNSC report to the licensee and follow-up actions are documented and assigned target completion dates.

Type I inspections are used to evaluate licensee programs and may be conducted after programmatic changes. As the licensees of the operating NPPs are well-established, Type I inspections are rarely conducted for the currently operating NPPs. Type I inspections are planned with a high degree of detail, with acceptance criteria spelled out in advance. The results from Type I inspections are transmitted by letter to licensees. These inspections involve both an onsite and remote desktop-based component.

Type II inspections are used to evaluate the output of licensee programs and are conducted at a regular frequency. The results of Type II inspections are transmitted by letter to licensees. These inspections involve both an onsite and remote desktop-based component.

Desktop inspections are used to evaluate the output of licensee programs and are conducted at a regular frequency. The results of desktop inspections are transmitted by letter to licensees. These inspections involve only a remote, desktop-based component.

Field inspections are limited scope, onsite inspections used to determine the current status of the NPP, and its personnel and management system. CNSC site staff at NPPs conduct field inspections at a regular frequency and communicate their preliminary observations to the licensees through a field inspection record. CNSC staff also submit a quarterly summary of the findings from field inspections by letter to the licensees.

Type I, Type II, field and desktop inspections are executed using inspection guides, which are further customized for inspections at specific NPPs. CNSC updated the suite of inspection guides during the reporting period and developed additional guides; there are now approximately 160 approved inspection guides. The guides are continuously improved to reflect the current state of the CNSC compliance program and changes to the licensing basis. CNSC staff also actively collect and act on lessons learned from inspections at NPPs.

Compliance verification baseline and additional activities

To help achieve regulatory effectiveness, efficiency, consistency and clarity, the CNSC compliance program uses a planned set of baseline compliance verification activities, which include inspections and other activities as noted above that are suited for typical NPP operation. The baseline program represents the minimum set of activities required to verify licensee compliance with regulatory requirements. The baseline activities represent a reasonable set of activities for a licensee with satisfactory safety performance and are balanced to reflect the relative risk significance of each of the CNSC SCAs. Within each SCA, a risk-informed approach is used to identify an effective and efficient set of compliance verification activities, which can be tailored to individual licensees and circumstances.

The baseline regulatory activities take place over a schedule of five years. For SCAs where the CNSC rating of licensee performance is below expectations, risk management principles

are used to identify focused activities that CNSC staff will undertake in the next planning period to supplement the baseline activities. Monitoring includes the quarterly review of results of all verification activities.

While most inspections are planned and scheduled with licensees, inspectors have and do use the power to conduct reactive inspections, in reaction to events or other findings (for example, inspections related to the failure of a pump motor for the primary heat transport system at Point Lepreau, as described in annex C).

During the reporting period, CNSC staff developed and documented the set of baseline compliance verification activities for the period 2023 to 2028. The revision used a risk-informed approach that balanced the use of the different types of activities available to reduce duplicative effort while allowing more resources to be available for potential reactive activities.

During the reporting period, CNSC leveraged virtual/augmented reality technologies, including digital twins, to enhance inspector training and added cross-functional training to broaden inspector capabilities.

Besides the CNSC, other organizations play a role in verifying the compliance of NPP licensees with the various requirements. As noted in subsection 7.1(b), CNSC has a [memorandum of understanding](#) with the Ontario Ministry of Labour, Immigration, Training and Skills Development to facilitate effective oversight and verification of conventional health and safety at NPPs in Ontario. As another example, Health Canada operates the [National Dose Registry](#) (NDR), which contains the dose records of all individuals in Canada who are monitored for occupational exposures to ionizing radiation. The NDR assists in regulatory control by notifying regulatory authorities of overexposures within their jurisdiction. See subsection 15(a) for details.

Licensee reporting, follow-up, recording and tracking

CNSC regulatory document [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants](#), consolidates and expands upon almost all legislated reporting requirements contained in the NSCA and its associated regulations that apply to NPPs. REGDOC-3.1.1 is cited in all PROLs and thus sets out the considered particularly significant to safety. CNSC staff may also investigate events of higher safety significance to independently confirm the causes and required corrective actions.

CNSC staff use the Central Event Reporting and Tracking System database to record the details of reportable instances; to code and sort reportable instances using various criteria; and to record licensee and CNSC follow-up.

Reportable instances deemed to be of noteworthy significance with respect to the protection of health, safety and the environment, the maintenance of national security, and compliance with international obligations are reported to the Commission in an event initial report, thus making the information available to all stakeholders.

REGDOC-3.1.1 requires the NPP licensees to report data for a set of 25 safety performance indicators on a quarterly basis. CNSC staff use these safety performance indicators to:

- benchmark acceptable levels of operational safety
- track operational trends important to safety and, in some cases, performance comparisons across NPPs

CNSC staff's assessment of safety performance indicator data is presented in the [Regulatory Oversight Report for Canadian Nuclear Power Generating Sites](#), described below

REGDOC-3.1.1 also requires a suite of quarterly and annual scheduled reports that provide more detailed information on specific programs including their improvements and overall performance, including certain normal business activities of interest to the CNSC or that require longer-term compliance monitoring. In addition, scheduled reports provide a more in-depth analysis of trending information from the performance indicators as well as a discussion and analysis on overall trends from reportable instances and long-term safety and regulatory issues.

timing for information that NPP licensees are required to report to the CNSC. It includes requirements for scheduled (periodic) and unscheduled (e.g., event) reports. During the reporting period, all licensees implemented a revision of REGDOC-3.1.1 (Version 3), which introduced requirements related to cyber security and other security reporting and repackaged information reported through annual and quarterly reports to create efficiencies or respond to new regulatory requirements.

REGDOC-3.1.1 provides detailed examples and guidance on the types of reportable instances (e.g., situations and events) that must be reported. The list is comprehensive and includes many events that would not meet the threshold for international reporting (such as for the Incident Reporting System or the International Nuclear Event Scale (INES)). Preliminary reports for the most safety-significant reportable instances must be provided to the CNSC immediately. Other preliminary reports must be provided within 14 days of becoming aware of a reportable instance. The least significant reportable instances are required to be reported quarterly or annually through scheduled reporting, primarily for trending and analysis of long-term safety and regulatory issues.

Licensees are required to assess the significance of the reportable instances in accordance with their management system. The urgency with which follow-up to the reportable instance should be conducted is determined during the CNSC review. The CNSC reviews do not aim to duplicate the assessments already performed by licensees; their purpose is to ensure licensees have adequate processes in place to take necessary corrective actions and incorporate the lessons learned from past reportable instances into their day-to-day operations. CNSC staff will only carry out detailed reviews of those reportable instances

Adjustment of compliance verification program due to the COVID-19 pandemic

During the previous reporting period, the CNSC followed its business continuity plans and adapted its compliance verification program to the conditions of the COVID-19 pandemic. Effective March 16, 2020, all CNSC staff in Ottawa and at regional and site offices were directed to work from home. During the reporting period, CNSC head office staff in Ottawa continued to work from home as a rule, while inspection practices largely returned to their pre-pandemic norm.

Regulatory oversight report

CNSC staff produce the [Regulatory Oversight Report for Canadian Nuclear Power Generating Sites](#), which is presented annually to the Commission and later published. In addition to the operating NPPs, recent reports have covered Gentilly-2 and the waste management facilities at the same sites as the NPPs. The regulatory oversight report

describes the results of CNSC staff's compliance verification activities and summarizes the safety performance at each NPP for all the CNSC SCAs, using the rating system described in annex E. It provides the Commission, the public, stakeholders, and licensees with information and feedback on performance and other topics of interest during a calendar year. In addition, the regulatory oversight report describes progress on issues that had been identified in the previous report. The Commission follows up with questions to CNSC staff and licensees at a Commission meeting and also invites submissions from intervenors. The CNSC provides funding for interventions to eligible applicants through its Participant Funding Program.

During the previous reporting period, the CNSC commenced comprehensive review of the process for all of its regulatory oversight reports. The objectives of the review were to:

- consider the frequency at which regulatory oversight reports should be presented to the Commission
- define and better understand the needs of the target audience(s)
- seek input from licensees, stakeholder, and Indigenous Nations and communities to help refine the content and delivery of the regulatory oversight RORs to the Commission

In support of the third objective, the CNSC published discussion paper [DIS-21-01, *The Canadian Nuclear Safety Commission: Regulatory Oversight Report Review*](#) during the previous reporting period to seek feedback on the reports and their process from licensees, stakeholder, and Indigenous Nations and communities. Following the feedback on discussion paper [DIS-21-01, *The Canadian Nuclear Safety Commission: Regulatory Oversight Report Review*](#), working groups were created to initiate changes to CNSC regulatory oversight reports, including the Regulatory Oversight Report for Canadian Nuclear Power Generating Sites. Incremental changes to the regulatory oversight reports were made, including streamlining and standardizing templates for all reports. Additional changes to the regulatory oversight reports are expected in the next reporting period as the CNSC explores alternative ways to share regulatory oversight information with Indigenous Nations and communities, the public and other interested parties.

7.2 (iv) Enforcement

Enforcement includes all activities to compel a licensee into compliance and to deter non-compliance with requirements. The choice of enforcement tool is governed by the CNSC graduated enforcement strategy handbook. It provides details on the effective application of the enforcement tools described below and outlines the responsibilities of CNSC staff and the Commission in their execution of these tools. If the initial enforcement action does not result in timely compliance, increasingly severe enforcement actions may need to be used. In the graduated approach, the severity of the enforcement measure depends on the safety significance of the non-compliance and other related factors, such as:

- the risk significance of the non-compliance with respect to health, safety, national security, the environment and Canada's international obligations
- the circumstances that have led to the non-compliance (including acts of willfulness)
- the licensee's previous compliance record
- operational and legal constraints
- industry-specific strategies, efforts and ability to return to compliance and/or rectify the situation

Graduated enforcement tools available to the CNSC include:

- recommendations

- notice of non-compliance
- increased regulatory scrutiny
- request from the Commission for information
- warning letters
- administrative monetary penalties (AMPs)
- orders
- licensing actions
- prosecution

Some of these tools are typically handled by CNSC staff and do not require the involvement of the Commission.

Recommendations and notices of non-compliance are the most common enforcement tools used for NPPs.

A recommendation is a written suggestion to affect an improvement based on good industry practice. It is, technically speaking, not an enforcement tool in that it is used when the licensee is still in compliance with regulatory requirements.

A notice of non-compliance is a written notice from the CNSC requesting that the licensee take the necessary action(s) to correct a non-compliance. The notice of non-compliance indicates that a non-compliance has been confirmed and requests that the licensee respond with one of the following:

- confirmation that compliance has been restored
- a timeframe for restoring compliance
- a timeframe within which a corrective action plan will be submitted

If compliance is restored within an acceptable time frame and to the satisfaction of the CNSC, no further regulatory action is necessary.

Increased regulatory scrutiny includes the focused verification activities referred to in subsection 7.2(iii)(b).

The Commission (or an authorized person) can make a formal request for action, as stipulated in subsection 12(2) of the [General Nuclear Safety and Control Regulations](#). These types of formal requests are infrequent. The licensee can be asked to explain how it plans to address a concern raised by the Commission or the authorized person.

As an example, in June 2024, CNSC staff issued separate letters to each operating NPP, invoking subsection 12(2) of the [General Nuclear Safety and Control Regulations](#), requesting evaluations of potential unaccounted neutron doses, characterization of neutron sources, and implementation of mitigation measures. Neutron radiation, not typically measured by standard dosimetry, was identified during routine radiation survey activities by an IAEA inspector at Bruce Power in March 2023. Subsequent neutron dose measurements at OPG's Waste Volume Reduction Building and Retube Component Processing Area detected neutron fields near containers holding refurbishment waste.

A warning letter notifies the licensee's senior management of unresolved non-compliance and informs them that CNSC management is aware of the situation. A warning letter specifically warns of the possibility of escalating enforcement if the non-compliance remains uncorrected.

An AMP is a financial penalty imposed by the CNSC, without court involvement, in response to a violation of a regulatory requirement. It can be applied to any person, which includes

corporations, subject to the NSCA. AMPs serve as a credible deterrent, thereby achieving higher levels of compliance.

The NSCA sets the maximum AMPs for individuals and persons other than an individual (i.e., a corporation or other institution) at \$25,000 and \$100,000, respectively and addresses the rules surrounding violations and designates who can issue AMPs and review them. The review framework for AMPs is based on the CNSC appeal process; reviews are conducted by the Commission, during which time payment is pending. The [Administrative Monetary Penalties Regulations \(Canadian Nuclear Safety Commission\)](#) set out the schedule of violations that are subject to AMPs under the NSCA, as well as the method by which the penalty amounts are determined, and the way notices of violation are served.

CNSC regulatory document [REGDOC-3.5.2, Administrative Monetary Penalties, Version 2](#), provides an overview of how AMPs are administered and how they fit in CNSC's approach to compliance enforcement.

The CNSC issued a total of 13 AMPs during the reporting period. Three of these AMPs were issued to an NPP. One was issued to address repeated non-compliance with requirements related to hours of work and recovery periods for workers in safety-sensitive positions. The second AMP was issued to address the licensee's loss of control of quarantined items. The third was a security-related AMP, which is outside the scope of this report:

The NSCA gives the Commission, inspectors and designated officers of the Commission the authority to issue an order without prior notice, where necessary to do so in the interests of health, safety, the environment, national security or Canada's international obligations. The NSCA includes provisions for the review of orders by the Commission, which includes an opportunity for the affected licensee to be heard.

Licensing action can be taken in the context of a licensing matter initiated by the licensee/applicant. The Commission could grant a licence for a shorter term – for example, so that it can reconsider a specific compliance issue in the relatively near future. Alternatively, the Commission could also grant a licence renewal for a shorter licence term to allow the licensee sufficient time to make certain improvements or provide clarifications before the licence is considered for the next renewal.

Examples of other licensing actions that can be initiated by the CNSC include:

- licence amendment: CNSC staff may recommend that the Commission amend a licence; licence amendments cover a wide range of possibilities and are decided case-by-case; an enforcement example might be the imposition in the licence of a limit to on-power operation.
- decertification of persons
- refusal to certify or renew certification
- licence suspension or revocation: CNSC staff may recommend that the Commission suspend or revoke a licence; this course of action can be taken in any of the following circumstances:
 - o the licensee is in serious non-compliance
 - o the licensee has been successfully prosecuted
 - o the licensee has a history of non-compliance
 - o the CNSC has lost confidence in the licensee's ability to comply with the regulatory requirements

Notwithstanding the above, the NSCA gives the Commission the authority, on its own motion, to renew, suspend in whole or in part, amend, revoke or replace a licence under prescribed conditions.

A licensee that is subject to enforcement action that involves an order or amendment, suspension or revocation of the licence, is entitled to appeal to the Commission to contest the action. For a licence amendment, suspension, or revocation, the licensee would normally receive advance notice and have an opportunity to be heard by the Commission.

Where warranted, prosecution is also an enforcement option available to the CNSC. Specific instances of non-compliance that might lead to prosecution include:

- exposures to the public or workers in excess of the dose or exposure limits
- failure to take all reasonable measures to comply with an inspector's order

Significant enforcement actions against NPP licensees are summarized for the Commission and stakeholders in the annual regulatory oversight report (see subsection 7.2(iii)(b)).

Summary of Significant Changes Since Previous Report

During the reporting period, Canada made the following changes to its legislative and regulatory framework.

- CNSC and the CSA Group continued to develop and revise regulatory framework documents across all 14 CNSC SCAs, with a focus on readiness for potential new-build.
- CNSC worked to adapt both its practices and regulatory framework to other emerging developments, such as DIET and AI.
- NPP applicants, CNSC staff, and the Commission undertook various activities related to the application for, initial granting of, or renewal of licences to site, construct, and operate NPPs at various sites.
- CNSC revised its 5-year baseline compliance verification program to increase capacity for reactive verification activities in response to emerging issues. CNSC began conducting the identified activities, which will be scheduled during the 2023-28 fiscal year⁸ timeframe.

Notable Achievement(s)

CNSC has established and continues to improve a large suite of customizable, comprehensive inspection guides that facilitate the consistent and effective execution of compliance verification activities at NPPs.

CNSC updated [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants \(Version 3\)](#), improving reporting efficiency and incorporating new requirements such as cybersecurity.

Future Focus

CNSC will continue to modernize regulatory oversight reports, with further changes planned to improve accessibility and engagement with Indigenous Nations and communities, stakeholders, and the public.

⁸ The CNSC fiscal year begins on April 1.

Article 8: Regulatory Body

1. *Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.*
2. *Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.*

Summary Statement for Article

Canada fulfills the obligations of article 8.

Introduction – CNSC Responsiveness to extraordinary circumstances and change

The CNSC has corporate business continuity plans that cover management and recovery from (non-nuclear) incidents or threats. They are supported by an emergency management business continuity plan for the Directorate of Power Reactor Regulation (DPRR). As noted in sub-article 7.2(iii)(b), during the previous reporting period, the CNSC activated its business continuity plans in response to the COVID-19 pandemic and adjusted its compliance verification program. More information on the CNSC's response to the pandemic is provided in the ninth Canadian report.

During the reporting period, the CNSC made various preparations to adapt to emerging technologies and changing circumstances, many of which are discussed in this article. CNSC's strategy for ensuring regulatory readiness for new reactor technologies is built upon three principles, shown in figure 8.1(a):

1. a robust but flexible regulatory framework that provides a sound legal basis upon which regulatory decisions can be made and enforced
2. risk-informed processes by which the regulatory framework is applied
3. a capable workforce with sufficient capacity and technical expertise, operating within an agile organization



Figure 8.1(a) Regulatory readiness for SMRs

The CNSC has an SMR Steering Committee to provide senior management governance, ensure the principles are appropriately balanced, and prioritize the activities that support the strategy, including those associated with the review and licensing of SMR technologies. The CNSC is also looking beyond the nuclear sector for models or examples of international harmonization with respect to technological advances and their regulation (e.g., in the aviation, medical, or transport sectors).

During the reporting period, the CNSC established the SMR readiness project to optimize its readiness to license and regulate SMRs. The project spans five years and has a total budget of \$50.7 million. It is premised on four pillars:

- regulatory predictability
- capacity and capability
- policy and shared responsibilities
- international collaboration

There are multiple initiatives under each pillar, some of which are described elsewhere in this report. For example, there are details on these SMR-related initiatives in:

- subsection 8.1(c) readiness of the CNSC's workforce, including the response to Challenge 9RM C-3
- subsection 8.1(g) international activities
- subsection 17(ii)(a) policy and shared responsibilities

During the reporting period, the CNSC also established the SMR Leadership Committee, which has a mandate to provide working-level recommendations and advice on issues related to the regulation of SMRs. It provides oversight and direction to work activities in the SMR readiness project, and it also supports the SMR Steering Committee.

8.1 Establishment of the Regulatory Body

The NSCA establishes the CNSC as the nuclear regulatory body in Canada. The CNSC strives for regulatory excellence; its vision, as stated in its *Navigator Manual* (see

subsection 8.1(d)), is “to be a world class regulator”. This vision is supported by a commitment to self-assessment, peer review and continual improvement.

The CNSC fulfills its mandate (see subsection 7.1(a)) through the work of the Commission, a quasi-judicial administrative tribunal comprising a maximum of seven members. Commission members are chosen on the basis of their credentials and are independent of all political, governmental, special interest group or industry influences. Members are appointed by the Governor in Council of Canada for terms not exceeding five years and may be reappointed. One member of the Commission is designated as both the President and Chief Executive Officer of the CNSC as an organization.

Subsection 16(1) of the NSCA stipulates that the Commission can employ staff (see subsection 8.1(b)) to meet the purposes of the NSCA.

The Commission conducts its business in an open and transparent manner. The public hearings and meetings of the Commission represent the public’s primary opportunity to participate in the regulatory process. For more information on openness and transparency, as well as the CNSC’s efforts to engage stakeholders, see subsection 8.1(f).

The Commission holds hearings for the purpose of considering inputs to licensing decisions (section 7.2(ii)(a)). The Commission also holds meetings to discuss other issues and conduct other business within its mandate (e.g., to approve draft CNSC REGDOCs for publication or consider NPP status, licensees’ performance and the results of CNSC compliance verification activities).

CNSC staff regularly attend public hearings and meetings to advise, report and make recommendations to the Commission.

Subsection 17(1) of the NSCA stipulates that the Commission can also retain the services of external persons having technical or specialized expertise to advise it, independently of CNSC staff. This provision is used as needed and would be the foundation for establishing *ad hoc* or permanent committees to support the Commission. An example was the External Advisory Committee on Pressure Tubes, established in July 2021, whose goal was to provide Commission members with objective and impartial expert advice in technical matters related to pressure tubes - notably on elevated equivalent hydrogen content and related modelling, as described in the ninth Canadian report.

The CNSC research program provides access to independent advice, expertise, experience, information and other resources via contracts and contributions placed in the private sector and with academic institutions and other agencies/organizations across Canada and around the world. The research program helps the CNSC meet its regulatory mission and is independent of the extensive R&D program conducted by the industry. Annex D describes the research objectives of the CNSC (and the Canadian nuclear industry) during the reporting period.

For some technical issues, the CNSC has also jointly sponsored, with the nuclear industry, independent technical panels to review certain aspects of a particular issue (such as the analysis of effects associated with the issue or the proposed methodology to address it). For examples of these reviews see the seventh and ninth Canadian reports.

8.1 (a) Position and funding of the CNSC within the government structure

Position of the CNSC in the government structure

The CNSC is independent of government and reports to the Parliament of Canada through a Minister, designated by the Governor in Council. Currently, this designate is the Minister of Natural Resources.

The Commission requires the involvement and support of the Minister of Natural Resources to make or amend regulations and to address matters of administration. Ministerial approval is required for regulation proposals submitted to the Governor in Council for approval. In addition, the Commission requires the involvement and support of the Minister for requests for funding of activities not funded under the [Canadian Nuclear Safety Commission Cost Recovery Fees Regulations](#), as described in the next subsection.

The Commission submits to Parliament its annual report as well as its *Departmental Plan*. The President of the CNSC, as the head of the Commission, appears before parliamentary committees to elaborate on matters related to the administration of the regulatory regime. Regulatory decisions by the Commission can be reviewed, but only by the Federal Court. As a federal agency, the CNSC is subject to various laws (e.g., the [Canadian Charter of Rights and Freedoms](#), the [Official Languages Act](#), the [Privacy Act](#), the [Access to Information Act](#) and the [Financial Administration Act](#)).

Although the CNSC is the clear regulatory authority with respect to nuclear safety in Canada, various other federal organizations play important, complementary roles. Legislation is established to set the relevant requirements for other areas of jurisdiction that are also applicable to nuclear-related activities. Memoranda of understanding and working relationships are established between these organizations and the CNSC to ensure nuclear regulation is effective and consistent, safety is not compromised, all responsibilities are borne by the appropriate body and no ambiguity or overlap exists. Examples of such areas of jurisdiction are emergency preparedness, the transportation of dangerous goods, environmental protection, and conventional health and safety.

CNSC staff communicate with management and staff of Natural Resources Canada (NRCan) in areas of mutual interest. NRCan formulates the Government of Canada's policy regarding uranium, nuclear energy and radioactive waste management. Another close partner is Global Affairs Canada, with which the CNSC frequently works to ensure the fulfillment of Canada's international commitments pursuant to bilateral and multilateral treaties, conventions and understandings.

Under the [Impact Assessment Act](#) (IAA) the CNSC provides technical expertise to the Impact Assessment Agency of Canada (IAAC), with Commission members participating as integrated review panel members. See subsection 7.2(ii)(a) for details.

In addition to federal government entities, the CNSC works with several provincial and municipal organizations, as appropriate, in fulfilling its mandate (see subsection 7.1(b)).

The CNSC issues licences for the nuclear operations of provincially-owned electrical utilities OPG, Hydro-Québec and NB Power (as well as for Bruce Power, which is a private-sector organization). The following publicly-owned institutions or agents of the federal and provincial governments also hold other types of CNSC licences:

- NRCan
- Canadian universities

- hospitals and research institutions
- federal and provincial government departments

Funding

The CNSC is a departmental corporation, listed in schedules II and V of the [Financial Administration Act](#).

The CNSC has statutory authority – pursuant to subsection 21(3) of the NSCA – to spend during a fiscal year any revenues that it receives in the current or previous fiscal year through the conduct of its operations. The revenues received from regulatory fees for licences and applications are charged in accordance with the [Canadian Nuclear Safety Commission Cost Recovery Fees Regulations](#). This authority to spend revenues provides a sustainable and timely funding regime to address the rapid changes in the regulatory oversight workload associated with the Canadian nuclear industry.

Revenue recovered from fee-paying applicants and licensees accounts for almost 70 percent of the CNSC's funding. While the CNSC always seeks to increase the efficiency of its operations, it can address workload pressures associated with fee-paying licensees through an increase of its regulatory fees.

CNSC activities that are not recovered through cost recovery fees are funded through annual appropriations from Parliament, which require the involvement and support of the Minister of Natural Resources. These appropriations account for the remaining 30 percent of the CNSC's funding. Certain organizations are exempt from cost recovery and are not charged licence fees. These include not-for-profit institutions such as schools, medical facilities and emergency services, as well as government departments or agencies that hold a licence for an abandoned, contaminated site (assuming the licensee did not create the contamination). In addition to the exempt organizations, the types of activities funded through the annual appropriations are activities that the CNSC is obliged to conduct and that have no direct benefit for individual licensees (e.g., activities related to non-proliferation, emergency preparedness, public information programs and the maintenance of the NSCA and its associated regulations). For fluctuations associated with these licensees or activities, the CNSC can also request incremental funding through the Government of Canada's annual budget process.

8.1 (b) Organization of CNSC staff

The CNSC consists of a President, the federally-appointed members of the Commission and over 1000 staff members, as of the end of the reporting period. Subsection 12(1) of the NSCA states that the President *“has supervision over and direction of the work of the members and officers and employees of the Commission”* including professional, scientific, technical and other officers employed for the purpose of carrying on the work of the Commission. The CNSC's organizational structure at the end of the reporting period is described in figure 8.1 (b):

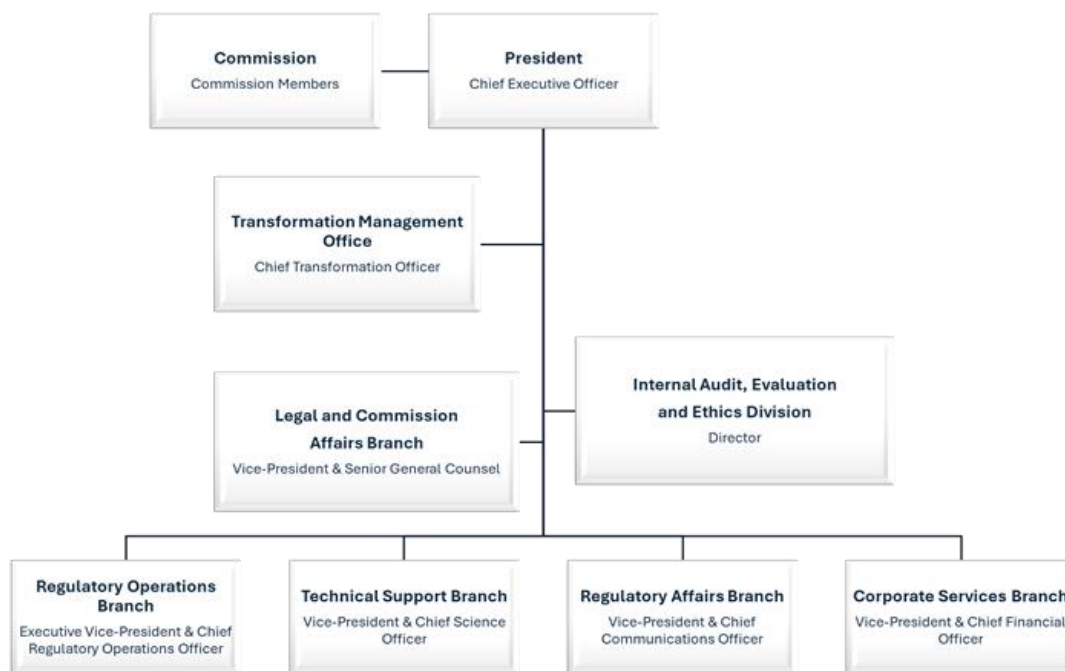


Figure 8.1 (b) Organization of the CNSC

Internal Audit, Evaluation and Ethics Division (IAEED)

The Internal Audit, Evaluation and Ethics Division (IAEED) provides a suite of independent, objective and neutral internal audit, evaluation and values and ethics services designed to support the achievement of the CNSC's strategic goals and improve the operations and staff experience at the CNSC. The division includes the Office of Values and Ethics, which provides services related to conflict of interest, external complaints, informal conflict management, investigation, and other areas (see annex 8.1(b) for additional details about the Office of Values and Ethics). IAEED reports directly to the CNSC President but also reports to the Departmental Audit Committee (DAC). The DAC is an independent, objective advisory committee to the President and Chief Executive Officer and provides assurance, advice and recommendations that inform decision-making at the CNSC. The DAC consists of five members composed of three external members, the CNSC President and the Commission Registrar (described in next subsection). The DAC reviews all core areas of CNSC management control and accountability, risk management, values and ethics practices, and the internal audit function.

The Transformation Management Office (TMO) was created in 2022. The TMO provides integrated project management and change management services to support the organization's transformational and horizontal initiatives.

The CNSC includes five branches that are led by five Vice-Presidents: Regulatory Operations, Technical Support, Regulatory Affairs, Corporate Services and Legal and Commission Affairs. Regulatory Operations Branch is described here, while the other Branches are described in annex 8.1(b).

Regulatory Operations Branch

The Regulatory Operations Branch is responsible for managing regulatory activities, including those related to licensing, compliance verification and enforcement. It is supported

by the other four CNSC branches, relying significantly on the advice of the Technical Support Branch (see annex 8.1(b)) for oversight of NPPs. Relevant regulatory decisions may be made by designated officers within the branch, if and when the Commission formally assigns specific authorities to those officers in accordance with the provisions set out in the NSCA and its regulations. It is headed by the CNSC Executive Vice-President and Chief Regulatory Operations Officer and comprises the following secretariat and directorates:

- Operations Secretariat
- Directorate of Power Reactor Regulation
- Directorate of Nuclear Cycle and Facilities Regulation
- Directorate of Nuclear Substance Regulation
- Directorate of Advanced Reactor Technologies

The Operations Secretariat supports effective implementation and maintenance of common operations activities in support of regulatory programs & corporate requirements.

The Directorate of Power Reactor Regulation regulates the operation of NPPs in Canada, in accordance with the requirements of the NSCA and its associated regulations. The directorate consists of the following five divisions:

- four regulatory program divisions (RPDs)
 - o Pickering
 - o Darlington
 - o Point Lepreau
 - o Bruce
- Power Reactor Licensing and Compliance Integration Division

The four RPDs are accountable for the planning, management and implementation of the power reactor regulatory program at their respective sites. At the end of the reporting period, this program pertained to operating power reactors. Each RPD also acts as a single point of contact for internal stakeholders and licensees for most issues associated with the site. A correspondence protocol is in place to govern both official communications (usually at the level of RPD director) and unofficial communications between CNSC staff and the licensees.

There are CNSC staff from each RPD who work onsite at each operating NPP to lead and assist in the conduct of CNSC compliance verification activities (described in subsection 7.2(iii)(b)). Led by a site supervisor, these site inspectors inspect the premises, monitor activities and verify compliance with the licensing basis. The inspectors are designated as such per section 29 of the NSCA. During the reporting period, DPRR issued a document, *Inspector Objectivity Principles*, to describe the measures that maintain inspector objectivity. The measures include, *inter alia*, the performance of inspections at other sites, review of inspection reports from other sites, inspector exchanges, and objectivity training.

Staff in the Darlington RPD who work at the Darlington site office conduct activities related to compliance verification for both OPG's licence to operate DNGS and licence to construct DNNP.

In addition to the site inspectors at the NPP, regulatory program officers and additional support staff at the CNSC's head office are also assigned to each RPD. The regulatory program officers contribute to work related to both licensing and compliance verification, as well as other areas such as outreach. The RPDs are also supported by staff from the Technical Support Branch.

The Power Reactor Licensing and Compliance Integration Division is accountable for discharging the CNSC's international obligations with respect to the NEA/IAEA Incident

Reporting System (see sub-article 19(vi)) and the International Nuclear Event Scale (INES). It also ensures consistency in licensing and compliance activities across NPP sites, assists in the development of LCHs and preparations for the renewal of NPP operating licences, identifies trends in compliance information, manages safety performance indicator data and conducts event investigations as needed. The Power Reactor Licensing and Compliance Integration Division coordinates the development of compliance verification guides and leads the developments of various reports related to NPPs, including the Canadian CNS reports and the [Regulatory Oversight Report for Canadian Nuclear Power Generating Sites](#).

The consistency of the implementation of the regulatory programs across the NPPs is fostered by a common approach to training (see subsection 8.1(c)). DPRR arranges regular meetings to foster common understanding and consistent approaches among directorate staff, inviting supporting staff as needed. This includes weekly teleconferences, divisional meetings, bi-monthly site supervisor meetings, quarterly review meetings, monthly workshops and semi-annual staff meetings.

The Directorate of Nuclear Cycle and Facilities Regulation and the Directorate of Nuclear Substance Regulation contribute to the regulatory program for NPPs. The Directorate of Nuclear Cycle and Facilities Regulation is responsible for, among other things, the various facilities associated with NPPs, such as uranium mines and refineries, conversion and fuel-fabrication facilities, and facilities for spent fuel storage and management of low- and intermediate-level radioactive waste. The Directorate of Nuclear Substance Regulation is responsible for some licences related to NPPs that fall outside the scope of the operating licence (e.g., licences for nuclear substances and radiation devices, as well as packaging and transport).

The Directorate of Advanced Reactor Technologies provides a dedicated directorate focused on innovative technologies (such as SMRs). It consists of two divisions:

- Advanced Reactor Licensing Division
- Advanced Reactor Assessment Division

The Advanced Reactor Licensing Division is mandated to provide regulatory oversight through licensing (licenses to prepare site and construct), compliance, and other activities for potential new SMRs to be built in Canada; this division ensures a state of readiness for licensing any emerging technologies.

The Advanced Reactor Assessment Division manages the CNSC's pre-licensing vendor design reviews, which provide vendors with regulatory guidance on their reactor designs. See the preamble to article 18 for more details on pre-licensing vendor design reviews.

8.1 (c) Maintaining competent staff

Workforce management - general

Maintaining a competent, agile and engaged workforce is critical to the CNSC's success and its goal of being "an employer of choice." Because of the limited availability of experienced technical staff within the nuclear industry and the anticipated attrition of CNSC staff, workforce planning is now integrated into the organizational planning cycle. Management teams meet quarterly to review short and long-term workforce plans (e.g., update critical roles, identify successors and develop learning plans). Capacity-building at the staff level to enhance readiness for new-build is a key priority.

The CNSC also sponsors employee networks to foster dialogue and raise issues that, in addition to benefitting individuals, make the overall regulatory workforce more receptive, insightful and adaptive. These include the Administrative Professionals Network, Women in STEM Network, Black Employee Network, Indigenous Network, Accessibility Network, Pride Network, Diverse Employee Network and Young Professionals Network.

Professional development - general

The CNSC values and is committed to the ongoing development of a professional, competent, versatile and motivated workforce. To ensure that the CNSC meets its evolving priorities and objectives, each CNSC staff member has an individual learning plan to identify both immediate and future development needs. The CNSC offers a variety of technical and non-technical training to its staff directly in support of those needs. During the reporting period, CNSC continued to increase the emphasis on training, workshops, and other learning opportunities associated with emerging technologies and new reactor designs (see next subsection for details).

The CNSC supports the building of leadership capability at all levels. During the reporting period, the following learning activities were offered: emotional intelligence, influence and persuasion (without authority), building high performance teams, building resilience and critical thinking, understanding and overcoming unconscious bias in the workplace, confronting and resolving issues, and communicating risk to the public.

To enhance the CNSC's leadership capacity, senior managers collectively assess leadership candidates against key leadership competencies and provide one-on-one individualized feedback to support the development of future leaders.

The CNSC's inspector training and qualification program (ITQP) combines core training, service-line specific training and on-the-job training to establish a consistent approach to train, assess and qualify inspectors across all service lines.

As part of the ITQP, the Directorate of Power Reactor Regulation uses a systematic approach for NPP-related knowledge and on-the-job-training for NPP site inspectors. This program includes a training plan that identifies the core, specific and on-the-job training required for NPP site inspectors. A training qualification record is used to document the inspector's progress and leave an auditable trail. Each inspector is required to take courses related to the regulatory process, CANDU design, non-technical topics (such as technical writing and effective interviewing), radiation protection and occupational health and safety. An inspector certificate is issued only when the CNSC's site supervisor at the NPP determines that the inspector-in-training has achieved all the training requirements and the inspector-in-training completes a formal evaluation, conducted by an independent evaluator. It takes an inspector approximately 18 months to obtain an inspector's certificate.

To support senior inspectors who are coaching inspectors-in-training, the CNSC offers a course in transferring knowledge effectively.

During the reporting period, DPRR also initiated a more formalized training program for its regulatory program officers.

The CNSC has a well-established 15-month co-op student program that comprises three rotations of five months each. To date the CNSC has welcomed students from the Royal Military College, Ecole Polytechnique, Ontario Tech University (formerly called the University

of Ontario Institute of Technology), McMaster University, the University of Saskatchewan, the University of British Columbia, and the University of Calgary.

Staffing Adjustments for New-Build

Challenge 9RM C-3 from Joint Eighth and Ninth Review Meeting

Optimize regulatory capacity and capability to effectively and efficiently assess licence applications for other nuclear technologies

To ensure CNSC is ready to effectively evaluate the anticipated influx of licence applications for various nuclear technologies, CNSC has focused on enhancing and expanding its technical ability and competency in SMRs and advanced reactors. CNSC staff are involved in multiple initiatives to optimize regulatory capacity and capability to ensure that the assessment of licence applications is as effective and efficient as possible. CNSC's SMR readiness project is further expanding the existing Canadian regulatory framework to incorporate SMRs and novel technologies alike.

Significant staffing actions have been accomplished to support continued readiness work and to review SMR licence applications. This includes hiring new staff and providing training on SMR and novel technologies. The CNSC's Strategic Workforce Plan 2024-2029 outlines in detail how CNSC is addressing regulatory capacity and capability (e.g., strategies for recruitment, retention, training, etc.) and was recognized by the IRRS Follow-Up Mission as a good practice.

Furthermore, CNSC is a key stakeholder in the [Federal Nuclear Science and Technology \(FNST\) Program](#) which includes valuable research in the "New Nuclear Technologies" theme area that includes SMRs and advanced reactor-driven research projects. The CNSC also partnered with Canada's Natural Sciences and Engineering Research Council to fund a new community of research on SMRs and novel technologies (see subsection D.5 of annex D for details).

In addition, under the CNSC's SMR readiness project, a systematic knowledge management process was developed to capture the knowledge gained in the licensing of SMRs (this knowledge applies to the overall CNSC licensing process, as well as to technical reviews and assessments). Implementation of the new process is expected during the next reporting period.

The follow-up mission of the [Integrated Regulatory Review Service](#) (IRRS; see subsection 8.1(e)) corroborated these observations, noting CNSC's continued good performance in ensuring the maintenance of qualified and competent staff to regulate existing facilities as well as emerging technologies.

The CNSC recently developed an approach to prioritize technologies with a higher likelihood of being implemented in Canada. It used a structured methodology that considered factors such as nuclear relevance, commercial viability and maturity, stakeholder and public acceptance, and regulatory readiness. Each technology was assessed qualitatively and semi-quantitatively, with ratings transformed into an overall readiness score. This prioritization will facilitate the CNSC's ongoing focus of regulatory preparedness on innovations most likely to be adopted in the Canadian nuclear sector.

Canada recommends that Challenge 9RM C-3 be closed.

8.1 (d) Management system and planning process for regulatory activities

The CNSC management system (known as the Navigator) links the people, processes and resources within the overarching regulatory framework. It reflects an integrated, fit-for-purpose approach to managing the performance of mandated functions, allowing for differences in implementation across CNSC programs and sub-programs. The CNSC management system is based on principles and requirements found within international quality standards and internationally recognized frameworks for organizational excellence. It also aligns with the IAEA safety standard [GSR Part 2 – Leadership and Management for Safety](#), and other related safety standards. Additional CNSC-specific elements, such as its regulatory philosophy, internal safety culture and strategic priorities, as well as its vision to remain a world class regulator, are all incorporated into the management system to ensure it meets the needs of the CNSC.

The CNSC *Navigator Manual* is the top-level document in the management system's document hierarchy. It applies to all CNSC staff and covers both regulatory activity areas and internal service activity areas.

The *Navigator Manual* explains how the organizational components of the CNSC fit together and describes at a high level the essential elements and interactions in CNSC's work. The manual identifies the high-level policies, principles and processes and mechanisms by which the CNSC achieves its goals and objectives. It is supported by policies, process documentation, detailed work instructions and other tools, developed as needed, that guide staff and collectively provide direction on how work is to be conducted at the CNSC.

The CNSC documents its operations planning process within the management system. The overall plan for the CNSC is summarized in its annual *Departmental Plan*, which is presented to Parliament.

At the working level, integral with its annual planning exercise, the CNSC organizes its inspections, assessments and other regulatory activities for NPPs by creating, implementing, monitoring and adjusting regulatory workplans for each NPP. Workplans are reviewed to ensure they cover specific goals, are risk-informed, and are consistent among NPPs. Activities in each NPP workplan are also consolidated into a summary – the regulatory activity plan – which is costed to establish an estimate of the annual licence fee for each NPP (see subsection 8.1(a)). The regulatory activity plan, along with a notification containing the licence fee estimate, is sent to each licensee at the beginning of each fiscal year.

8.1 (e) Assessment and improvement mechanisms

Continuous improvement at the CNSC is driven by an organizational commitment to excellence and facilitated by specific initiatives and reviews.

Office of the Auditor General

The Canadian government's Office of the Auditor General regularly conducts audits of various CNSC programs. The eighth Canadian report described the results and follow-up for the most recent audit that was relevant to the CNS. In October 2022, the Office of the Auditor General released its findings of an audit on the management of low- and intermediate-level radioactive waste.

EPREV mission to Canada

In June 2023, the follow-up to the 2019 [Emergency Preparedness Review](#) (EPREV) mission to Canada took place. The CNSC, along with other federal, provincial and municipal emergency preparedness and response stakeholders, as well as the licensees of operating NPPs, participated in the mission. See subsection 16.1(g) for details on the results.

Integrated Regulatory Review Service (IRRS) mission to Canada

In June 2024, the CNSC hosted a follow-up IRRS mission that focused on the status of each of the 4 recommendations and 16 suggestions from the 2019 mission. The mission demonstrated Canada's dedication to continuous improvements to regulatory excellence with the closing of 2 of the 4 recommendations and 10 of the 16 suggestions. The mission review team also identified CNSC's good performance in its continued efforts to ensure the maintenance of qualified and competent staff to regulate existing facilities as well as emerging technologies. Although not all recommendations and suggestions are within the scope of the CNS, the status of each one is described here for completeness.

The first recommendation (IRRS Recommendation R1) concerned enhancement of the Canadian radioactive waste management policy framework and associated strategies. The recommendation was closed based on progress, including NRCan's publication in March 2023 of a modernized *Radioactive Waste Management and Decommissioning Policy*. It established a national plan for the long-term management of all of Canada's radioactive waste in collaboration with Indigenous people, community partners and other involved parties. See the eighth [Canadian National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management](#) for more information.

The second recommendation (IRRS Recommendation R2) was related to establishing dose constraints for all Class I facilities, which was addressed by the development of [REGDOC-2.9.2, Controlling Releases to the Environment](#). The recommendation remains open as the implementation of the new requirements will take several years; see article 15 (a) for details.

The third recommendation (IRRS Recommendation R3) was related to consistency of radiation protection requirements. It has been partly addressed by revisions to the *Radiation Protection Regulations*, although additional work is ongoing (see article 15).

The final recommendation (IRRS Recommendation R4) was related to the revision of guidance for package design certification applications. This recommendation was closed based on the observation that Canada's regulation of transport of nuclear substances is consistent with IAEA [SSR-6 \(Rev.1\), Regulations for the Safe Transport of Radioactive Material](#), and based on Canada's commitment to work with the United States of America on a revision to CNSC regulatory document [RD-364, Joint Canada-United States Guide for Approval of Type B\(U\) and Fissile Material Transportation Packages](#).

The status of the 16 suggestions from the IRRS mission is summarized in table 6.

Table 6: IRRS mission suggestions

Suggestion	Response and Status
The Government should consider explicitly addressing SF-1, Principle 4 (Justification) in its legal framework.	Principle 4 of IAEA No. SF-1, Fundamental Safety Principles states that facilities and activities that give rise to radiation risks must yield an overall benefit. Canada did not accept this suggestion since its regulatory framework meets the intent of Principle 4. The purpose of the NSCA includes limiting, to a reasonable level, the risks to national security, the health and safety of persons and the environment that are associated with nuclear energy and nuclear substances. This involves a value judgement, which is enabled by the entire regulatory framework. The determination of reasonable vs. unreasonable risk is an exercise of justification that embodies SF-1, Principle 4. In addition to the NSCA, the Canadian Environmental Assessment Act, 2012 and the Impact Assessment Act, 2019 require a proponent of a designated nuclear project to justify the project in terms of safety, protection of the public and environment, and socio-economic factors. Proponents must explain the need for the project and assess various alternatives and alternative means to carry out the project. The Commission must consider the results of this assessment prior to issuing a licence.
The Government should consider expressly assigning, in its legal framework, the prime responsibility for safety to the person or organization responsible for a facility or an activity	Canada did not accept this suggestion. As noted in subsection 9(a), the NSCA and the General Nuclear Safety and Control Regulations outline how prime responsibility for safety is assigned to licensees.
The Government should consider enhancing the legal framework to explicitly stipulate that compliance with regulations and requirements established or adopted by the regulatory body does not relieve the person or organization responsible for a facility or an activity of its prime responsibility for safety.	Canada did not accept this suggestion. As noted in subsection 9(a), the NSCA and the General Nuclear Safety and Control Regulations outline how prime responsibility for safety is assigned to licensees.
The CNSC should consider continuing to focus on its human resources management plan to ensure that CNSC continues to have access to a sufficient number of qualified and competent staff to regulate existing facilities and activities as well as new and emerging technologies in accordance with the nature of facilities.	This suggestion was closed. The IRRS team noted, as a 'good performance', that the CNSC's human resources plans clearly and transparently address challenges and risks and include a wide range of diverse strategies and actions, as well as performance indicators to track and measure outcomes in line with the organization's strategic objectives. The strategies and actions in the human resource plans ensure access to the competencies and skills required to regulate existing facilities and activities, as well as to address new and emerging technologies.

Suggestion	Response and Status
CNSC should consider consolidating all elements of its safety policy into a single document.	This suggestion was closed. The IRRS Team noted that, in March 2023, the CNSC consolidated all elements of its safety policy into a single document, Summary of CNSC Safety-related Policies .
CNSC should consider revising its current and planned requirements in the area of decommissioning to align with the IAEA guidance that entombment is not considered an acceptable strategy for planned decommissioning of existing NPPs and future nuclear facilities.	This suggestion was closed. The IRRS team noted the CNSC's established regulatory authorization process, including the review and assessment for a disposal facility and also revised regulatory requirements and guidance for the proposed decommissioning end states involving in-situ confinement. In January 2021, the CNSC published a new version of REGDOC-2.11.2, Decommissioning that addresses <i>in situ</i> decommissioning.
CNSC should consider establishing a procedure to ensure the systematic implementation of justification in the authorisation of all practices involving radiation sources.	This suggestion remains open. The CNSC's regulatory framework substantively addresses the concept of justification through the authorization review process (discussed in first suggestion, above). CNSC revised an internal program document to provide further clarity. CNSC also noted this suggestion for reconsideration during the next update of the NSCA.
The CNSC should consider including notification alone as an option for the regulatory control of nuclear substances and radiation devices in accordance with a graded approach.	This suggestion remains open. CNSC considered developing and implementing a system to allow for notification, on its own, as an option for the regulatory control of nuclear substances and radiation devices. However, CNSC found no significant gain of efficiency gained over current practice for licensing very low-risk applications. CNSC noted this suggestion for reconsideration during the next update of the NSCA.
The CNSC should consider consistently implementing the concept of dose constraints for all facilities and standardising regulatory practice for derived release limits (DRLs).	This suggestion remains open. It is related to IRRS Recommendation R2; see subsection 15(a).
HC should consider undertaking a survey of radionuclide levels in building materials or indoor gamma dose rates arising from building materials to determine if they make a significant contribution to public exposure.	This suggestion was closed. The IRRS team noted that Health Canada surveyed radionuclide levels in building materials and found no evidence that domestically-sourced building and construction materials make a significant contribution to public exposure.
CNSC should consider formalizing the practice of inspector exchanges between licensee locations for inspection assistance to ensure the operating experience and lessons learned from assisting other CNSC staff perform inspections at different licensee locations are maximized.	This suggestion was closed. The IRRS team noted that the CNSC formalized practices to facilitate the exchange of inspectors' experiences, OPEX and lessons learned. During the reporting period, CNSC issued a policy on inspector objectivity. Also, DPRR issued a document, <i>Inspector Objectivity Principles</i> , to describe the measures it has taken to maintain inspector objectivity (discussed in subsection 8.1(b)).

Suggestion	Response and Status
CNSC should consider its process to formalize all elements used to ensure a comprehensive, regular review of the objectivity and independence of the on-site inspectors.	This suggestion was closed. See notes above.
The CNSC should consider performing unannounced inspections for uranium fuel fabrication, refining and conversion facilities.	This suggestion was closed. The IRRS team noted that the CNSC performs unannounced inspections (when appropriate) and has strengthened formal program guidance to ensure proper consideration during inspection planning.
CNSC should consider implementing a systematic gap analysis between the IAEA requirements and the regulatory framework and updating the regulatory framework as necessary.	This suggestion was closed. The IRRS team noted that CNSC staff considers applicable IAEA requirements when conducting regulatory analysis for the development or update of regulatory framework elements. See subsection 7.2(i)(b) for more details.
CNSC should consider the requirements of SSR-4 and relevant IAEA guidance when specifying safety requirements and criteria for fuel cycle facilities.	This suggestion was closed. The IRRS team noted that CNSC published REGDOC-2.4.4, Safety Analysis for Class IB Nuclear Facilities . While Canadian nuclear fuel cycle licensees continue to comply with IAEA SSR-4, Safety of Nuclear Fuel Cycle Facilities , REGDOC-2.4.4 formalizes its requirements within the Canadian context.
The CNSC should consider establishing or adopting guidance aligned with IAEA TS-G-1.4.	This suggestion was closed. The IRRS team noted that the CNSC adopted IAEA TS-G-1.4, The Management System for the Safe Transport of Radioactive Material by referencing it in a 2021 revision of CNSC regulatory document REGDOC-2.14.1, Volume I, Information Incorporated by Reference in Canada's Packaging and Transport of Nuclear Substances Regulations, 2015 .

Additional information on the 2019 IRRS mission and its follow-up can be found at:

- [Canada's response to the 2019 IRRS Report - Canadian Nuclear Safety Commission](#)
- [2024 IRRS follow-up mission report](#)

Other CNSC improvement initiatives

In 2019 the CNSC launched a strategic review, called Project Athena, to prepare for anticipated changes to the nuclear industry. The project gathered evidence from multiple lines of evidence such as self-evaluations, benchmarking and engagement with stakeholders and benefited from nearly 700 staff suggestions to improve or enhance the CNSC's work. The project, finalized in 2022, resulted in 11 transformative business cases which were approved by the Executive Team. In 2022, the TMO was created, in part, to implement the business cases. The TMO prioritized and sequenced the 11 business cases, implementing project teams for those cases that were assessed as having the highest benefit to the organization, including modernizing operational planning and streamlining internal processes.

During the reporting period, CNSC established the Disruptive, Innovating, Emerging Technologies (DIET) program. It includes the DIET Working Group and the Innovation Hub,

which facilitate the internal and external sharing of information on innovation. This allows the nuclear industry to share early innovation ideas by creating a “safe space” for industry and academia stakeholders to share their innovations, new ideas, and results with CNSC staff. The DIET program also provides a forum for staff to learn about DIET.

Finally, the CNSC invited the IAEA to lead an independent assessment of regulatory safety culture during the reporting period and is developing a plan to address the findings. See subsection 10(e) for details.

CNSC internal oversight

CNSC management controls include self-assessments, internal audits, advisory engagements, and evaluations. These services follow internal CNSC guidance, as well as established Government of Canada policies and procedures.

The Operations Secretariat is responsible for the self-assessments, whereas IAEED conducts the internal audits, advisory engagements and evaluations per an integrated, multiyear, risk-based audit and evaluation plan that is approved by senior management. Internal audits and advisory engagements assess the management system and its processes whereas evaluations assess programmatic results. Internal audit and evaluation reports are shared with the Canadian government’s Treasury Board Secretariat and on the CNSC external website, while advisory engagement reports are shared internally.

During the reporting period, the CNSC conducted 12 internal audit, advisory and evaluation engagements, including the following that were relevant to NPPs:

- 2024-2025 Joint Audit and Evaluation of the Risk-Informed Compliance Verification Processes (Directorate of Power Reactor Regulation)
- 2024-2025 IT Tools and Services and Reliability for Inspectors
- 2023-2024 Small Modular Reactor Governance Framework Review Report
- 2023-2024 Follow-up Audit to the 2019 IRRS Mission
- 2022-2023 Joint Audit and Evaluation of Cyber-Security Oversight over Licensees
- 2022-2023 Inspector Training and Qualification Program Readiness Assessment Report

The various assessments result in action plans that are approved and then monitored by senior management. In addition, the CNSC participated in horizontal audits with other federal departments during the reporting period, including [Report 6—Management of Low and Intermediate Level Radioactive Waste](#).

8.1 (f) Openness and transparency, engagement and consultation

Dissemination of information – general

Dissemination of objective scientific, technical and regulatory information is a part of the CNSC’s mandate (see subsection 7.1(a)). The CNSC takes advantage of various means of communication to maximize the dissemination of information and engagement with stakeholders, which benefits both stakeholders and the CNSC.

Documents submitted for Commission proceedings are available on the CNSC website. As part of its commitment to openness and transparency, the CNSC actively supports the Government of Canada's Open Government initiative. The CNSC publishes key regulatory data and reports on the Government of Canada’s [Open Government Portal](#) (open.canada.ca), making information accessible to the public in a standardized, searchable,

and reusable format. This includes data on environmental releases from nuclear facilities, derived release limits (DRLs), and results from the Canadian Radiological Monitoring Network (CRMN), among other datasets. During the reporting period, the CNSC continued to lay the groundwork to expand the availability of compliance and licensing data through open data platforms, further enabling public oversight and engagement.

The CNSC has many outreach and engagement activities focusing on youth, Indigenous Nations and communities, municipal governments in the areas where major facilities are located, medical communities, professional associations and non-governmental organizations. To reach target audiences, the CNSC uses many tools such as its website, Facebook, X (formerly Twitter), LinkedIn, YouTube, webinars, interactive online modules, email updates to subscribers and attendance at third-party events and conferences. CNSC staff also host information sessions to explain to stakeholders how the nuclear industry is regulated and how stakeholders can participate in the regulatory process.

During the reporting period, the CNSC held regularly scheduled meetings with Indigenous Nations and communities to discuss topics in which they expressed interest, as well as hosting webinars regarding new-build projects and other major licensing-related topics.

The CNSC is equally committed to helping licensees and the nuclear industry to understand and comply with the CNSC's regulatory framework. The CNSC has undertaken a variety of engagement activities, including the following:

- offering information sessions on draft regulatory documents
- participating in the Certification and Training Advisory Group (co-chaired by the CNSC and the industry), involving policy-level discussions about the training and certification of NPP personnel
- participating in COG Nuclear Safety Peer Group meetings, as well as meetings of the Chief Nuclear Officer/CNSC Executive Forum (discussed at the end of this subsection) to promote common understanding of generic safety and licensing issues

Open and transparent processes

In keeping with federal policies on public consultation and regulatory fairness, the legislative and regulatory framework for nuclear regulation is open and transparent. The CNSC is fully committed to maximizing the openness and transparency of its affairs and the undertakings of the Commission.

The CNSC takes all stakeholder feedback into account when finalizing its regulatory approach. In cases where diverse viewpoints are presented to the CNSC, additional consultations or meetings may be used to explore the issue. However, in all cases, the CNSC sets requirements in accordance with the best available science and other information.

Before the Commission makes decisions about whether to license nuclear-related activities, it considers applicants' proposals, recommendations from CNSC staff and stakeholder views. Each decision to grant a license is based on information demonstrating that the activity or the operation of a given facility can be carried out safely and that the environment will be protected. To promote openness and transparency, the Commission conducts its business where possible in public hearings and meetings and, where appropriate, in the communities that host the activities or facilities. Members of the public can participate in hearings via written submissions and oral presentations. Commission hearings and meetings can also be

viewed online as webcasts on the CNSC website, and transcripts of public hearings and meetings are also made available.

For example, Part 2 of a hearing associated with the licence renewal for the Point Lepreau NPP was held in May 2022 in the host community and considered more than 250 public submissions. As another example, Part 1 of the hearing associated with the licence renewal of the Darlington NPP was held virtually during the reporting period. Part 2 was scheduled in the host community in June 2025. In preparation, CNSC promoted public participation by advertising in local community newspapers, notices sent to CNSC email subscribers, CNSC's Facebook, X (Twitter), LinkedIn and YouTube channels. CNSC information sessions were also held in the community, in person and virtually. The Commission were scheduled to consider more than 80 public submissions (both written and oral) during these hearings.

The CNSC also has significant opportunities for public involvement in its regulation-making process (subsection 7.2(i)(a)) and its writing process for regulatory documents (subsection 7.2(i)(b)). The use of CNSC discussion papers and the analysis and publication of the feedback they generate have also enhanced the degree and interactive nature of engagement.

The CNSC takes every opportunity to encourage other national nuclear regulators and international organizations involved in nuclear safety to share information with the public.

Facilitating Indigenous and public participation in the regulatory process

The CNSC has established two funding programs to ensure that Indigenous Nations and communities, members of the public, and interested parties are able to meaningfully participate in the CNSC's regulatory processes: The Participant Funding Program (PFP) and Indigenous and Stakeholder Capacity Fund (ISCF).

The PFP was launched in 2011. It offers funding to Indigenous Nations and communities, members of the public, and interested parties to support their participation in the CNSC's Commission proceedings for major projects, licensing decisions, and other topics of regulatory interest such as regulatory oversight reports. Recipients can use the funding to hire a consultant, review documentation, host meetings with the CNSC on specific projects, submit a written intervention to the Commission, and travel to the Commission proceeding to present before the Commission (where applicable). During the reporting period, the CNSC awarded \$5.3M through the PFP to support meaningful participation in Commission proceedings and to bring value-added information to the Commission through informed and topic-specific interventions.

Following extensive feedback from Indigenous Nations and communities and interested parties on their capacity needs, the CNSC launched the ISCF in 2023. The ISCF provides funding to help Indigenous Nations and communities and interested parties gain the capacity necessary to engage in the CNSC's regulatory processes prior to and throughout the lifecycle of nuclear facilities and activities in Canada (i.e., more continuously rather than in the context of specific Commission proceedings). Indigenous Nations and communities can apply for funding to hire full-time staff to coordinate engagement with the CNSC as well as to conduct Indigenous knowledge studies. In addition, funding is available to both Indigenous Nations and communities and interested parties to review CNSC regulatory documents, participate in workshops with CNSC staff, participate in environmental and regional monitoring, and purchase IT equipment, among other eligible activities. During the reporting

period, the CNSC awarded \$7.8M through the ISCF to support capacity and relationship-building with the CNSC.

Indigenous consultation and engagement

In alignment with Canada's obligations under the [United Nations Declaration on the Rights of Indigenous Peoples Act](#), the CNSC remains committed to advancing reconciliation with Indigenous Nations and communities and ensuring that Indigenous rights are meaningfully reflected in nuclear safety regulation. This includes recognizing the principles of free, prior, and informed consent (FPIC), incorporating Indigenous knowledge systems into environmental and safety assessments, and engaging Indigenous Nations and communities as partners in regulatory processes.

In February 2025, a Federal Court decision⁹ affirmed that both the United Nations Declaration and FPIC are critical interpretive tools that must inform the Commission's assessment of whether the Crown's duty to consult and, where appropriate, accommodate has been fulfilled. The Federal Court held that administrative tribunals like the CNSC have the authority—and obligation—to consider UNDRIP as a contextual factor in legal decision-making, reinforcing that FPIC is not a veto but a right to a robust, inclusive process.

The CNSC's consultation and engagement practices continue to be guided by Canada's Aboriginal Consultation and Accommodation Guidelines (March 2011) and the CNSC's own policy statement, Commitment to Indigenous Consultation and Engagement. These frameworks outline the CNSC's approach to building respectful relationships and fulfilling its legal obligations as both a Crown agent and Canada's nuclear regulator.

CNSC regulatory document [REGDOC-3.2.2, Indigenous Engagement](#) sets out clear expectations for licensees whose proposed projects may trigger the Crown's duty to consult, ensuring that potential or established Indigenous and/or treaty rights and interests are considered. While the CNSC retains ultimate responsibility, procedural aspects of consultation may be delegated to licensees. The implementation of REGDOC-3.2.2 has led to more consistent and meaningful engagement, improved alignment between CNSC and licensee approaches, and strengthened relationships with Indigenous Nations and communities. This REGDOC is currently being updated to reflect enhanced guidance.

The CNSC's Indigenous Knowledge Policy Framework, published in 2021, provides a principles-based approach for respectfully incorporating Indigenous knowledge into regulatory processes. It emphasizes collaboration, consent, and protection of sensitive cultural information, and aligns with the Impact Assessment Act and UNDRIP. Indigenous knowledge continues to enhance the CNSC's understanding of potential project impacts and contributes to more rigorous and culturally informed oversight.

Beyond project-specific consultations, the CNSC has formalized long-term engagement through Terms of Reference with several Indigenous Nations and communities. Staff remain committed to ongoing engagement regardless of formal agreements, recognizing that sustained dialogue builds trust and supports more effective participation in CNSC activities. This approach reflects the CNSC's dedication to reconciliation and is consistent with

⁹ Kebaowek First Nation v. Canadian Nuclear Laboratories, reference 2025 FC 319

Canada's broader commitment to implementing UNDRIP and advancing meaningful partnerships with Indigenous Peoples.

Collaborative approach to the resolution of safety issues

The Chief Nuclear Officers/CNSC Executive Forum provides an effective channel of high-level communication between the executives of NPP licensees responsible for safe nuclear operations and the CNSC. The participants discuss strategic issues that involve both the licensees and the CNSC, thereby promoting a mutual understanding of and helping to focus action on various safety issues related to NPPs. It is used to identify strategic challenges and opportunities that may influence the Canadian nuclear power industry and the CNSC. The forum helped focus efforts to address various safety issues during the reporting period. Although the forum is not a mechanism for decision making, it has facilitated dialogue on the following:

- existing and emerging issues pertaining to the CNSC's mandate for health, safety, security and the environment
- new industry developments, major projects and planned emergency exercises
- respective focus areas and strategic plans and priorities where practical and appropriate
- IAEA missions and other third-party audits planned at Canadian NPPs, such as those conducted by the International Physical Protection Advisory Service, Operational Safety Review Team, and EPREV, and their outcomes
- discussion of new regulatory requirements, introduced through regulations and REGDOCs, to understand the impacts of implementation at the NPPs

As another example of collaboration, the CNSC also participates with industry members in the standard-setting work of the CSA Group, as described in subsection 7.2(i)(b).

8.1 (g) International activities and harmonization

The CNSC participates in various international activities and contributes to international harmonization with respect to nuclear regulation. The CNSC chairs the CANDU Senior Regulators' Meeting, which is organized through the IAEA, to facilitate the sharing of regulatory information that is specifically relevant to CANDU NPPs. The CNSC also actively participates in the G7's Nuclear Safety and Security Group.

The CNSC has signed numerous memoranda of understanding with the nuclear regulators of other countries. During the reporting period, CNSC entered into a trilateral memorandum of cooperation with the United States Nuclear Regulatory Commission and the United Kingdom's Office for Nuclear Regulation that has focused on advanced reactor technologies and AI (see subsection 7.2(ii)(a) and 7.2(i)(b), respectively). In addition, CNSC signed two separate bilateral memoranda of cooperation with the National Atomic Energy Agency of the Republic of Poland in June 2023 and the Swedish Radiation Safety Authority in May 2024.

The CNSC is also an active participant in the IAEA's SMR Forum. Topics under discussion include collaboration, joint assessments, mutual regulatory recognition/acceptance and harmonization.

Canada supports the IAEA's Nuclear Harmonization and Standardization Initiative (NHSI) and participates in the IAEA Regulatory Cooperation Forum.

8.2 Status of the Regulatory Body

8.2 (a) Independence within Government Structure

The NSCA separates the functions of the regulatory body from organizations that promote or use nuclear energy. The mandate of the CNSC (see subsection 7.1(a)) focuses clearly on the health, safety and security of persons, the preservation of national security and the protection of the environment, and the implementation of Canada's international obligations. The mandate does not extend to economic matters (such as the promotion of nuclear power).

The Commission is a quasi-judicial independent administrative body that exercises its powers in an independent manner. Commission members are subject to guidelines on conflict of interest and ethics that assure separation between them and the various stakeholders. Commission members hold office "during good behaviour" rather than being appointed "at pleasure". This means they can only be removed for cause (such as fraud). No member of the Commission has ever been removed for cause.

The Commission's decisions are not subject to review by any minister or other parts of the government executive. The NSCA provides that only the Governor in Council may issue directives to the Commission and these must be broad and not directed at any particular licensee. In addition, such an order would be published in the *Canada Gazette* and laid before each House of Parliament. To safeguard the integrity of the Commission's role as an independent decision maker, contact between the Commission and CNSC staff occurs through the Commission Registry (formerly called the Secretariat). With the exception of the Commission Registry and the President, CNSC staff have limited interaction with the Commission.

The CNSC, as an organization, is also independent of other organizations in the government, as described in subsection 8.1(a). As stated there, the CNSC does not report to a minister, but rather to Parliament through the Minister of Natural Resources.

8.2 (b) Other mechanisms that facilitate regulatory independence

The CNSC fosters open interaction and communication with its stakeholders, thereby continuously gathering input from all parties with an interest in Canada's nuclear industry. Transparent regulatory processes make the consideration of that input more systematic and fairer (see subsection 8.1(f) for more information). These provisions help prevent undue influence from any one party or concern. Other mechanisms that help maintain the independence of the CNSC include a risk-informed framework for decision-making as well as a strong framework for ethical and responsible action. Details of the CNSC's framework for ethical and responsible action, which is administered by IAEED, are provided in annex 8.1 (b).

Summary of Responses to Applicable Challenges and Suggestions

Challenge 9RM C-3 from Joint Eighth and Ninth Review Meeting

Optimize regulatory capacity and capability to effectively and efficiently assess licence applications for other nuclear technologies

CNSC is enhancing and expanding its technical ability and competency in SMRs and advanced reactors. CNSC staff are involved in multiple initiatives to optimize regulatory

capacity and capability to ensure that the assessment of licence applications is as effective and efficient as possible. These include the development of a knowledge management process and an approach to prioritize technologies that have a higher likelihood of being implemented in Canada. CNSC's SMR readiness project is further expanding the existing Canadian regulatory framework to incorporate SMRs and novel technologies alike.

CNSC has hired new staff and provided training on SMR and novel technologies. CNSC is a key stakeholder in the FNST Program, which includes valuable research in the "New Nuclear Technologies" theme area that includes SMRs and advanced reactor-driven research projects. The CNSC partnered with NSERC to fund a new community of research on SMRs and novel technologies. The CNSC also developed a knowledge management process for knowledge gained in the licensing of SMRs.

In addition, NSERC and NRCan agreed to co-fund research projects that focus on SMR supply chain development, fuel supply, and waste management. Canada recommends that Challenge 9RM C-3 be closed.

Summary of Other Significant Changes Since Previous Report

In addition to the work to address Challenge 9RM C-3, the following significant changes are also noted.

- The CNSC established the SMR readiness project, which spans 5 years and embodies numerous initiatives to optimize its readiness to license and regulate SMRs.
- The CNSC established the DIET program, which includes the DIET Working Group and the Innovation Hub that facilitate the internal and external sharing of information on innovation.
- The CNSC hosted an independent (IAEA) assessment of regulatory safety culture and began developing a plan to address the findings.
- The CNSC launched the ISCF to help Indigenous Nations and communities and interested parties gain the capacity to engage in the CNSC's regulatory processes prior to and throughout the lifecycle of nuclear facilities and activities.
- The CNSC signed a trilateral memorandum of cooperation with the United States Nuclear Regulatory Commission and the United Kingdom's Office for Nuclear Regulation, and bilateral memoranda of cooperation with the National Atomic Energy Agency of the Republic of Poland and the Swedish Radiation Safety Authority.

Notable Achievement(s)

The CNSC hosted a follow-up IRRS mission that focused on the status of each of the 4 recommendations and 16 suggestions from the 2019 mission.

The CNSC is significantly enhancing its capacity to assess licence applications for novel nuclear technologies.

Future Focus

CNSC will continue to focus on optimizing its workforce as the technologies and levels of interest in new-build evolve.

Article 9: Responsibility of the Licence Holder

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

Summary Statement for Article

Canada fulfills the obligations of article 9.

9 (a) Legislation assigning responsibility to the licence holder

Paragraph 26(e) of the NSCA prohibits any person from preparing a site for, or constructing, operating, modifying, decommissioning or abandoning a nuclear facility without a licence granted by the Commission. As stated in sub-article 7.2(ii), the Commission can issue licences only to applicants who are qualified to operate the NPP and who will adequately provide for the health and safety of persons and the protection of the environment.

Subsection 12(1) of the [General Nuclear Safety and Control Regulations](#) assigns various responsibilities to the licensees regarding nuclear safety. Paragraph 12(1)(c) requires the licensee to take all reasonable precautions to protect the environment and the health and safety of persons and to maintain the security of nuclear facilities and nuclear substances. Other paragraphs assign responsibility to the licensee to:

- provide and adequately train a sufficient number of qualified workers
- provide and maintain the required devices
- require that all people onsite properly use equipment, devices, clothing and procedures
- take all reasonable precautions to control the release of nuclear or hazardous substances to the environment
- take measures to instruct its staff on security provisions and to alert itself in the event of illegal activities or sabotage

9 (b) Means by which licence holders discharge safety responsibility

For the most part, Canada has a relatively non-prescriptive nuclear regulatory regime for NPPs that sets general requirements and performance standards, thereby allowing the licensees some flexibility to meet them in a manner that best meets their needs. The licensees are responsible for addressing the requirements in their systems, programs, processes and designs. Descriptions of these provisions are submitted to the CNSC at the time of licence application. Once accepted by the CNSC, these provisions become part of the licensing basis for the NPP (defined in subsection 7.2(ii)(a)) and dictate future regulatory activities.

Licensees must demonstrate that NPP operations satisfy performance standards and that the NPP continues to meet applicable criteria throughout its licence period and the designated operating life.

As explained in subsection 13(a), all licensees implement and maintain a management system, which applies to the licensee organizations as well as organizations contracted by the licensees. An NPP management system is expected to establish safety as the

paramount objective, foster the safe operation of the NPP during all phases of its life-cycle, and implement practices that contribute to excellence in worker performance. Licensee management systems have various provisions that help ensure safe operation, such as ensuring worker competence, sharing and using OPEX, verifying the correctness of work, identifying and resolving problems and controlling changes. The licensees' processes also require independent assessments to confirm the effectiveness of the management systems in achieving the expected results. These measures help ensure that the licensees' responsibility to safety is fulfilled.

Each licensee structures its organization so that the safety of the nuclear facilities under its responsibility is optimized. Each licensee has appointed a key management leader who is responsible for the operation and safety of the NPP. These nuclear executives or nuclear officers participate in the Chief Nuclear Officers Forum (see subsection 9(c)).

During operation, licensees fulfill their responsibilities through the following specific activities that are described elsewhere in this report:

- complying with the regulatory requirements set out in applicable laws and regulations
- operating in accordance with the licensing basis (article 19)
- defining and following safe operating limits and working within them (sub-article 19(ii))
- developing safety policies and an organizational culture committed to ensuring safe NPP operation (article 10)
- monitoring employee performance, facility performance and OPEX to ensure expectations are met (subsection 12(a), subsection 14(ii)(a) and sub-article 19(vii))
- ensuring adequate financial resources are available to support the safety of each NPP throughout its life (sub-article 11.1)
- ensuring adequate qualified resources are always available to conduct planned activities and establish contingencies, as well as to manage unplanned situations, including emergencies (subsection 11.2(a))
- maintaining the necessary human resources in the long term (see subsection 11.2(b))

9 (c) Other mechanisms that facilitate the licence holder's execution of responsibility

Peer and other reviews

The licensees host independent reviews that help confirm that their responsibilities for safety are being met. For example, the NPP licensees are members of the World Association of Nuclear Operators (WANO) and host WANO reviews on a regular basis (see subsection 14(i)(e)). As another example, Bruce Power, OPG and NB Power initiate regular, independent, external nuclear safety assessments through a Nuclear Safety Review Board (NSRB) to provide assurance that the requirements of their respective nuclear safety policies and nuclear management systems are being fulfilled. The NSRB is a team of external industry experts that performs assessments (typically three to five days in duration) of NPP activities that might affect nuclear safety and performance. The NSRB reports directly to the Chief Nuclear Officer at OPG and NB Power, while at Bruce Power it reports to the Board of Directors.

Collective measures

Although the regulatory framework and licensee governance are in place to ensure each individual licensee fulfills its responsibility to safety, the licensees in Canada also act collectively to help fulfill that responsibility. The purpose of this collective effort is to pool understanding and expertise (when appropriate), coordinate and prioritize the resolution of issues and improvement initiatives and enhance overall adherence to regulatory requirements.

In addition to membership in WANO and the CSA Group, all NPP licensees in Canada and Canadian Nuclear Laboratories (CNL) are members of the CANDU Owners Group (COG, described in subsection D.1 of chapter I). COG has provided the mechanism for many projects to improve the safety of CANDU reactors, several of which are described in this report. In addition to its R&D program (described in annex D.2), COG facilitates the execution of licensee responsibility by:

- sharing OPEX and providing support to resolve technical and operating problems for all COG members
- initiating and managing jointly-funded projects and services
- adopting common strategies and plans for the resolution of regulatory issues related to nuclear safety
- sharing best practices, delivering jointly-developed training programs and developing knowledge-retention tools such as the CANDU textbook

COG has initiated two vehicles for industry members to develop common technical positions to support SMR deployment among vendors and partners. One is the SMR Technology Forum, which allows industry members to collaborate in common areas of interest; the other is the SMR vendor participants program, which allows vendors to share perspectives and lessons learned.

In addition to ongoing COG programs, the members form peer groups to address specific issues that arise. During the previous reporting period, COG established a Pandemic Forum to exchange information, develop best practices, and conduct benchmarking.

The Chief Nuclear Officers Forum, which includes senior representatives from all NPP licensees and CNL, facilitates a coordinated approach to resolving significant technical and regulatory issues. It provides high-level direction to, and oversight of, the work done by peer groups to better understand and resolve safety issues. The benefits include consistency of licensing positions, alignment of strategic directions and pooling of resources. COG facilitates the meetings of the Chief Nuclear Officers Forum, which helps ensure the alignment of the high-level direction with ongoing COG programs and projects.

Members of the Chief Nuclear Officers Forum also engage in high-level communications with CNSC executives (see subsection 8.1(f)).

Proactive disclosure and public communications

CNSC regulatory document [REGDOC-3.2.1, Public Information and Disclosure](#), requires all major licensees, including NPPs, to maintain active public information and disclosure programs. Programs must be supported by robust disclosure protocols regarding events and developments involving their facilities or activities. Program requirements are derived from the objectives of the Commission in the NSCA and paragraph 3(j) of the

[Class I Nuclear Facilities Regulations](#), which requires licence applicants to describe “the proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed.”

The public disclosure protocols must describe the type of information or reports to be made public, the criteria for determining when such information and reports are to be published and the medium of disclosure. To define what information and reports are of interest to the different audiences, the licensees and applicants must consult with stakeholders and interest groups. The protocols must be posted on the internet and any revisions sent to the CNSC.

The elements of the licensees’ public information and disclosure program, along with specific examples of the outreach activities conducted by NPP licensees and licence applicants during the reporting period are, provided in annex 9(c).

9 (d) CNSC verification and oversight of licensees’ responsibilities

To ensure that the licensees comply with the various regulatory requirements, the CNSC:

- sets and documents clear requirements using a process that includes consultation
- cooperates with other organizations and jurisdictions to foster the development of consistent regulatory requirements
- indicates acceptable ways to meet regulatory requirements, but allows licensees to propose alternative methods that take into account risk and cost-benefit
- promotes compliance with regulatory expectations
- verifies that processes and programs satisfy regulatory requirements
- enforces requirements using an escalating, consistent regulatory approach based on the level of risk
- uses appropriate industry, national, international or other standards

These regulatory activities are described in more detail in sub-article 7.2 and cover all operational states, including accidents. Comprehensive reporting requirements (see subsection 7.2(iii)(b)) help CNSC confirm that licensees continue to meet their responsibilities. Subsection 8.1(b) describes how the CNSC maintains trained, experienced inspectors at the NPPs on a permanent basis. They provide a high degree of day-to-day interaction with the licensees and scrutiny of their activities.

The licensing basis for each NPP is established through the process of issuing each licence, reaffirming the responsibility of the licensees. Licensees implement new regulatory documents and standards, on a regular basis, both at licence renewal and during the licence period.

The transparency of the Canadian nuclear regulatory framework and the licensing process also helps ensure that the licensees’ execution of their responsibility to safety is apparent to all stakeholders.

9 (e) Summary of fulfillment of safety responsibilities during the reporting period

During the reporting period, NPP licensees fulfilled the fundamental responsibilities for safety as required by the NSCA and its regulations. The licensees’ fulfillment of this responsibility was manifested by the strong safety record of the Canadian NPPs during

the reporting period, as described throughout this report. The use of regulatory enforcement action such as licensing actions or prosecution (as described in sub-article 7.2(iv)) by the CNSC was not required for resolving safety-related issues at Canadian NPPs. The CNSC's regulatory activities involving promotion and verification of compliance were sufficient to address and resolve safety-related issues and the regulatory tools were adequate to maximize conformance with regulatory requirements by all NPP licensees.

The licensees further fulfilled their responsibility to safety during the reporting period by implementing numerous improvements to safety, as described elsewhere in this report. Since NPPs were originally constructed, the NPP licensees in Canada have made many safety improvements based on CNSC requirements, industry research, national and international OPEX and heightened public expectations.

Summary of Significant Changes Since Previous Report

There were no significant changes specifically related to the fulfillment of this article. The NPP licensees continued to fulfil their responsibility for safety during the reporting period.



PART C: GENERAL SAFETY CONSIDERATIONS

Part C consists of seven articles:

- Article 10 Priority to Safety
- Article 11 Financial and Human Resources
- Article 12 Human Factors
- Article 13 Quality Assurance
- Article 14 Assessment and Verification of Safety
- Article 15 Radiation Protection
- Article 16 Emergency Preparedness

Article 10: Priority to Safety

Each Contracting Party shall take the appropriate steps to ensure that all organizations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

Summary Statement for Article

Canada fulfills the obligations of article 10.

Introduction and general requirements

The collective priority given to safety of organizations engaged in activities related to nuclear facilities is, in part, demonstrated by their commitment to peer review and continuous improvement. For example, the Canadian NPP licensees regularly participate in World Association of Nuclear Operators (WANO) assessments (see subsection 14(i)(e)). The Canadian government also demonstrates a commitment to peer review and improvement, including the hosting of missions from the IAEA's Integrated Regulatory Review Service (IRRS) and EPREV (Emergency Preparedness Review) service (see subsections 8.1(e) and 16.1(g), respectively). Further, the licensees and CNSC demonstrate an ongoing commitment to safety through their sponsorship of, and involvement in, safety-related R&D activities (see annex D for details).

The [Class I Nuclear Facilities Regulations](#) require licence applicants for Class I facilities to describe their proposed measures to promote and support safety culture.

The NPP licensees have implemented CNSC regulatory document [REGDOC-2.1.2, Safety Culture](#), which:

- formalizes the CNSC's commitment to promoting a healthy safety culture in the nuclear industry by providing a clear definition and describing the characteristics of a healthy safety culture, ensuring a shared understanding of these concepts between the CNSC and its stakeholders
- formalizes requirements and expectations for licensees regarding safety culture at NPPs
- clarifies and implements the CNSC's oversight role and strategy to verify that NPP licensees are conducting and implementing appropriate safety culture self-assessments and that corrective actions arising from these assessments are effectively implemented

REGDOC-2.1.2 applies to both safety culture and security culture as they coexist and mutually reinforce one another. The term safety culture is understood to include security culture.

NPP licensees conduct safety culture self-assessments on a regular basis; see subsection 10(b). During the reporting period, the Canadian NPP licensees also participated in a country-specific safety culture forum for Canada; see subsection 10 (e).

10 (a) Establishment of licensee policies and supporting processes for NPPs that give due priority to safety

Nuclear power poses significant and unique hazards due to the enormous energy in the reactor core, radioactive material and decay heat produced by the fuel. To make safety an overriding priority, the executive and management of an organization must state and demonstrate safety as a core value. Its management system must consistently uphold and restate this priority at all levels of the management structure. The management system (see article 13) provides assurance that policies, principles and high-level safety requirements are adequately carried through to licensee activities.

All NPP licensees have prioritized safety in their management system through policies that give due priority to nuclear safety. All licensees have also embedded in their management systems the principle that safety is the paramount consideration that guides decisions and actions. The implementation of the principles found in these policies differs by licensee, as described in annex 10(a).

NPP licensees' management system processes ensure that conditions adverse to safety are systematically evaluated and resolved. Corrective action programs are formalized to ensure issues affecting safety are addressed properly and promptly. These processes continue to mature each time they are used, and the lessons learned are shared with the other licensees through various OPEX fora.

Operability evaluations are completed when the ability of systems and components to carry out their safety-related function is uncertain. Decision-making processes are used to resolve significant problems that require a prompt, coordinated response to indeterminate or known degraded conditions that affect safety. Other practices, such as management presence in the field and oversight committees, also help keep the priority on safety.

NPP licensee management systems are based on CSA Group standard N286-12, *Management system requirements for nuclear facilities*, which builds upon the principle that safety is the paramount consideration guiding decisions and actions by including a requirement on safety culture that states:

Management shall use the management system to understand and promote a safety culture by:

- (a) issuing a statement committing workers to adhere to the management system;
- (b) defining and implementing practices that contribute to excellence in worker performance;
- (c) providing the means by which the business supports workers in carrying out their tasks safely and successfully, by taking into account the interactions between individuals, technology, and the organization; and
- (d) monitoring to understand and improve the culture.

These requirements are reinforced for reactor design in CNSC regulatory document [REGDOC-2.5.2, *Design of Reactor Facilities*](#), which requires that design activities shall proceed under a management system that recognizes the importance of a healthy safety culture.

Measures that fulfill the above requirements are described elsewhere in this article as well as in articles 12 and 13.

Many other organizations, besides the licensees, conduct activities that are directly related to the safety of NPPs. However, per article 9, it is the licensee that is directly responsible for safety. The NPP licensees' management systems have provisions to verify the policies of other organizations that the licensees engage for contracted work. See subsection 13(a) for details. In addition, licensees are providing safety culture training to contractors and vendors, which has resulted in improved understanding of nuclear safety, this is discussed further in subsection 10(b). These efforts to improve the safety culture of contractors and vendors have shown benefit in improved quality of materials being provided by vendors and lower rates of injuries and near-miss occurrences with on-site contractors. Such efforts are being applied to new-build projects, such as DNNP.

10 (b) Safety culture of NPP licensees

General approach

The safety culture at Canadian NPPs is based on a collective belief among all employees and management that safety is the first priority when decisions are made and work is performed. Employees and management accomplish this priority by considering risks and maintaining adequate safety margins, maintaining respect and a sense of responsibility for the reactor core and reactor safety and confirming that a task can be performed safely before executing it. The foundation of safety culture is further established by constantly examining nuclear safety, cultivating a "what if?" approach to safety planning and preparation, embracing organizational learning, and promoting a "just culture" that aims to learn as much as possible from events or near misses without removing the possibility of holding persons responsible for their actions.

Clear lines of authority and communication are established, so that individuals throughout the organization are aware of their responsibilities toward nuclear safety. Senior management is ultimately responsible for the safety of the NPP and is, therefore, expected to develop processes to encourage and track the effectiveness of safety programs and to demonstrate through action that safety is the overriding concern. Supervisors' behaviour must also show that they expect their workers to follow safety processes while, at the same time, encouraging a questioning attitude. At the individual level, the emphasis is on nuclear professionalism and accountability for each individual engaged in an activity that affects the safety of the NPP. All employees are expected to be aware of and adhere to all procedures. This approach ensures that rules, policies and regulations related to reactor safety, radiation safety, environmental protection, industrial safety, security, fire protection and other relevant areas addressed in the procedures are followed. These expectations are promoted through training and leading by example; monitored through field observations, oversight committees and self-assessments; and strengthened by means of coaching and mechanisms to encourage problem identification and effective corrective action.

Safety culture self-assessments

NPP licensees conduct safety culture self-assessments, conduct follow-ups to assess safety culture issues, develop appropriate corrective actions and complete post-assessments.

The benefits of a safety culture assessment are the learning and improvement opportunities created. However, in a safety culture self-assessment there is the potential for licensees to overlook key topics or circumstances due to complacency and over-familiarity with internal ways of conducting business. For this reason, the industry has taken several approaches to try to overcome the potential for “organizational blindness,” including:

- the development of common safety culture assessment guidance and information exchange among Canadian NPP licensees through the COG Safety Culture and Human and Organizational Factors Peer Group; the licensees use guidance from WANO, the Institute of Nuclear Power Operations (INPO) and the Nuclear Energy Institute (NEI) as their primary source of self-assessment requirements
- the inclusion of safety culture monitoring as part of regular and third-party assessments undertaken by industry monitoring groups such as Nuclear Safety Review Boards and Corporate Nuclear Oversight Teams, in addition to Internal Nuclear Oversight and Functional Area Monitoring which are independent of the functioning of the organizations.
- the implementation of safety culture monitoring processes between safety culture assessments to identify possible, subtle changes in safety culture

The NPP licensees have adopted the nuclear safety culture monitoring panel process, which monitors corrective action programs, internal events, trends, and organizational changes that are indicative of the health of the organization’s nuclear safety culture, and identifies areas of strengths and potential concern that merit additional attention by the organization. They also monitor the actions from safety culture assessments on a periodic basis. Executive management considers the insights produced by this process.

The results of safety culture self-assessments and other safety culture activities during the reporting period are summarized here for the licensees of operating NPPs.

All Canadian NPPs have implemented REGDOC-2.1.2, and as such, conduct comprehensive nuclear safety and security culture self-assessment at least every five years. The established assessment methodology has two phases: a detailed safety and security culture survey that is sent to all employees and resident contractors, and an onsite assessment by an assessment team involving interviews, focus groups, document review and observations. The assessment focuses on perceptions, attitudes and behaviours of the organization.

The assessment methodology continues to be refined based on the lessons learned from each preceding assessment and industry best practices. For example, the CANDU Owners Group (COG) recently developed a tool that will allow survey output and onsite assessment findings to be captured in the same database, enhancing efficiency.

Ontario Power Generation

During this reporting period, OPG completed five comprehensive divisional nuclear safety and security culture assessments in accordance with REGDOC-2.1.2.

- Pickering
- Nuclear Sustainability Services
- Corporate division (supporting nuclear)
- Enterprise Project Organization (including contract and vendor partners)
- Darlington

For each assessment, the model of safety culture, the structure of the assessment process and the results of the assessment were consistent with the Institute of Nuclear Power Operations (INPO) traits and attributes of a healthy nuclear safety culture with the addition of a nuclear security trait. Additionally, the assessments met the guidance in Nuclear Energy Institute document ([NEI-09-07, 'Fostering A Strong Nuclear Safety Culture; Rev 0'](#)). Assessment teams were comprised of both internal and external team members from various organizations. Each assessment included a comparison of the assessment results against the previous assessment for that division; highlighting success in closed gaps and identifying areas that require continuous improvement or additional actions. Collectively, the assessment teams concluded that OPG has a healthy nuclear safety culture, healthy respect for nuclear safety, and nuclear safety is not compromised by production priorities. Additionally, OPG was found to have a healthy nuclear security culture.

The insights from these assessments were used to address areas in each division that require additional focus, and the corrective action program was used to address the findings. In addition to the comprehensive divisional assessments, OPG has instituted Nuclear Safety & Security Culture Monitoring Panels (NSSCMP) which are tasked with overseeing the key process indicators, including pulse surveys, that reflect the state of the organization's nuclear safety and security culture on an ongoing basis. These panels, which are comprised of senior leadership, convene twice a year to deliberate on the 11 nuclear safety and security culture traits. In doing so, strengths and potential concerns that merit additional attention by the organization are identified and acted upon. The use of the NSSCMP further promotes meaningful conversations and sharing of lessons learned amongst station leaders to ensure any emergent issues that could impact nuclear safety and security culture are addressed.

OPG plans to conduct additional safety culture assessments in accordance with REGDOC-2.1.2. The next planned assessment will be conducted on Pickering NGS in 2026.

Bruce Power

The most recent nuclear safety and security culture assessment was a comprehensive, site-wide self-assessment completed in 2022. The assessment used the INPO/WANO framework for 10 traits of a healthy nuclear safety culture and drew upon IAEA guidance for conducting assessments of culture for security. This was the second assessment of safety culture, conducted at Bruce Power, that also integrated an assessment of security culture.

The 2022 assessment included a survey, interviews, and focus groups. In addition, the 2022 assessment included contract workers and vendors. The insights from the 2016 survey were utilized to address key areas of weaknesses. The survey identified measurable improvements that resulted in an improved contractor and vendor understanding of why nuclear is special and unique, and improved worker engagement in problem analysis through implementation of focus groups and learning teams. An area that was identified for improvement was the resolution of longer standing safety and facility condition issues. The overall results from the assessment were considered and the corrective action program was used to address findings.

Bruce Power plans to conduct another safety culture assessment in 2027, in accordance with REGDOC-2.1.2.

NB Power

NB Power continues to fully adopt and integrate the INPO/WANO framework for the 10 traits of a healthy nuclear safety culture into all aspects and levels of station operations. The traits and action statements in the framework provide information on what the traits should mean to all employees at NB Power and are continuously reviewed by all employees at NB Power.

NB Power conducted a comprehensive nuclear safety and security culture assessment in the fall of 2021 in accordance with REGDOC-2.1.2; which, for the first time, incorporated security culture into the assessment.

The assessment compared the results against the previous (2016) assessment. The assessment team concluded that Point Lepreau has a healthy nuclear safety and security culture and a strong respect for nuclear safety and that security, and that nuclear safety and security are not compromised by production pressure.

To ensure a continued focus on nuclear safety culture, pulse surveys and monitoring panels are utilized between assessment cycles to gage for possible subtle changes in safety culture within the organization against the 10 traits with tailored action plans being developed based on the survey results.

NB Power plans to conduct another safety culture assessment, in accordance with REGDOC-2.1.2.

10 (c) Safety culture in other nuclear industry organizations

In addition to the licensees of operating NPPs, other organizations that make significant contributions to nuclear safety also conduct safety culture self-assessments, e.g., the CNSC, as described in subsection 10(d), and organizations that are contracted by the licensees to carry-out safety-critical work. As an illustrative example, the following describes the program of AtkinsRéalis, which offers a variety of services to NPP licensees.

The two nuclear-technology organizations comprising AtkinsRéalis (see section D.1) have been INPO supplier members since 2015, and have developed and implemented a comprehensive “Building a Culture of Excellence” program based on the INPO framework, including the 10 traits of a healthy nuclear safety culture. AtkinsRéalis performs regular, six-month trend analyses of its human performance and event/non-conformance programs, as well as annual self-assessments of at least one trait or tool. These are used to identify areas of improvement, training needs and execute both individual and AtkinsRéalis-wide coaching. Recent self-assessments have led to enhancements in the pre-job brief process.

General Electric-Hitachi (GEH, which is the design authority for DNNP) takes an approach taken for Nuclear Safety and Security Culture that is based upon various industry standards, including but not limited to, International Organization for Standardization (INPO) [12-012, Traits of a Healthy Nuclear Safety Culture](#), guidance in the International Atomic Energy Agency’s [GS Part 2, Leadership and Management for Safety](#) General Safety Requirements, and REGDOC-2.1.2. The GEH Executive

Leadership Team and employees of GEH are committed to ensuring that a strong, positive nuclear and safety and security culture is established, fostered and actively monitored for all nuclear activities using metrics, periodic surveys and management reviews. Under GEH's Quality Assurance Program, GEH has established measures to ensure an appropriate safety conscious work environment within GEH operations - one of the key nuclear safety and security culture traits.

Canadian NPPs and AtkinsRéalis actively promote the implementation of a robust safety culture programs in their supply chains.

10 (d) Regulatory Review and Control

REGDOC-2.1.2 defines safety culture as:

- the characteristics of the work environment, such as the values, rules and common understandings that influence workers' perceptions and attitudes about the importance that the organization places on safety.

REGDOC-2.1.2 is based upon the following safety culture framework from the IAEA:

- Safety is a clearly recognized value.
- Accountability for safety is clear.
- A learning organization is built around safety
- Safety is integrated into all activities in the organization.
- A safety leadership process exists in the organization.

Safety performance can be influenced by the ways in which responsibilities are assigned within the organization, from the senior management team to the personnel in the field where operational activities are carried out. It can also be influenced by the ways in which organizational changes are made and communicated to staff, and by the effectiveness of its training programs.

When reviewing NPP management systems, the CNSC pays particular attention to the way that nuclear, radiological and conventional safety, environmental protection and the security of the facility are all managed and integrated within the general management system. Canadian management system requirements address the need to promote safety culture (as discussed in subsection 10(a)) and include several measures related to organizational changes.

CNSC staff also check for other indicators of a healthy safety culture at NPPs, such as whether:

- documentation exists that describes the importance and role of safety in the operation of organization, such as a safety management program
- the use of continuous self-assessment of safety culture is evident

CNSC staff examine the self-assessment approach for safety culture proposed by each licensee and review licensees' plans to conduct specific assessments. They also provide licensees with feedback on their self-assessments and examine how licensees evaluate security culture in the context of safety culture. During the next reporting period, CNSC staff will continue to confirm that NPP licensees have engaged in activities to foster a healthy safety culture and are monitoring safety culture by conducting comprehensive, systematic and rigorous assessments.

10 (e) Priority to safety at CNSC

The regulatory independence of the CNSC enables it to prioritize safety in all its activities. The *CNSC Navigator Manual* has clear statements on the consideration of safety in every decision made. The CNSC's management system and *Navigator Manual* also reflects the CNSC's commitment to and understanding of the key aspects of a healthy regulatory safety culture. Specific policies, such as the Safety Culture Policy, Policy on Science in a Regulatory Environment, and the Open-Door Policy, also support this prioritization. Further, all regulatory processes within the CNSC management system are developed respecting the CNSC's focus on protecting the health and safety of the people and the environment and fulfilling Canada's international obligations.

In cooperation with the Nuclear Energy Agency (NEA) and WANO, the CNSC hosted a country-specific safety culture forum for Canada during the reporting period. The NEA issued a [summary report](#), which was subsequently reviewed during a first-of-a-kind workshop between the CNSC and Canadian NPP licensees. The workshop identified 'physiological safety' as a common national theme on which to focus future culture-related effort. Further, to meet its Safety Culture Policy, CNSC invited the IAEA to lead an independent assessment of regulatory safety culture in 2024. CNSC plans to develop, in the summer of 2025, a management action plan to address the suggestions and recommendations from the final report of the independent assessment of regulatory safety culture.

During the reporting period, the CNSC also created a safety culture monitoring group and established a practice for regular reporting to CNSC managers and staff on regulatory safety culture, which is expected to begin in the fall of 2025.

Notable Achievements

CNSC hosted a country-specific safety culture forum for Canada (in cooperation with NEA and WANO).

CNSC hosted an IAEA-led independent assessment of regulatory safety culture.

Future Focus

CNSC plans to develop a management action plan to address the suggestions and recommendations from the independent assessment of regulatory safety culture.

Licensees will continue to conduct safety culture assessments, while using tools such as ongoing monitoring panels and pulse surveys to track and improve nuclear safety and security culture between assessment cycles.

Article 11:

Financial and Human Resources

1. *Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.*
2. *Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.*

Summary Statement for Article

Canada fulfills the obligations of article 11.

11.1 Adequacy of financial resources

The NPP licensees' primary responsibility for safety (article 9) dictates the provision of adequate financial resources to support the safety of each NPP throughout its life.

Paragraph 3(1)(l) of the [General Nuclear Safety and Control Regulations](#) requires all licence applicants to provide a description of any proposed financial guarantee relating to the activity to be licensed. In addition, NPP licensees in Canada are required by licence conditions, imposed pursuant to a specific reference in subsection 24(5) of the NSCA, to provide financial guarantees acceptable to the CNSC for the costs of decommissioning NPPs.

The following subsections describe the funding of operations, safety improvements, safe storage and decommissioning, as well as the provision for nuclear liability and compensation. The funding of new reactor construction is omitted, since there was no construction during the reporting period.

11.1 (a) Financing of operations and safety improvements made to nuclear power plants during their operating life

Canadian NPP licensees maintain budgets for operation, maintenance and capital improvements. For large-scale improvements, an item is costed for financing over the estimated remaining effective lifetime of the NPP. Expenditures are dictated by the licensee's financial position, current and planned performance, service obligations (electrical load forecast) and financial and business strategies. These inputs are used to develop the envelopes for ongoing operating expenditures and capital investments.

Canadian NPP licensees place a high priority on safety-related programs and projects. This ensures significant financial resources are applied to safety improvement programs and projects throughout the life of each NPP.

11.1 (b) Financial resources for safe storage and decommissioning

Licensees of nuclear facilities, including spent fuel and radioactive waste management facilities, must provide guarantees that ensure adequate financial resources are available for the decommissioning of these facilities and management of the resulting radioactive wastes. Canada's NPP licensees have opted for different methods of supplying decommissioning financial guarantees, as detailed by CNSC regulatory document [REGDOC-3.3.1, Financial](#)

[Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities](#).

In each case, the financial guarantee arrangements include legal agreements that grant the CNSC access to the guaranteed funds in the event of default by the licensee. The licensees maintain preliminary decommissioning plans, cost estimates and financial guarantees and report periodically to the CNSC that these remain valid, in effect and sufficient to meet the decommissioning needs. The preliminary decommissioning plans and financial guarantees are kept up to date in response to events such as changes to NPP operating plans, changes in financial conditions and the development of plans for the long-term management of spent fuel under the *Nuclear Fuel Waste Act*. The financial guarantees encompass not only the decommissioning of the NPP but also the safe storage of nuclear waste and spent fuel produced by the NPP. NPP licensees submit to the Commission annual reports on the status of their financial guarantees

The decommissioning financial guarantees required from NB Power and OPG cover the full breadth of decommissioning, including the initial steps to place the facilities in a safe storage state. Under the lease conditions of the Bruce site to Bruce Power, the owner (OPG) maintains the decommissioning financial guarantees for the Bruce reactors.

Further details on financial guarantees and decommissioning can be found in the ninth Canadian report and in the *Canadian National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*.

The financing of the placement of Pickering Units 2 and 3 into safe storage and the isolation of interfaces to the operating NPP (as described in previous Canadian reports) was provided primarily from OPG's nuclear decommissioning fund. During the reporting period, OPG shut down Units 1 and 4 and began their transition to safe storage, with completion expected by mid-2028. The same financing strategy is being used to support both design and constructions activities associated with the safe storage of Units 1 and 4.

11.1 (c) Requirements under the Nuclear Liability and Compensation Act

The civil liability regime provided by the *Nuclear Liability and Compensation Act* establishes the absolute, exclusive and limited liability of the operator for civil damages. It is designed to provide certainty on the treatment of legal liability for nuclear damage resulting from a nuclear incident (including losses resulting from a preventive measure) and to provide prompt compensation with minimal litigation. Highlights of the legislation include the following:

- The absolute liability limit of an NPP operator is \$1 billion.
- Compensable damage includes, in addition to bodily injury and property damage under the current legislation, some forms of psychological trauma, economic loss, losses resulting from preventive measures and environmental damage.
- The limitation period is 30 years for submitting compensation claims for bodily injury and loss of life.
- Operators are required to maintain financial security to cover their full liability limit.
- A quasi-judicial claims tribunal replaces the courts, if necessary, to accelerate claim payments and provide an efficient and equitable forum.

In 2021, Natural Resources Canada (NRCan) undertook the first five-year review of the \$1 billion liability limit under the [Nuclear Liability and Compensation Act](#). Subject to the legislative requirements, the review considered the consumer price index, international nuclear liability standards, and other considerations. The main findings from the five-year review were:

- Canada continues to have a strong liability regime and high standards.
- Taking inflation into consideration, the nuclear third-party liability limit could be increased to \$1.1 billion.
- To assure that the appropriate insurance market capacity can be provided, increases to the liability limit should be gradually phased in.
- Following internal analysis and the public comment period, several considerations were identified that were outside the scope of the five-year review. Of note was the recommended review of the financial security requirements for low-risk installations to determine their appropriateness, as well as the existing indemnity fee structure used to calculate the Government's fees charged for indemnification.

11.2 Adequacy of human resources

Paragraph 12(1)(a) of the [General Nuclear Safety and Control Regulations](#) requires licensees to “ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the Act, the regulations made under the Act and the licence.” The expression “Adequate human resources” means the employment of enough qualified staff to carry out all normal activities and to respond to the most resource-intensive conditions under all operating states, including normal operations, anticipated operational occurrences, design-basis accidents, and emergencies.

As described in the following subsections, the licensees have extensive programs for training, staffing, examination, workforce capacity evaluation, hiring, knowledge retention and R&D that contributed to the effective management of human resources.

11.2 (a) Requirements and measures related to staffing levels, qualifications, training and certification of workers

Licensees are responsible for the safe operation of their respective NPPs. As such, they are responsible for both training and testing their workers to ensure they are fully qualified to perform the duties of their positions.

Licensee training programs

CNSC regulatory document [REGDOC-2.2.2, Personnel Training](#), sets out the expectations for the analysis, design, development, implementation, evaluation, documentation and management of existing and new training at nuclear facilities, including the principles and elements essential to an effective training system. Licensees must ensure that the workers who carry on licensed activities are trained and qualified to do the work assigned to them through the use of a training system that is systematically developed and performance-oriented. Licensees must also use this training system whether the training is defined, designed, developed, implemented, evaluated, recorded and managed internally by the licensee or externally through vendors or contractors.

The CNSC regularly performs compliance verification activities to evaluate licensees' training programs and to verify that all workers, including certified staff, temporary workers and contractors, are qualified and competent to perform the work assigned to them. Regulatory activities include the assessment of training processes and procedures, review and evaluation of licensee training programs and onsite evaluation and inspections of training program outputs.

Licensee training programs are established in accordance with the principles of the systematic approach to training, which ensures that licensee staff receive training pertinent to

their positions. Departmental programs are routinely reviewed, and training needs analytically identified to allow training courses to be revised or developed as necessary to guarantee that the training replicates the procedures and equipment used in the NPPs. Furthermore, training program evaluation processes and procedures are regularly applied to assess the effectiveness of the training programs. Licensees use performance and accreditation objectives and criteria for training programs, such as those developed by INPO. All key training performance areas are evaluated and assessed against these objectives quarterly. OPG, for example, uses them as the basis for a number of training performance indicators.

All NPP licensees have internal training programs that focus on training in CANDU technology and on the development of soft skills (such as behavioural competencies). OPG is currently developing training programs to support the construction and operation of a BWRX-300 plant. Operations and maintenance training is provided to create and maintain job performance capability. This training normally includes classroom instruction, workshops, full-scope simulator exercises, on-the-job instruction, supervisory coaching and informal briefings. Most staff are also trained to a radiation protection level that qualifies them to be responsible for their own protection, sponsor supplemental staff and provide radiation protection oversight.

A number of enhancements have been made to the training programs at Canadian NPPs during the reporting period. NPP licensees are transitioning from traditional training approaches to more responsive approaches that are continuous, self-paced, collaborative, and more experiential. The licensees are optimizing mentoring, leveraging technology and learning systems, employing dynamic learning activities (described in Annex 11.2(a)), and making greater use of simulators. Annex 11.2(a) provides several examples from Bruce Power, OPG and NB Power.

The number of staff working in the regulatory field is too small for a single Canadian NPP licensee to maintain and deliver an in-house training program on regulatory affairs. Therefore, an industry working group coordinates a joint regulatory affairs training program. It includes courses on the following topics, developed by individual licensees, the CNSC and Canadian Nuclear Laboratories (CNL) and coordinated by COG:

- NPP operating licences
- [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants](#)
- the NSCA and its regulations
- regulatory issues management

Licensee training programs consider the requirements for supplemental personnel, who are important to licensees' performance of critical work on safety systems and safety-related systems during maintenance outages (e.g., electrical, hoisting and rigging, pressure boundary) as well as personnel performing a contract management role. While supplemental workers are typically recruited to augment outages, they can also be involved in engineering or design work. The training programs consider previous training and experience through the use of standard task evaluations based on the Electric Power Research Institute (EPRI) methodology or apprentice-related certificates of qualification. The training and qualification of supplemental workers ensures familiarity with nuclear-related practices such as human performance tools and corrective action programs. Specialized training is provided in areas such as environmental qualification, foreign material exclusion, respiratory protection, human performance and radiation protection, all of which include industry-related OPEX. The

programs to assess the competencies of the supplemental staff include the evaluation of the knowledge and skills necessary to conduct specific work at the NPPs.

Other industry members also maintain training programs related to nuclear safety. For example, AtkinsRéalis provides internal and external training in CANDU technology as well as training in other nuclear technologies that support its products and services for NPPs. During the design phase of retube projects, AtkinsRéalis utilizes three-dimensional smart-plant software for the layout of the feeders. Integration of this software with laser scans of the reactor building structures produces real-space holographic simulations of the feeder and the surrounding structures that can be used to train the feeder installers to carry the feeder to the final installation location (i.e., wearing a holographic headset) prior to completing the actual field execution work. In addition, the innovation has been utilized in various projects to identify in advance any potential interferences with surrounding structure within the building that may occur during the transfer of the feeders into the reactor building for installation.

The training activities at AtkinsRéalis include those related to the design-engineering process, reactor design technology, pressure boundaries, Canadian nuclear standards, human performance, and management leadership, including participation in INPO training. Training has been provided both in Canada and other countries. The training program is integrated with development programs as part of performance reviews.

Qualification and numbers of workers

The CNSC defines and establishes regulatory requirements and criteria for the qualification, examination, certification and numbers of licensee personnel, including certified staff at NPPs.

Annex 11.2(a) provides specific details on the hierarchy of these requirements and guidance. Some of the more pertinent documents are discussed in detail in the following.

CNSC regulatory document [REGDOC-2.2.3, Personnel Certification, Volume III: Certification of Reactor Facility Workers, Version 2](#) sets the requirements for the certification and the renewal of the certification of workers employed in designated positions at reactor facilities, including NPPs (the CANDU designated positions are described in annex 11.2(a)). Notably, the REGDOC sets requirements for processes by which the licensees train, evaluate, and otherwise qualify their candidates for certification by the CSNC. CNSC staff administers certification examinations and requalification tests to senior health physicists, while the NPP licensees are responsible for administering valid examinations and tests for all other certified workers. The CNSC provides oversight of the training, certification examination, and requalification testing programs and acts as the certifying body, verifying that certified workers employed at NPPs meet qualifications specified by the CNSC. Recent changes in the regulatory framework will allow greater diversity of candidates into the initial training programs. This will be accomplished through both flexibility in timelines during the qualification process for individuals and also accounts for greater flexibility in learning and evaluation preferences.

One aspect of ensuring the presence of a sufficient number of qualified workers is defining the minimum number of workers with specific qualifications who will be available to the nuclear facility at all times. This sufficient number is known as the minimum staff complement (MSC). CNSC regulatory document [REGDOC-2.2.5, Minimum Staff Complement](#) provides guidance to assist Class I nuclear facility licensees and applicants to demonstrate to the

CNSC how they ensure the presence of a sufficient number of qualified workers. The number and qualifications of workers should be adequate to successfully respond to all credible events, including the most resource-intensive conditions for any facility state. The MSC is specific to each facility and is influenced by the design of the facility, operating and emergency procedures and organizational functions.

NPP licensees conduct a systematic analysis to determine the specific numbers and qualifications of staff required in the MSC. This analysis considers all work groups essential to ensuring the safe operation of the NPP and adequate emergency response capability, such as certified and non-certified staff, maintenance, emergency response and fuel handling. It also considers the response necessary to mitigate the consequence of all design-basis events including common-mode events and multi-unit events. For NPPs, CNSC staff reviews the licensee's systematic analysis that is used to determine the MSC and observe the integrated validation exercises used to demonstrate the adequacy of the MSC. The analyses and validation reports are part of the licensing basis for each NPP.

At Pickering, significant staff reductions are not expected to be required as a result of the current transition of reactors at the NPP. OPG established and implemented an integrated resourcing plan to ensure there is an engaged and skilled workforce that enables continued operational excellence through the next stages of operations. This integrated plan includes the plans for resourcing as well as plans for the physical plant, such as the safe storage project, decommissioning, and refurbishment. Resourcing plans are in place to ensure that an adequate number of qualified employees are available to continue safe operations through to the end of commercial operations and that internal redeployments into other areas such as decommissioning and refurbishment are optimized.

Efforts are underway by current and future licensees to define the training, qualification, and certification requirements for SMRs through the Certification and Training Advisory Group and licensee-specific meetings with the CNSC. The focus is establishing programs and processes appropriate for newer, simpler reactor technologies with additional inherent safety features. OPG is currently developing training programs to support the construction and operation of a BWRX-300 plant.

The NPP LCHs include a requirement for licensees to maintain a business continuity plan. Such plans provide for essential services through a sustained period with significant employee absenteeism. In response to the COVID-19 pandemic, all NPP licensees implemented their business continuity plans. More information on their response to the pandemic is provided in the ninth Canadian report.

11.2 (b) Capability maintenance at NPP sites

Core programs

The nuclear industry in Canada has robust workforce-development and worker-replacement programs in place to meet future needs, as well as leadership development programs. Changes in workforce demographics and anticipation of increasing industry human resources requirements (e.g., due to refurbishments and possible new construction that may compete for resources with other large energy-related projects) have led to initiatives in four related areas:

- workforce capability analyses
- hiring programs

- external training programs
- knowledge-retention programs

Industry-wide effort is also aimed at maintaining R&D capacity.

Most of the examples and details in the following are for NPP licensees. However, other supporting organizations with safety-related activities also strive to maintain safety-related capability – a few illustrative examples are also provided for AtkinsRéalis.

Workforce capability analyses – licensee and vendors

NPP licensees regularly conduct detailed workforce capability analyses to predict gaps between forecast supply and planned resource levels in the operator, maintenance and engineering job-families. These analyses focus on assessing critical gaps in skills that need to be retained, replaced and resourced. Training requirements are also identified.

Annex 11.2(b) provides, as an example, a detailed description of the workforce planning process used by Bruce Power.

OPG and Bruce Power continue to collaborate to ensure that industry vendor capability exists to perform complex work at both utilities. For workforce capability, this joint initiative ensures sufficient capacity to perform the volume of work and feasibly mitigate schedule overlaps between OPG and Bruce Power. The workforce focus is on three streams.

Improve supply and demand data

- OPG, Bruce Power, the Electrical Power Systems Construction Association, vendors and unions share skilled trades information and development of forecasts (total nuclear long-term demand for all nuclear-related skilled trades) and partnership strategies. Currently, trade supply for boilermakers is critical to meeting forecast demand.
- Trade demand forecasts are updated quarterly.
- Trade demand forecasts are being actively updated to include trades related to Safe Storage, SMRs, Pickering and Bruce refurbishment, Darlington New Nuclear Project and Renewable Generation.
- Other specialized trade forecasts have been developed working with labour-market consultants.

Build new source of trades

- Tri-partite agreement between Durham College, the Boilermakers' Union and OPG fast-tracked 100 new pre-apprentices into the Boilermakers' Union for 2019.
- A new boilermaker "helper" classification was created to help address supply challenges.
- OPG and Bruce Power collaborated with the United Association of Plumbers and Pipefitters and the Canadian Welding Bureau Foundation to build 21 new welding booths in 4 Durham Region high schools and engage youth in hands-on training at union training halls.
- "Introduction to Millwright" programs have successfully recruited approximately 40 candidates from Indigenous and women's groups to undergo training as millwright apprentices, with opportunities to work at OPG and within the broader energy section.
- A pilot collaboration with millwrights and Durham College hired four women from Durham College as millwright apprentices.
- Participated in 45 outreach events, trade fairs and career fairs in 2024 to educate and promote careers in skilled trades.

Optimize the current supply of trades

- OPG and Bruce Power streamlined practices for security clearance.
- The Job Ready Dispatch program was created to eliminate the need for duplicate trades training.
- OPG and Bruce Power maximized the use of travel cards and permit trades
- OPG and Bruce Power created the Temporary Foreign Worker program with the Government of Canada to promote the recruitment of skilled trade persons from outside Canada.
- OPG's Indigenous Opportunities Network supports the recruitment and retention of Indigenous peoples across the enterprise, including refurbishment projects.
- The ION Indigenous Opportunities Network partners with Kagita Mikam, a local Indigenous employment and training agency to provide employment and training support for Indigenous peoples in the skilled trades.
- The Government of Canada helped establish Indigenous partnerships aimed at raising awareness of opportunities.

Succession- planning processes are also in place at the NPPs to predict, plan and prepare for the replacement of senior-level personnel to build a pipeline of leaders to ensure business continuity and manage risk. Leadership positions at all levels, including executives, middle management and first-line managers, down to the level of department manager, are reviewed to identify and develop future successors. Assessments of employee successor readiness to assume a position (from "ready now" to "ready in one to two years" to "ready in three to five years.") are being conducted. Individual development plans are used as a tool to capture goals and actions that will bridge development gaps and prepare potential candidates to assume critical positions as employees retire.

To accelerate the proficiency and effectiveness of leaders and bridging anticipated readiness gaps at senior levels, OPG uses a variety of focused learning and development approaches utilizing a combination of experiences, exposure and education. This includes leadership and targeted learning events, cohort-based development programs, on-demand learning and workshops on critical people leadership topics.

Some examples of training innovations at the NPPs related to leadership are provided in annex 11.2(a).

AtkinsRéalis addresses workforce capability through a comprehensive resource-management system that focuses on the delivery of engineering products and services to nuclear facilities around the world, the refurbishment of existing reactors and the construction of new reactors. This system covers various groups in AtkinsRéalis and takes an optimal approach to dealing with changes in the business, balancing customer needs and ensuring a consistent approach. System elements are grouped based on supply, demand, resource planning, resource development and performance management. Skills of individual technical staff are identified and maintained with succession plans established to meet commercial demands. Attrition risks are actively managed, and gaps in worker skills, knowledge and qualifications are identified and addressed using a combination of targeted and on-the-job training.

AtkinsRéalis' employee qualification program maintains the qualification status and training of employees in a database that acts as a qualification, skill, and certification validation repository to support requirements and processes. The database maintains qualification information such as the engineering personnel qualification record, which is a document outlining the required qualifications for an engineering role/position and the evidence to

support that an individual has obtained the required qualifications and experience to perform work within that role.

Current hiring programs

NPP licensees continued to replenish their workforces through hiring programs to recruit workers into the operator, maintenance and engineering job-families. Recruitment of mechanical and control maintenance workers and operators is largely conducted through community colleges; the NPP licensees have established partnerships with colleges in their regions, often advising on curriculum and career opportunities (see previous subsection). Recruitment of engineers includes both experienced workers and new graduates from Canadian universities, some of which offer nuclear engineering programs.

To further promote the industry and increase the pool of potential applicants, the NPP licensees are active in programs such as campus outreach and robotics competitions, as well as in organizations such as Women in Nuclear and North American Young Generation in Nuclear.

Women in Nuclear-Canada emphasizes and supports the role of women in addressing the general public's concerns about nuclear energy and the application of radiation and nuclear technology. Women in Nuclear-Canada also works to provide an opportunity for women to succeed in the industry through initiatives such as mentoring, networking and personal development opportunities. The industry has collaborated on a number of joint initiatives in partnership with Women in Nuclear, including the production of a video to encourage young women in high school to pursue a career in the nuclear industry and an initiative to provide the human resources community with recommendations for developing more robust strategies to have women pursue trades careers in the electricity sector.

A number of young professionals in the licensee organizations and AtkinsRealis are part of North American Young Generation in Nuclear. This organization provides opportunities for a young generation of nuclear enthusiasts to develop leadership and professional skills, create life-long connections and engage and inform the public.

The NPP licensees also have programs aimed at hiring members of Indigenous Nations and communities. For example, during the reporting period, Bruce Power met its targets in hiring a minimum of 50 Indigenous people each year either directly or through vendors (in addition to training, as discussed above, Bruce Power is funding scholarships and internships for Indigenous people). Both NB Power and OPG have similar programs.

At AtkinsRéalis, the supply of personnel in needed skills is maintained by internal postings and external hiring, including that of experienced personnel on contract (such as retirees, including those from licensee organizations). Furthermore, recruitment by SNC-Lavalin Nuclear utilizes innovative partnerships with Canadian universities.

Comprehensive assessment of capability for anticipated new-build

The Canadian Nuclear Association (CNA) is exploring the potential workforce needs of the sector for all possible new nuclear growth. A major constraint is the workforce and talent pool required to deliver on the potentially significant expansion of nuclear energy. The CNA noted, from stakeholders and partners spanning industry, universities, colleges, youth, unions, trades, government (including CNSC), Indigenous advocacy and engagement groups, global

bodies, and the utilities involved in nuclear energy, the necessity of a comprehensive national workforce needs assessment.

This work will identify the potential growth in the labour supply that may be required between now and 2050 to ensure that a capable workforce is developed to support new nuclear (SMRs and large-scale) deployments across Canada. This will include effort needed from all stakeholders and partners to support regulatory activities (see subsection 8.1(c) for additional information on CNSC's workforce planning). It will also consider the changing needs of the current workforce, which will be impacted by attrition and the changing needs for skills given technological changes (e.g., automation). The potential growth will be presented in a number of scenarios that are aligned with different nuclear energy demand scenarios. The results of these forecasts will:

- define potential for long-term workforce requirements, which will help the sector better understand where efforts will be required and enable it to start the necessary workforce planning
- form the basis for key messages for government and the public, clearly stating the scope of the challenge of substantially increasing nuclear energy capacity in Canada as part of the road to net zero emissions
- support the development of government policy options that should be considered by governments, and which will highlight the roles they can play in enabling the development of a reliable nuclear workforce to support the growth of the nuclear sector
- strengthen the sector's collaborative efforts to unite around this critical challenge through engagement and consultation on the approach, findings, and draft recommendations

The project involves a number of phases.

- Phase 1 development of a number of nuclear energy growth demands to 2050 (complete)
- Phase 2 development of a workforce project model that can produce in-depth needs assessments and projections of the nuclear workforce required to enable the growth projections of the sector out to 2050
- Phase 3 development of a national workforce plan for the private sector that includes key areas of development and key policy and program options for governments' consideration, aimed at enabling the necessary growth and development of a nuclear workforce that can reliably support the growth of the nuclear sector out to 2050

Phases 2 and 3, along with the public release of the results, are anticipated to be completed by summer 2025.

External training programs

There are multiple Canadian universities and community colleges with programs in engineering physics and other areas important to the nuclear industry, most with connections to industry partners. Some specific examples follow.

The Ontario Tech University has a nuclear engineering program designed specifically to meet industry needs. Its Faculty of Energy Systems and Nuclear Science offers undergraduate (bachelor's), post-graduate (master's) and doctorate (PhD) degrees, graduate courses and diploma programs that focus on nuclear engineering, radiation science and related areas to support continuing-education needs.

More than 680 undergraduate students, over 100 graduate diploma students, 110 master's students and nine PhD students have graduated from the programs offered by the Faculty of Energy Systems and Nuclear Science since 2007. A close interface with industry members, the CSA Group and the CNSC is used to formulate advice on the curriculum and make available thesis and research topics at the university. Ontario Tech University is strongly committed to promoting educational and career opportunities for women in science and engineering. The nuclear programs focus on reactor kinetics, reactor design, plant design and simulation, radiation detection and measurement, radiation biophysics and dosimetry, radiation protection, environmental radioactivity, nuclear security, production and utilization of radioisotopes, waste management, fuel cycle, radiation chemistry and material analysis with radiation techniques.

The [University Network of Excellence in Nuclear Engineering](#) (UNENE) is an alliance of 12 Canadian universities, several nuclear industry organizations in Ontario, including the Ontario NPP operators and CNSC. UNENE was created to provide a sustainable supply of qualified nuclear engineers and scientists to meet the current and future needs of the Canadian nuclear industry through university-based graduate courses and training courses. UNENE Head Office is located at McMaster University, but the main universities that provide graduate level courses include Ontario Tech University, Western University, Queens' University, and University of Waterloo. Through UNENE, nuclear professorships in participating universities have been sustained. The above-mentioned five universities currently offer a common graduate-course-based master of engineering (M.Eng.) program aimed at professionals already working in the nuclear industry. In the past 15 years since UNENE creation, 116 students have graduated from the UNENE M.Eng. program. Currently, there are 22 active students in the program. A new, shorter diploma program was introduced by UNENE in April 2015 to enable young industry professionals to acquire focused knowledge in selected areas of expertise. UNENE also supports M.Sc. and Ph.D. research.

[CANTEACH](#) is a web-based knowledge repository that provides high-quality technical documentation relating to the CANDU nuclear energy system. The CANTEACH program was established by AECL, OPG, COG, Bruce Power, McMaster University, l'École Polytechnique de Montréal and the Canadian Nuclear Society. Its aim is to develop and maintain a comprehensive set of web-accessible documents for use in various aspects of education, training, design and operation. The CANTEACH program continues to accumulate information contributed by the Canadian nuclear industry, universities and the CNSC.

UNENE has published a peer-reviewed CANDU textbook "The Essential CANDU" for senior undergraduate and graduate students, educators, trainers and working professionals. It consists of two volumes and was updated in April 2017. It enables those new to CANDU technology to learn about the overall system and pursue specialized topics in depth. As such, it prepares undergraduates for a career in the nuclear industry, facilitates the technical training of new employees, and supports knowledge enhancement of experienced employees. It also supports university level nuclear education curricula. It is available on the UNENE website and is intended to be a living document.

Knowledge-retention programs

Knowledge management and retention continue to be important focus areas for the NPP licensees. Various knowledge management and mitigations plans exist for critical and

“at-risk” roles due to the departure of a significant portion of the nuclear industry’s knowledge workers.

Some of the initiatives implemented by NPP licensees in Canada to mitigate knowledge retention risks include:

- knowledge repositories that use common documentation
- a high-potential development program for emerging leaders and middle managers that accelerates the development of high-potential employees for future leadership roles
- integrated development plans with succession plans that identify ready and ready-now candidates for future leadership roles and incorporates mentoring and knowledge transfer plans for these roles
- a recruitment and resourcing strategy to achieve a mix of new graduates, experienced hires, on-the-job developmental opportunities and rotations, and contract staff
- partnerships with selected external service providers to provide a new means of implementing projects
- ongoing mentoring and coaching of employees
- on-the-job and classroom-based training communities for sharing best practices and discussing solutions to common issues and challenges
- centres of excellence, which establish a critical mass of expertise and a consistent enterprise-wide approach in key areas important to the business

For example, OPG uses both internal and external approaches to knowledge management. The internal approach uses internal tools and resources to assess the risk of knowledge loss by determining a total attrition factor that includes a rating based on the estimated time until retirement (or departure) and the position criticality. This information is then utilized in developing an approach to manage the key issues. The external approach involves engaging a vendor to capture knowledge through specialized knowledge mapping software. Both approaches are integrated into OPG’s succession-planning cycle when critical and “at-risk” roles are reviewed and identified, with specific focus placed on critical positions where knowledge loss is the greatest threat.

OPG managers periodically review knowledge-retention plans to assess the overall criticality of the roles and the availability of knowledge to the organization.

As another example, NB Power continues to implement a knowledge management initiative. Critical skills have been identified using a document and metric that includes a position risk factor and retirement departure factor broken into positions that require several years of experience to develop the necessary knowledge, specialists with unique or crucial technical expertise and/or a licence-mandated leadership role. For those positions deemed critical, knowledge transfer tool kits were circulated to directors and managers for completion by those in critical roles supported by their leadership. The tool kits identify and capture knowledge in the areas of process/technical knowledge as well as informal working knowledge.

To support the knowledge management and retention initiatives of Canadian NPPs, AtkinsRéalis provides the following engineering support services:

- attachment of AtkinsRéalis staff to Canadian NPPs and international divisions of AtkinsRéalis
- provision of training programs (see subsection 11.2(a))

AtkinsRéalis monitors critical skills to ensure that knowledge is maintained in the various disciplines required to safely design, modify and service new and existing reactors. In addition, knowledge management is supported by succession planning (including individual development plans) and the training program.

Maintaining R&D capability

On a semi-regular basis, COG produces a report on the R&D capability of the Canadian nuclear industry. This report examines and documents Canadian R&D capability in order to ensure adequate financial resources for R&D, with the view of supporting continued safe and reliable operation of NPPs. The last assessment in 2023 of the different R&D programs provided evidence that the current plans and funding for the regular COG R&D program and the new Strategic R&D program, supplemented by joint projects for high-priority issues, were adequate to maintain the R&D capabilities in the CANDU industry. While the older experimental facilities at Canadian Nuclear Laboratories are facing the possibility of decommissioning due to underutilization, the Chalk River site is being rejuvenated and continues to meet the foreseeable R&D requirements of the CANDU community.

Canada recognizes that it is important to retain adequate core R&D capability, preserve expert knowledge and train future experts. There has been some focus on funding of nuclear power R&D, and the Canadian nuclear industry prioritizes R&D programs to ensure that they sustain the core R&D elements of people and facilities.

The CNSC monitors both the capability of the Canadian nuclear industry to sustain R&D and the results of the R&D programs themselves.

Annex D describes the R&D programs for Canadian NPPs during the reporting period.

Summary of Significant Changes Since Previous Report

NPP licensees are transitioning from traditional training approaches to more responsive approaches that are continuous, self-paced, collaborative, and more experiential. The licensees are optimizing mentoring, leveraging technology and learning systems, employing dynamic learning activities, and making greater use of simulators.

Notable Achievement(s)

Industry organizations have developed and maintained effective processes and methods to attract and develop technical staff and leaders and retain critical knowledge. They have also enhanced their proactive, comprehensive, and collaborative efforts related to workforce planning.

CNA engaged widely and assessed the future workforce needs of Canada's nuclear sector in a thorough and adaptive manner, while identifying related strategies and recommendations.

Future Focus

CNA plans to monitor the response to the recommendations stemming from its workforce assessment, use of the workforce models, and the evolution of the workforce and activities in the nuclear energy sector in order to facilitate implementation of the strategies where reasonable.

Article 12: Human factors

Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

Summary Statement for Article

Canada fulfills the obligations of article 12.

Introduction and applicable requirements

“Human factors” are the factors that influence human performance as it relates to the safety of a nuclear facility or activities over all phases, including design, construction, commissioning, operation, maintenance and decommissioning. These factors include characteristics of the humans, technology and organization. Some examples are organizational and management structures, policies and programs, allocation of functions to humans and technology, design of user interfaces, staffing provisions, work schedules, design of procedures, training, and the physical work environment. The application of human factors knowledge and methodologies across the human, technology and organizational aspects of work systems can help to prevent errors and prevent problems from escalating at all levels of the business.

“Human Performance” consists of the human activities carried out in a work setting and the results of these activities. In December 2023, the CNSC published regulatory document [REGDOC-2.2.1 Human Performance \(Version 2\)](#), which superseded [REGDOC-2.2.1 Human Factors](#) (March 2019). This new REGDOC clarifies requirements and provides guidance and context for achieving safe and effective human performance. The CNSC considers human factors and human performance during its licensing, compliance and standards-development activities.

During licensing, the CNSC evaluates the extent to which the applicant has considered human factors and applied that knowledge in its proposed programs. The CNSC has issued several other regulatory documents and guides to assist licensees and licence applicants in the planning and implementation of human factors activities. Human factors is a cross-cutting domain, so considerations of human factors are also included in additional regulatory documents relevant to other CNSC SCAs and systems. In addition, a number of CNSC regulatory documents include specific requirements for the consideration of human factors during new-build projects. Human factors are also considered in a number of CSA Group nuclear standards. In the next reporting period, CNSC staff will continue to develop and improve the regulatory framework in support of human factors, including initiatives to further define expectations for human factors in design.

The CNSC subdivides its assessment of human factors into technical review areas. The sub-article/subsection number in table 7 indicates where the factor is described in this report.

Table 7: Location of technical review area topics

Technical review area	Sub-article/subsection
Reporting and trending	7.2(iii)(b), 19(vii)
Safety culture	10(b)
Minimum staff complement	11.2(a)
Human performance program	12(a)
Fitness for duty	12(b)
Procedures	12(c)
Human actions in safety analysis	12(d)
Human factors engineering	12(e)
Organizational performance	12(f)
Work organization and job design	12(g)
Accident management and recovery	19(iv)

12 (a) Human Performance Programs

The update of [REGDOC-2.2.1, Human Performance \(Version 2\)](#) advocates an overarching view and systemic coordination of the factors that influence human performance, to support workers and teams. This integrated consideration of human performance adopts a systemic approach to establish, understand and make explicit the relationships between the humans, technology and organization involved in the licensed activity. This organizational learning aims to understand the work in terms of successes and problems to continually develop more resilient ways of working. Four requirements relate to documenting the strategy and practices for managing human performance, implementing a systemic approach for managing human performance, identifying responsibilities for human performance and developing and sustaining continual improvement. CNSC requested the NPP licensees to submit their implementation plans for REGDOC-2.2.1 Version 2 in September 2025.

The human performance program provides a human-centric view of the work activities to understand the work and its context to be able to learn and continually improve. An effective human performance program integrates the full range of human factors considerations – not just the people but also the technology and organization in which they work – to ensure that people are fully supported and to strengthen the ways that desired outcomes can be achieved and sustained. For example, the desired human performance is supported by hardware and software design that considers the users, high-quality procedures, good procedural adherence, effective work organization and careful job design. It is also necessary to ensure workers are fit for duty and are supported by appropriate organizational mechanisms, continual monitoring and an organizational commitment to improvement. (These provisions are discussed in subsequent subsections.)

The requirement for a licensee to have a human performance program is a licence condition in NPP operating licences. An NPP licensee's human performance program should be developed, reviewed for effectiveness and updated continually and at all phases of the NPP lifecycle, from design through to decommissioning. All Canadian NPPs have implemented human performance programs that emphasize detection and correction of human errors as well as managing defences against human error and supporting workers to achieve the

desired safety performance. The CNSC recognizes the benefits when licensees encourage employees to get more involved in devising methods to improve the quality, reliability and safety of their work, as well as when they more fully understand their role in nuclear safety. Licensees' improvement programs encourage assessment of internal and external events and OPEX as opportunities to address problems before errors occur. All licensees conduct detailed reviews of operational conditions, activities, incidents and events (e.g., review of station condition records), as well as apparent-cause evaluation or root-cause analyses to facilitate the detection and correction of human performance and other issues related to human factors. Licensees have developed coding schemes to effectively identify and track the causes of adverse conditions (see sub-article 19(vii)).

In this learning environment, licensees strive to operate in a blame-free environment, this approach increases the willingness of staff to identify errors in their work.

The mechanisms by which NPP licensees assign responsibilities and accountabilities for human performance are described in annex 12(a).

CNSC staff's review of human performance programs assesses the licensee's ability to create, integrate and implement defences that prevent or mitigate the consequences of human error in work activities, and learn from successful daily work activities to support its workers to achieve the desired human performance. This includes a review of programs for performance monitoring that detect latent organizational conditions and weaknesses, the consideration of human and organizational factors in organizational processes, strategies for improvement and the licensee's overall commitment to fostering a healthy safety culture.

The CNSC staff's review of performance monitoring and improvement focuses on ensuring that there is a systematic, objective and comprehensive process for monitoring and improving safety. The CNSC staff's reviews of NPP events ensure that corrective action plans are systematically developed, comprehensive and effective for addressing the causes of an event.

12 (b) Fitness for duty

Fitness for duty is a broad topic that touches on occupational medicine, physical and psychological fitness, and the management of fatigue and alcohol and drug use. Fitness for duty is defined as a condition in which workers are physically, physiologically and psychologically capable of competently and safely performing their tasks.

The CNSC has several regulatory documents that address various aspects of fitness for duty. CNSC regulatory document [REGDOC-2.2.3, *Personnel Certification, Volume III, Certification of Reactor Facility Workers, Version 2*](#), requires licensees to have a documented fitness-for-duty program for certified workers. More detailed requirements are contained in the following three related regulatory documents.

CNSC regulatory document [REGDOC-2.2.4, *Fitness for Duty: Managing Worker Fatigue*](#) includes a comprehensive suite of expectations for managing worker fatigue at high-security sites, including NPPs. These measures are intended to reduce high levels of fatigue and fatigue-related errors. Fatigue management provisions apply to all workers who could pose a risk to nuclear safety or security. Prescriptive limits on hours of work apply to a smaller subset of workers in safety-sensitive positions. The prescriptive limits focus on the highest risk aspects of shiftwork – extended shifts and night work.

CNSC regulatory document [REGDOC-2.2.4, *Fitness for Duty, Volume II: Managing Alcohol and Drug Use, Version 2*](#) applies to all workers holding safety-critical or safety-sensitive positions at high-security sites and includes the full breadth of requirements, including drug and alcohol testing, needed to provide reasonable assurance that these workers are free from the influence of alcohol and drugs while at work. As part of the process to ensure workers possess the capacity to perform their jobs safely and competently, licensees are required to implement alcohol and drug testing across a broad range of testing circumstances including random testing. Random and pre-placement testing is limited to workers in safety-critical positions such as control room operators. In January 2021, the CNSC published Version 3 of Volume II of REGDOC-2.2.4, which expanded the approved drug testing methods, and their associated cut-offs, to include oral fluid testing and point-of-collection testing. Other changes in response to the legalization of the recreational use of cannabis in Canada were also included.

In July 2021, Canadian NPPs initiated, using a phased approach, the implementation of most of the provisions of [REGDOC-2.2.4, *Fitness for Duty, Volume II Version 3*](#). These requirements included mandatory alcohol and drug testing of safety-sensitive and safety-critical positions for-cause under reasonable grounds, as well as for post-incident situations and as part of return-to-duty or follow-up testing for those identified with a substance-use disorder. Mandatory random drug and alcohol testing requirements for nuclear workers were to come into effect in January 2022.

Prior to the implementation of random drug and alcohol testing, the unions that represent the affected workers submitted a joint petition to the Federal Court of Canada to suspend certain requirements. In January 2022, the Federal Court granted an injunction allowing the labour unions' application to put on hold the implementation of pre-placement (that is, testing a worker before hiring them and/or upon transferring them to a safety-critical position) and random alcohol and drug testing of workers in safety-critical positions at high-security facilities.

In June 2023, the Federal Court released its decision dismissing the judicial review and siding with the CNSC. The court's judgement stated that pre-placement and random testing provisions were reasonable and do not infringe on the [Charter of Rights and Freedoms](#). The unions appealed the ruling to the Federal Court of Appeal. In November 2024, the Federal Court of Appeal upheld the Federal Court ruling and confirmed that the Commission's decision to adopt these requirements was reasonable, within its authority, and did not breach Charter rights. The unions then applied for leave to the Supreme Court of Canada. After the end of the reporting period (May 2025), the Supreme Court dismissed the unions' application for leave.

Now that the legal matter is settled, Canadian NPPs will be required to implement random and pre-placement alcohol and drug testing for safety-critical positions.

Supervisors are also trained to monitor workers as they arrive on the job for signs of impairment as well as physical or emotional fatigue. Licensees' regular health screening programs include the opportunity for assessment from a mental health perspective if and as required. Additionally, there are support programs for employees who voluntarily disclose drug or alcohol issues.

In addition to the requirements for fitness for duty noted above, CNSC regulatory document [REGDOC-2.2.4, *Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical and*](#)

[Psychological Fitness](#) sets out the fitness-for-duty requirements specific to nuclear security officers including the requirement to obtain medical, physical and psychological certificates. The physical fitness test that officers are required to undertake is also included.

12 (c) Procedures

NPP licensees have processes for developing, validating, maintaining and modifying technical procedures used for testing, maintenance and operations (both normal and abnormal). In addition, most licensees have a writers' guide that addresses relevant human factors considerations for written procedures.

CNSC staff's review of procedures focuses on ensuring there is an adequate process for the development, validation, implementation, modification and use of procedures that account for human performance. CNSC staff also focus on ensuring that the process is implemented effectively and that there are demonstrated mechanisms for managing procedural adherence.

12 (d) Human actions in safety analysis

Human actions are considered in probabilistic and deterministic safety analyses to examine the possible contribution of human error and human reliability to hazards and risks.

Human reliability analysis is an integral component of probabilistic safety assessment (PSA) in situations where humans are involved in system performance. (More information on PSA is provided in subsection 14(i)(d).) It is a method for estimating the probability that a system-required human action, task or job that is necessary for safety will not be completed successfully within the required time period. It can also consider the probability that extraneous tasks or actions detrimental to system reliability or availability will be performed. Other safety analyses that consider human actions include hazard and operability studies, failure modes, effects analyses, and hazard analyses.

Licensees use industry-accepted human reliability assessment methods within their PSAs to incorporate the probability of human errors in their fault tree system models and event tree sequence models. While the CNSC does not require its licensees to use any particular method for human reliability analysis, it verifies that the method chosen meets industry good practices and is carried out in a systematic way. One commonly used method is the technique for human error rate prediction.

CNSC staff's review of human actions focuses on the execution of tasks performed under emergency operating procedures, both in the control room and in the field. The review assesses the timing, context and criticality of these actions, as well as the associated performance shaping factors that may influence human reliability.

12 (e) Human factors in engineering

The consideration of human factors engineering (HFE, but also referred to as human factors in design) applies to the entire system design of new facilities and to the modification and decommissioning of existing facilities and extends beyond nuclear systems of NPPs (e.g., balance of plant, fuel handling, engineered tooling, waste management systems, offsite emergency centre and emergency equipment). HFE is concerned with ensuring that the design modification or decommissioning of facilities, systems and equipment integrates information about human characteristics, performance and limitations so as to ensure safe

and reliable task and system performance and to minimize the potential for human error. The concept considers the cognitive, physical and sensory characteristics of people who operate, maintain or support the system, ensuring that the system and equipment are designed to support human performance.

HFE effort increases with higher levels of interface complexity or criticality; greater HFE effort is typically required for reactor operator tasks.

The NPP licensees have implemented several documents with HFE requirements. CNSC regulatory document [REGDOC-2.5.2, *Physical Design – Design of Reactor Facilities*](#), includes requirements for addressing human factors in the design of new NPPs (see sub-article 18 (iii) for details). In addition, CNSC regulatory document [REGDOC-2.6.2, *Maintenance Programs for Nuclear Power Plants*](#) and CSA Group standard N290.12-14, *Human factors in design for nuclear power plants* include requirements for addressing human factors in maintenance and design, respectively.

A description of how the Canadian nuclear industry considers human factors through its application of HFE is provided in annex 12(e).

As part of a PSR, licensees must determine the extent to which the current NPP and its performance conform to modern standards and practices and identify any gaps between those standards and actual performance (see subsection 14(i)(b) for details). The CNSC expects that modern HFE principles and standards as well as other best practices will be consulted when considering NPP modifications. CNSC staff continue to work with licensees conducting PSRs to ensure the reviews against modern standards address expectations related to human factors that could limit safe long-term operation. In addition, modifications in response to the Fukushima accident (described in previous Canadian reports) have included HFE considerations.

CNSC staff's review of HFE ensures that there is a systematic process for effectively incorporating human factors considerations into system requirements, definition, analysis, design, verification and validation activities, as well as monitoring engineering design changes following implementation. CNSC staff also focus on ensuring that the process of incorporating HFE is implemented effectively by suitably trained, qualified and competent human-factors specialists.

12 (f) Organizational performance

CNSC staff review the licensees' management processes related to organizational performance (e.g., business planning, the establishment of the organization, change management of roles and responsibilities, communications, and resourcing) and consider the influence of such processes on safety performance at Canadian nuclear facilities. For example, safety performance at NPPs can be influenced by the ways in which organizational changes are made and communicated, how contractors are managed, how the organization conveys its vision and mission, and how responsibilities are assigned within the organization — from the senior management team to the field where the work is carried out.

The CNSC's review of licensees' organizational processes and performance is described further in subsection 10(d).

12 (g) Work organization and job design

Work organization and job design relate to the organization and provision of a sufficient number of qualified staff and the organization and allocation of work assigned to staff to ensure that work-related goals are achieved in a safe manner. They include, but may not be limited to, staffing levels and MSC, which are discussed in more detail in subsection 11.2(a).

Summary of Significant Changes since Previous Report

Canada's court system upheld the legality of Version 3 of [REGDOC-2.2.4, *Fitness for Duty, Volume II: Managing Alcohol and Drug Use*](#). Specifically, the Federal Court (later confirmed by the Federal Court of Appeal) stated that its provisions for pre-placement and random testing for alcohol and drug use were reasonable.

CNSC published [REGDOC-2.2.1, *Human Performance \(Version 2\)*](#), providing updated guidance and requirements to strengthen systemic human performance programs across the nuclear sector.

Future Focus

NPP licensees will work to implement random and pre-placement alcohol and drug testing for safety-critical positions.

Licensees, licence applicants, design organizations and vendor/contractors will continue to incorporate HFE into nuclear design projects, including those related to new-build and refurbishment.

Article 13: Quality assurance

Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

Summary Statement for Article

Canada fulfills the obligations of article 13.

13 (a) General management system requirements

Safe and reliable operation requires a commitment and adherence to a set of management system principles and, consistent with those principles, the establishment and implementation of a planned and systematic pattern of actions that achieve the expected results.

The [Class I Nuclear Facilities Regulations](#) require each licence applicant to propose its management system for the following licensed activities:

- site preparation
- construction
- operation
- decommissioning

The CSA Group standard, N286-12, *Management system requirements for nuclear facilities*, is the management system expectation for all new licence applications and licence renewals for NPPs. CSA N286-12 promotes the integration of management systems and requires that safety be the paramount consideration guiding decisions and actions. It follows and builds on the model provided in the IAEA general safety requirements document [GSR Part 2, Leadership and Management for Safety](#). N286-12 applies to the top management with overall accountability for the facility, throughout its lifecycle including design, supply chain, construction, commissioning, operation and decommissioning and integrates the management system requirements for health, safety, environment, security, economics and quality. Management systems based on CSA N286-12 include processes to define, plan and control the licensed activities by identifying relevant requirements to be met; establishing objectives that achieve the requirements; identifying and controlling risks; establishing plans, measures and targets; monitoring that results are achieved; and taking appropriate corrective measures if they are not. As part of the management system, these processes are subject to regular monitoring and reporting to assess effectiveness and identify opportunities for improvement.

CSA N286-12 stipulates the following:

- The management system is used to develop understanding and promote a safety culture.
- Requirements are identified, risks to objectives are identified and controlled, and results are monitored to ensure planned results are achieved.
- The organizational structure, authorities, accountabilities, responsibilities, and decision-making process are defined.

- Resources required to carry out the business plan with a focus on competent human resources, and the means to achieve this requirement, are identified.
- Processes exist to ensure effective communications and to make workers aware of the relevance and significance of their work.
- The management system is documented, information is provided to those who need it in a timely manner, and document control and records are managed.
- Work is planned, controlled and independently verified, including when conducted by third parties (i.e., contractors).
- Problems are identified, evaluated, documented, and resolved, and the effectiveness of the resolution confirmed.
- Required changes are identified, justified, reviewed, approved, implemented and assessed.
- Self-assessments and independent assessments are conducted.
- Experience gained within the industry and from other industries is reviewed for relevance and used to initiate improvement.
- Management continually improves the management system and periodically assesses its effectiveness to achieve planned results.

The CNSC expects licensees' management systems and performance to demonstrate adherence to these principles through the implementation of processes aligned with the generic requirements that apply to all their licensed activities.

During the previous reporting period the CSA Group published CSA N286.0.1:21, *Commentary on N286-12, Management system requirements for nuclear facilities*. It aids users that have a management system aligned with CSA N286-12 or plan to implement a management system per the requirements of CSA N286-12. It provides background information on certain clauses and requirements, based on experience collected since the standard was published.

In addition, CNSC regulatory document [REGDOC-2.1.1, Management System](#) provides licensees and applicants with information on the CNSC SCA Management system, along with supplemental information on various current issues related to management systems. This includes information related to CSA N286-12, and supporting information on:

- management systems that are applicable to different types of CNSC licensees
- specific topics that have been the subject of recent developments in management system standards, as well as those of recent regulatory interest with respect to management systems:
 - leadership, safety culture, supply chain (including counterfeit, fraudulent and suspect items (CFSIs) and contractor management), configuration management and software quality assurance
- radiation safety oversight related to nuclear substances, radiation devices and Class II nuclear facilities

Increasingly, the nuclear supply chain has become more global and interconnected. While this has the potential to bring about efficiencies, it also means the supply chain is open to new risks, as it becomes vulnerable to malicious actors who wish to disrupt and manipulate it. This could be through the insertion of counterfeit, fraudulent and suspect items, with potentially catastrophic effects.

New and emerging technologies, such as AI, may provide industry, regulators, and governments with new tools to detect and thwart supply chain attacks. However, AI may also enable malicious actors to identify supply chain vulnerabilities and take actions to disrupt it. The CNSC, through its DIET program has been working with the Vienna Centre for

Disarmament and Non-Proliferation as well as other bodies on issues around AI and the nuclear supply chain to explore and identify potential means to mitigate such risk.

13 (b) Requirements for contractors and suppliers

The management system described in CSA N286-12 also applies to supplier(s) contracted by NPP licensees to perform the life-cycle activities of design, supply chain, construction, commissioning, operation, and decommissioning of the nuclear facility. Notably, it applies equally to engineering procurement and construction providers for refurbishment and new build projects and to other providers for routine operations at existing NPPs. However, the top management of the licensee of the nuclear facility remains accountable to ensure the requirements of the standard are met.

Sub-article 19(v) includes additional information on the necessary capabilities of licensee's technical staff in the context of supply chain management.

NPP licensees maintain effective supply chain management and procurement quality assurance programs that discover and mitigate the intrusion of CFSIs into their operations. Sub-article 19(vii) describes how the licensees disseminate and act upon information related to CFSIs. To further improve the effectiveness of their programs, the licensees implemented a variety of enhancements to increase surveillance of suppliers and sub-suppliers quality programs and to enhance awareness and training of supply chain staff with respect to CFSIs. Requiring suppliers to follow the CSA Group standard N299, *Quality assurance program requirements for the supply of items and services for nuclear power plants* strengthens the licensee programs in this area. CSA N299 is an update to the former Z299 series of standards into which requirements for measures to address CFSIs have been introduced. As an example, AtkinsRéalis has implemented CSA N299 as part of its overall corporate quality assurance program.

As an example of contractor oversight, during the reporting period, NB Power undertook a significant replacement program for large motors (primary heat transport, moderator, emergency core cooling, and shutdown cooling). NB Power instituted direct oversight through both the procurement and engineering processes of the suppliers' and manufacturers' quality assurance programs to ensure that the highest quality standards of workmanship and technical specifications were met and maintained. This oversight was also expanded to the manufacturing, assembly and testing of new main generator stator bars (to be installed in the next reporting period).

As another example, OPG is overseeing work by General Electric-Hitachi (GEH) related to the construction of the BWRX reactor at the DNNP. The goal of engineering oversight is to provide the necessary review and support to all non-owner parties, enabling them to provide assurance that the new nuclear facility is built to cost and can operate safely and reliably for its expected design life while meeting all health, safety, environmental, security, economic, regulatory, and quality requirements. Per OPG's oversight plan, the DNNP Owners Engineering groups focus on the design, procurement and construction phases of the project. OPG is accountable to provide project management and oversight of the project scope to ensure that all non-owner parties engaged in engineering, procurement, and construction deliver the products and services with acceptable quality and appropriate project controls. GEH shares its quality assurance program with OPG to facilitate the oversight.



Summary of Significant Changes Since Previous Report

During the reporting period, OPG and GEH established formal arrangements for engineering oversight to assure that engineering, procurement, and construction activities for DNNP meet applicable safety-related and other requirements.

Notable Achievement(s)

NPP licensees and other parts of the nuclear supply chain have strengthened supply chain oversight and contractor management, including enhanced surveillance and training of contractors.

Article 14:

Assessment and verification of safety

Each Contracting Party shall take the appropriate steps to ensure that:

- (i) comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;*
- (ii) verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.*

Summary Statement for Article

Canada fulfills the obligations of article 14.

14 (i) Assessment of Safety

The CNSC and NPP licensees conduct or arrange various comprehensive safety assessments, including assessment of licence applications, periodic safety review (PSR), deterministic safety analysis, probabilistic safety assessment (PSA), third party assessments, and assessments of CANDU safety issues.

14 (i) (a) Assessment of licence applications

CNSC staff perform detailed assessments of safety in relation to NPP licence applications. Sub-article 7.2(ii) describes the general CNSC licensing process for both new-build projects and currently operating NPPs and provides specific information related to CNSC licences to prepare the site for, construct and operate an NPP. The CNSC's assessment of safety for a licence application is conducted against the application requirements set out in the [General Nuclear Safety and Control Regulations](#), the [Class I Nuclear Facilities Regulations](#), and other relevant regulations. The CNSC has also published licence application guides for NPPs to supplement the regulations. They are written in the context of the 14 CNSC SCAs as well as the other matters of regulatory interest described in annex E.

For an application to renew a licence, CNSC staff review the applicant's performance under each of the SCAs. CNSC staff also review the applicant's operational plans and proposals for work to maintain and improve safety during the next licence period. For operating NPPs, this includes reviews of the PSR and integrated implementation plan (IIP) of improvements that the applicant has undertaken in support of the renewal application process.

CNSC staff use assessment plans, along with staff work instructions and comprehensive sets of technical assessment criteria to aid their assessments. The results of the assessment are presented to the Commission in support of CNSC staff's licensing recommendations during licensing hearings for NPPs. The results impact the content of the draft licence and LCH that CNSC staff present to the Commission for its consideration. See sub-article 7.2(ii) for more information on the overall approach to licensing and details for licensing during the lifecycle phases of NPPs, which apply to both new-build projects and existing NPPs.

During the reporting period, OPG applied for a licence to construct a BWRX-300 reactor at the DNNP site. Using a risk-informed approach, CNSC staff reviewed the application using the NSCA and its associated regulations, while also leveraging modern codes, standards, and guidance (both domestic and international) to support its review. CNSC staff concluded that OPG's application for a licence to construct satisfactorily addressed all 12 applicable SCAs and that OPG was qualified to carry on the activities authorized by the licence to construct) and would make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed. At the end of the reporting period, after reviewing the application and CNSC staff's recommendations, the Commission granted OPG a licence to construct for a 10-year period.

During the previous reporting period, NB Power applied for a renewal of its licence to operate Point Lepreau, for a period of 25 years. As this was the first application for this length of licensing period for an NPP (significantly greater than 10 years), CNSC staff benchmarked with international regulators that regularly licence for long-term operations. CNSC staff also engaged in substantial Indigenous and public outreach prior to the licence renewal hearing, attending NB Power's Community Liaison Committee meeting, discussing the renewal application at regularly-held Indigenous engagement meetings, hosting two webinars and attending NB Power open houses where they presented information on the application.

CNSC staff assessed all of the SCAs as satisfactory, as well as other matters of regulatory interest (e.g., Indigenous consultation, financial guarantees). They noted that NB Power maintained adequate provisions to protect the public and workers throughout the current licensing period. CNSC staff noted that NB Power's PSR did not identify any major gaps between the current state of the NPP and modern requirements and confirmed that its IIP identified corrective actions and completion dates for closing the identified gaps, noting that the committed safety improvements would maintain Point Lepreau in a state comparable to that of a new NPP. CNSC staff also confirmed that NB Power's preliminary decommissioning plan met the regulatory requirements and that the associated financial guarantee made adequate funds available to cover the decommissioning costs outlined in the plan.

CNSC staff concluded that NB Power remained qualified to carry on the activity (NPP operation) and would continue to make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed. The results of the assessment were presented to the Commission during Part 1 of the licensing hearing (previous reporting period); Part 2 of the hearing took place in May 2022. The Commission subsequently decided to renew the Point Lepreau operating licence for a period of 10 years. The rationale for this decision was largely based around the necessity for Indigenous Nations and communities to be able to intervene during Commission hearings (as opposed to Commission meetings, where decisions are not being made).

During the reporting period, OPG applied for a renewal of its licence to operate the Darlington Nuclear Generating Station for a period of 30 years. CNSC staff assessed as satisfactory all the SCAs, as well as other matters of regulatory interest (e.g., Indigenous consultation, financial guarantees). They noted that OPG maintained adequate provisions to protect the public and workers throughout the current licensing period. CNSC staff noted that OPG's PSR did not identify any major gaps between the current state of the NPP and modern requirements and confirmed that its IIP identified corrective actions and completion

dates for closing the identified gaps, noting that the committed safety improvements would maintain the Darlington NGS in a state comparable to that of a new NPP. CNSC staff also confirmed that OPG's preliminary decommissioning plan met the regulatory requirements and that the associated financial guarantee made adequate funds available to cover the decommissioning costs outlined in the plan.

CNSC staff concluded that OPG remained qualified to carry on the activity (NPP operation) and would continue to make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed. The results of the assessment were presented to the Commission during Part 1 of the licensing hearing for the renewal (March 24, 2025), where CNSC staff recommended a licence period of 30 years; Part 2 of the hearing was scheduled to take place June 24-26, 2025.

14 (i) (b) Periodic safety review

Per CNSC regulatory document [REGDOC-2.3.3, *Periodic Safety Reviews*](#), the documentation to be submitted to the CNSC for a PSR includes:

- PSR basis document
- reports on the review of each safety factor (safety factor reports)
- global assessment report
- IIP

The IIP identifies corrective actions and safety improvements that address all gaps found in the PSR. REGDOC-2.3.3 requires the licensee to obtain CNSC staff acceptance for both the PSR basis document and the IIP. Additional direction on PSR is provided in CSA Group standard N290.18-17, *Periodic safety review for nuclear power plants*; it is cited as a guidance document in the LCHs of operating NPPs.

The following subsections describe the developments during the reporting period for PSRs applicable to each of the operating NPPs.

Bruce

Bruce Power conducted a PSR in support of the 2017 application for renewal of the licence to operate Bruce A and B for a period of 10 years. This period includes the major component replacement (MCR) outages.

Bruce Power submitted the combined IIP for Bruce A and B (the designs are similar and they share common programs) in 2016. The IIP was approved through the licence renewal process in 2018. The operating licence includes a condition that requires Bruce Power to implement the IIP. The CNSC reviews Bruce Powers IIP reports annually to confirm that Bruce Power is making progress on all IIP items. As of December 2024, Bruce Power had completed 78 of 191 IIP items. At the end of the reporting period, CNSC staff were reviewing the 2024 IIP annual report.

In December 2024, CNSC staff approved the PSR basis document for the 2027 Bruce Power PSR. Bruce Power will work on the safety factor reports in 2025 and 2026, with the global assessment report and IIP scheduled for completion in early 2027 for submission to the CNSC with the next licence renewal application.

Pickering

The most recent comprehensive PSR for Pickering (named PSR2) was completed in support of Pickering commercial life extension to 2024 (part of the 2018-2028 licence). PSR2 was an update building on the review basis of previous integrated safety reviews (ISRs³) and life extension assessments in the OPG fleet. Specifically, it consisted of:

- the Pickering B ISR, performed in support of potential refurbishment and continued operation (for another 30 years) of Pickering Units 5-8
- the ISR for Pickering units 1 and 4 performed in the early 2000s prior to their return to service, in support of approval to restart units 1 and 4
- The Darlington ISR, performed in support of refurbishment and continued operation (the programmatic parts were applicable to Pickering).

The Pickering PSR2 IIP concluded that OPG had effective programs and processes for continued safe operation through 2024 (projected end of commercial operations). It was approved through the licence renewal process in 2018. The operating licence included a condition requiring OPG to implement the IIP. As part of the associated IIP, OPG committed to completing enhancements, which were subsequently accepted by the CNSC. By June 2021, OPG had completed all the committed IIP actions and CNSC staff had accepted them as closed.

Between 2019 and 2023, OPG planned to extend commercial operation of Units 5-8 to the end of 2026, requiring an update to the PSR2 assessment. OPG conducted an incremental review of the PSR2, named PSR2-B, reassessing the time-dependent elements (i.e., the resolution actions from PSR2 that were flagged for commercial operation until the end of 2024). This addendum to the PSR assessed the period of 2024 to 2026 for commercial operation of Units 5-8. The PSR2-B IIP was accepted by the CNSC in July 2023 and approved through the licence renewal process in 2023. The review considered a two-year licensing period for Units 5-8. The current Pickering (2018-2028) operating licence includes a condition that requires OPG to implement the IIP.

By December 2024, the final PSR2-B commitments (the last IIP assignments and resolution actions) were completed and accepted as closed by the CNSC.

In January 2024, the Government of Ontario announced its support for OPG to proceed with the scoping and definition phases of Pickering refurbishment. The planned refurbishment of Pickering Units 5-8 is for an anticipated additional 30 years of operating life. For refurbishment and the next licence period, OPG will produce a comprehensive PSR (named PSR3). The CNSC accepted the PSR3 basis document in May 2024. The PSR3 will be an update that builds upon the previous PSRs and ISRs completed for the OPG fleet. Specifically, it will consist of:

- the previous ISRs listed above
- PSR2 and PSR2-B
- the Darlington PSR (D-PSR, described below), performed in support of the recent licence renewal (10 years of continued operation)

OPG is currently (2025) submitting the 15 safety factor reports to the CNSC. OPG plans to submit the global assessment report to the CNSC in 2026 and the IIP in 2027.

Darlington

OPG had conducted an ISR in support of its application for its current licence to operate Darlington. The IIP was approved through the licence renewal process in 2015. The

operating licence included a condition that required OPG to implement the IIP. The refurbishment work began in October 2016 and will continue into the next reporting period. The current IIP consists of 622 items and as of December 2024, OPG had completed 571 IIP items and were progressing according to the schedule for each IIP item.

The licence to operate Darlington contained a separate condition requiring OPG to conduct its first PSR (D-PSR) in support of its next licence renewal. The D-PSR project for Darlington licence renewal, covering 2025 to 2035, was completed. CNSC accepted the IIP in March 2024.

Point Lepreau

NB Power completed and submitted a PSR, global assessment report and IIP in June 2021 in support of the 2022 application for renewal of the license to operate. The CNSC reviews NB Powers IIP reports annually to ensure that NB Power is progressing all IIP items as committed. As of December 2024, NB Power completed 328 of 346 IIP actions with CNSC staff reviewing and closing 285 IIP actions within this period.

The next PSR is planned for submission to the CNSC in 2031.

14 (i) (c) Deterministic safety analysis

General requirements and approach

Deterministic safety analysis is a rigorous method to demonstrate that safety objectives for postulated accidents at NPPs are met. The set of requirements and siting criteria used to assess the acceptability of currently operating NPPs can be found in subsection 14(i)(c) of the seventh Canadian report. For new-build, CNSC regulatory document [REGDOC-2.5.2, Design of Reactor Facilities](#) stipulates the design requirements, including those typically demonstrated by deterministic safety analysis. The CNSC has revised REGDOC-2.5.2 in the of Version 2.1, which combines the content from the previous version of REGDOC-2.5.2 (Version 2) and CNSC regulatory document RD-367 “*Design of Small Reactor Facilities*”.

Requirements for the submission of deterministic safety analyses are found in the [Class I Nuclear Facilities Regulations](#). Paragraph 5(f) requires an applicant for a construction licence to submit a preliminary safety analysis report. The regulations also specify supporting design information that must be submitted in an application for a licence to construct a Class I nuclear facility (see article 18 for details).

For new-build projects, REGDOC-2.5.2 stipulates that the preliminary safety analysis report shall assist in the establishment of the design-basis requirements for items important to safety and demonstrate whether the NPP design meets applicable requirements.

The [Class I Nuclear Facilities Regulations](#) also stipulate requirements for an application to operate a Class I nuclear facility. Per paragraphs 6(a) and 6(b), an application for a licence to operate shall contain descriptions of the systems, structures and equipment of the facility, including their design and design operating conditions. Paragraph 6(c) further requires the application to contain a final safety analysis report demonstrating the adequacy of the design of the facility. For details on the content of a typical safety analysis report for a currently operating NPP, see annex 14(i)(c) of the ninth Canadian report.

REGDOC-2.5.2 further states that the final safety analysis report shall:

- reflect the as-built NPP

- account for postulated aging effects on structures, systems and components (SSCs) important to safety
- demonstrate that the design can withstand and effectively respond to identified postulated initiating events
- demonstrate the effectiveness of the safety systems and safety support systems
- derive the operational limits and conditions for the plant, including:
 - operational limits and set points important to safety
 - allowable operating configurations, as well as constraints for operational procedures
- establish requirements for emergency response and accident management
- determine post-accident environmental conditions, including radiation fields and worker doses, to confirm that operators are able to carry out the actions credited in the analysis
- demonstrate that the design incorporates sufficient safety margins
- confirm that the dose limits and derived acceptance criteria are met for all anticipated operational occurrences and design-basis accidents
- demonstrate that all safety goals have been met

The licensees use integral mechanistic models in sophisticated computer codes to simulate accident progression and consequences. The tools and methodologies used in licensees' safety analysis reports are supported by national and international experience and are validated against relevant test data and benchmark solutions. The licensees follow CSA Group standard N286.7, *Quality assurance of analytical, scientific and design computer programs for nuclear power plants*, which is part of the licensing basis for all operating NPPs. The NPP licensees have established specific validation programs in accordance with N286.7 for industry standard tool (safety analysis) codes to provide the necessary confidence in the analytical results. During the reporting period, the industry extended the validation of these codes to align with expanded applications. In accordance with CNSC regulatory document [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants](#), the NPP licensees, within five years of the date of the last submission of their NPP description and final safety analysis report (or when requested by the CNSC), must submit an updated NPP description and an updated final safety analysis providing:

- a description of the changes made to the site and the NPP's SSCs, including any changes to the design and design operating conditions of the SSCs
- safety analyses that have been appropriately reviewed and revised and that take into account the most up-to-date and relevant information and methods, including the experience gained and lessons learned from the situations, events, problems or other information reported pursuant to REGDOC-3.1.1

Updates to safety analysis reports for existing NPPs are continuous.

During the reporting period, CNSC staff reviews of the safety analysis reports confirmed that the safety margins for all operating NPPs remained acceptable.

In addition to the analysis of design-basis accidents, licensees perform analyses of design extension conditions accidents (a subset of beyond-design-basis accidents (BDBAs), including severe accidents. In this context, a design extension conditions accident is abdba that is not included in the NPP design basis but for completeness is analyzed using best-estimate methods.

An example of a design extension conditions accident resulting in fuel damage but maintaining intact core geometry is a large-break loss of coolant accident (LBLOCA) coincident with a loss of emergency core cooling where the moderator serves as an ultimate

heat sink. This event was formerly considered as a design-basis accident and its analysis continues to (typically) be included as part of safety reports. Other BDBAs, such as a prolonged station blackout, are analyzed using PSA, which is discussed in subsection 14(i)(d).

If the safety consequences of an event are significant (e.g., severe core and fuel damage and the potential to exceed the regulatory dose limits), it is referred to as a severe accident. NPP licensees are continuing to perform further deterministic analyses for representative severe core damage accidents. Such safety analysis has already been conducted to help decide on the scope of refurbishment activity for NPPs undergoing life extension. The licensees are also evaluating the existing models for BDBA analyses to specifically address multi-unit events.

Furthermore, NPP licensees use deterministic severe accident analyses to:

- develop computational aids, guidelines and procedures
- identify potential strategies for mitigating severe accident consequences
- assess instrumentation and equipment survivability and the habitability of facilities in severe accidents
- train staff and conduct validation exercises

Updating safety analysis requirements and methods

The key document related to safety analysis is CNSC regulatory document [REGDOC-2.4.1, *Deterministic Safety Analysis*](#). Aligned with the IAEA standards on safety analysis, it has modernized and improved operation of Canadian NPPs. REGDOC-2.4.1 identifies high-level regulatory requirements for an NPP licence applicant's preparation and presentation of deterministic safety analysis in the evaluation of event consequences. REGDOC-2.4.1 prescribes a systematic process for event identification and classification of the events into categories based on event frequency. It requires BDBAs to be addressed.

During the reporting period, the NPP licensees continued to revise safety analyses in the context of their planned and structured implementation of REGDOC-2.4.1. For example, OPG completed analyses of events for Darlington that included common cause, loss of flow, and loss of reactor power regulation.

To better coordinate safety report updates across the industry, the NPP licensees have established a safety analysis improvement program through COG; one of its purposes is to facilitate the implementation of REGDOC-2.4.1. Specific areas of focus for the program include assessing the impact of aging on the heat transport system and evaluating the conservatism of, and correcting inconsistencies in, the safety analyses. The activities undertaken as part of the safety analysis improvement program were chosen, in part, to address the CANDU safety issues described in subsection 14(i)(f). The program is being led by Bruce Power.

Each licensee uses PSR to assess the gaps between the requirements of REGDOC-2.4.1 and the existing safety report and prioritize the safety report updates. The safety margins and degree of conservatism in the analyses will continue to be re-assessed in light of OPEX and new knowledge, for example in the area of aging management.

New-build projects are expected to fully comply with REGDOC-2.4.1.

Fire safety assessment

Each NPP has a fire protection assessment (which involves a fire hazard assessment and fire safe shutdown analysis) that is issued and submitted to the CNSC in accordance with CSA Group standard N293-12, *Fire protection for nuclear power plants*, which is part of the licensing basis for all NPPs. Per their commitment to the CNSC, the licensees resolve any recommendations to enhance fire protection or corrective actions, following revisions of the fire protection assessments.

14 (i) (d) Probabilistic safety assessments

A PSA is a comprehensive and integrated assessment of the safety of an NPP that considers the probability, progression and consequences of equipment failures or transient conditions to derive numerical estimates that provide a consistent measure of safety. There are three levels of PSAs:

- Level 1 identifies and quantifies the frequency of sequences of events that may lead to the loss of core structural integrity and massive fuel failures
- Level 2 starts from the Level 1 results and analyzes the containment behaviour, evaluates the radionuclides released from the failed fuel and quantifies the frequency of releases to the environment
- Level 3 starts from the Level 2 results and analyzes the distribution of radionuclides in the environment, evaluating the resulting effect on public health

The main objectives of a PSA are to:

- provide a systematic analysis that gives confidence that the design will comply with the fundamental safety objectives as established in IAEA [No. SF-1, Fundamental Safety Principles](#)
- demonstrate that a balanced design has been achieved
- provide confidence that small changes of conditions that may lead to a catastrophic increase in the severity of consequences (i.e., cliff-edge effects) will be prevented
- assess the quantitative safety goals (the frequency of occurrence for severe core damage states and the risks of major radioactive releases to the environment) as defined in REGDOC-2.5.2, or as established in the licensing basis for the facility
- assess the frequency of occurrence and the consequences of site-specific external hazards
- identify NPP vulnerabilities and systems for which design improvements or modifications to operational procedures could reduce the probabilities of severe accidents or mitigate their consequences
- assess the adequacy of emergency procedures
- provide insights into the severe accident management (SAM) program

Requirements for probabilistic safety assessment

The CNSC revised regulatory document [REGDOC-2.4.2, Probabilistic Safety Assessment \(PSA\) for Reactor Facilities, Version 2](#), in May 2022 to take into account developments related to new nuclear technologies including SMRs. It sets out the requirements for the PSAs of NPPs and other reactor facilities including small reactor facilities and non-power reactors (test and research reactors) using a graded approach. It applies to both construction and operation phases, and for both existing NPPs and new-build projects. One of the key requirements is CNSC acceptance of the methodology and the computer codes used by the licensees for the PSA. Version 2 of REGDOC-2.4.2 refers to the following sources of general guidance on PSA methodology.

- IAEA [Specific Safety Guide SSG-3, Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants](#)
- IAEA [safety series SSG-4, Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants](#)
- CSA Group standard N290.17-17, *Probabilistic Safety Assessment for Nuclear Power Plants*

The PSA update interval in REGDOC-2.4.2 (Version 2) is five years – or sooner if major changes occur in the facility. The updates are subject to regulatory review. During this 5-year period, updates are also made to the external hazard analysis, which takes into account effects of climate change.

CNSC safety goals

The assessments of the probabilities of occurrences for severe core damage states, along with the assessments of the risks of major radioactive releases into the environment, are compared with safety goals. Quantitative safety goals for new NPPs are established in CNSC regulatory document [REGDOC-2.5.2, Design of Reactor Facilities](#). Version 2.1 of REGDOC-2.5.2 includes a revision of the quantitative safety goals for small-release frequency and large-release frequency. They are formulated (see table 8) to be generally applicable to a wider range of possible reactor technologies and are consistent with those in International Nuclear Safety Advisory Group (INSAG) document [INSAG-12, Basic Safety Principles for Nuclear Power Plants](#).

Table 8: Quantitative safety goals

Safety goal	Rationale	Numerical objectives (REGDOC-2.5.2 Version 2.1)
Core damage frequency	Related to severe accident prevention	The sum of frequencies of all event sequences that can lead to significant core degradation shall be less than 10^{-5} per reactor-year.
Small-release frequency	Related to accident mitigation, focusing on the release that would trigger evacuation	The sum of frequencies of all event sequences that can lead to any release to the environment that requires temporary evacuation of the local population or a release to the environment of more than 10^{15} Bq of I-131 shall be less than 10^{-5} per reactor-year.
Large-release frequency	Related to accident mitigation, focusing on release that would trigger	The sum of frequencies of all event sequences that can lead to any release to the environment that requires long-term relocation of the population or a release to the environment of more than 10^{14}

	long-term relocation	Bq of Cesium-137 shall be less than 10^{-6} per reactor-year.

Although there are no explicit requirements for safety goals at the existing NPPs, the CNSC does expect the licensees of operating NPPs to establish safety goals that are aligned with international practices. Consistent with INSAG-12 and/or IAEA SSG-3, the NPP licensees have established and meet, the following safety goals for the existing NPPs:

- severe core damage frequency of less than 10^{-4} per reactor-year
- large-release frequency of less than 10^{-5} per reactor-year

Consistent with international practice, small-release frequency is not included in the safety goals of existing Canadian NPPs.

CNSC staff have prepared a white paper on the quantitative health objective (QHO). The QHO is defined as an incremental increase of less than 0.5% in the lifetime probability of developing a spontaneous cancer in Canada, corresponding to approximately 100 mSv of dose (average dose received acutely and/or chronically over a lifetime). The paper will provide a holistic picture of the CNSC's existing safety goals, concepts, objectives, and principles, and introduce the concept of a new safety objective in the form of a QHO. The QHO is discussed in relation to the potential health risks in the unlikely event of a severe nuclear accident with offsite radiological releases, and may be proposed for consideration and utility within the CNSC regulatory framework.

Development of probabilistic safety assessment and implementation of REGDOC-2.4.2

REGDOC-2.4.2 requires Level 1 and Level 2 PSAs to be conducted for facilities that include all potential, site-specific initiating events and potential hazards; that is:

- internal initiating events and internal hazards
- external hazards, both natural and human-induced, but non-malevolent

Consideration of potential combinations of hazards is also required, and the screening criteria of hazards shall be acceptable to the CNSC. These requirements include consideration of all sources of radioactivity (other than the reactor core such as the spent fuel pool (also called irradiated fuel bay). REGDOC-2.4.2 requires the inclusion of multi-units if applicable. A PSA is required for both the full-power and shutdown states of the NPP, as well as any state where the reactor is expected to operate for extended periods of time.

REGDOC-2.4.2 endorses a graded approach towards risk assessment of NPPs, where the level of analysis, the depth of documentation and the scope of actions necessary to comply with PSA requirements are commensurate with the relative risk and the characteristics of a facility or activity.

NPP licensees have completed Level 1 and Level 2 PSAs that address, among other things, re-evaluation of site-specific external initiating events. These include:

- Level 1 and 2 at-power internal events
- Level 1 and 2 shutdown state internal events
- Level 1 and 2 at-power internal flood events
- Level 1 and 2 at-power fire events
- Level 1 and 2 at-power seismic

- Level 1 and 2 at-power high wind events

In addition to this scope, Point Lepreau conducted a tsunami hazard analysis to assess the hazard from the Atlantic coastline.

All licensees completed full-scope PSAs by 2020 that are in full compliance with REGDOC-2.4.2 requirements. All licensees continue to update their PSAs every five years or sooner if the facility undergoes major changes. See table 9 for the update status.

Table 9: Status of PSAs at each NPP

Facility	Year of most recent PSA
Bruce A and Bruce B	2024
Point Lepreau	2021
Darlington	2020
Pickering	2023 (Pickering A) 2022 (Pickering B)

To address requirements for the irradiated fuel bay PSA, which may be dealt with through alternative methods to PSA (as allowed by REGDOC-2.4.2), guidance has been developed by industry.

Industry has collaborated through COG in the development of a concept-level, whole-site PSA methodology. A comprehensive and first-of-a-kind pilot study for Pickering whole-site risk assessment was completed in December 2017 to evaluate the overall risk, including the multiple reactor units (“multi-unit” risk), other sources of radioactivity on the site (such as irradiated fuel bays), internal and external hazards, and reactor operating modes other than full power and outages states. The results illustrated the site-level risk in terms of core damage frequency and large-release frequency and demonstrated that Pickering met the CNSC’s requirements to prevent unreasonable risk to the environment and to the health and safety of persons. In addition, Bruce Power and OPG (Darlington) submitted aggregate risk values, which demonstrated that safety goals for severe core damage frequency and large-release frequency were maintained. They also demonstrated adherence to the IAEA fundamental safety principle: Protect people and the environment from harmful effects of radiation.

NB Power developed the PSA for Point Lepreau considering all hazards. The assessment of the contributions to risk from the different hazard groups used two approaches. The first approach consisted of a simple summation of separate PSA results where appropriate. The second approach involved a master PSA model that integrated all hazards. Results obtained with the “master model” are lower than the “simple aggregate results” and both approaches demonstrated that safety goals for severe core damage frequency and large-release frequency were met.

Use of probabilistic safety assessment

Licensees are utilizing the results from their PSAs to manage operational and outage risks, as well as in their design-change programs to assist in determination of the best design options. Typical applications, in addition to those listed in the bulleted list of

main objectives at the start of section 14(i)(d), include the use of PSA results in conjunction with deterministic analytical results to refine programs for reliability and maintenance. For example, PSA results are used to support the identification of the systems and components important to safety for the reliability program (see sub-article 19(iii)). Recent developments at NPPs indicate a growing use of PSAs for risk monitoring. All licensees have used the most recent revisions of the PSAs to develop computerized tools (e.g., for equipment out of service) for routine risk-monitoring for both outages and full-power operation. The licensees will continue to use the PSAs to enhance operational risk monitoring programs, optimize testing and maintenance programs and provide input to NPP design changes and decisions on refurbishment and safety improvement. For example, OPG investigated and implemented cost-effective measures to reduce the core damage frequency for existing NPPs as part of the overall operational plan until the end of life for Pickering.

The CNSC utilizes the results of PSAs to evaluate licensee performance, identify safety improvement opportunities, evaluate proposed plant changes or licensing basis changes, and inform compliance verification programs for the NPPs. To that end, CNSC staff completed a risk handbook project to provide introductory PSA training for CNSC regulatory program officers and site inspectors and to summarize each operating NPP licensee's PSA results and important risk insights in a user-friendly, web-based application. The handbooks have interactive dashboards and tables, including search, sorting and filter capabilities. They also enable trending of systems and components important to safety using information from the licensees' annual risk and reliability reports. The handbook assists with CNSC inspection planning by helping inspectors to focus on multi-unit initiating events and/or accident precursors as well as using PSA importance measures to help with identifying systems and components with the highest unavailability significance.

14 (i) (e) Reviews by the World Association of Nuclear Operators (WANO)

The NPP licensees are members of WANO, which aims to help its members achieve the highest levels of operational safety and performance. WANO conducts periodic evaluations to promote excellence in the operation, maintenance and support of operating NPPs, with a focus on safety and reliability. These evaluations are not required by law or regulation but are requested on a voluntary basis by WANO members. WANO reviews have evolved from defined peer review cycles to a 'Continuum model' where licensees are constantly reviewed in all areas through the support of dedicated departmental points of contact and Continuum leads at WANO. Continuum reviews are used to identify areas to improve, which are supported by focused WANO and industry experts. Continuum reviews occur between formal peer reviews, which are utilized to ensure gaps to excellence are identified and appropriate actions are implemented. Additional details of the WANO peer-review process are provided in the sixth Canadian report.

The following WANO peer reviews were conducted in Canada during the reporting period.

Bruce A and B (corporate)	July 2022
Bruce A	October 2023
Bruce B	November 2024
Point Lepreau	September 2022, February 2025 (Continuum Site Visit)

The feedback, insights and learning from the WANO peer-review process are highly valuable. The process drives major improvements and helps to continually raise the standard

of performance and practice across the industry. In support of general improvement, WANO shares good practices identified during reviews with all members.

The following WANO peer reviews are planned in Canada during the next reporting period:

Bruce A and B (corporate)	June 2025
Bruce A	August 2025
Bruce B	November 2026
Darlington	May 2025
Pickering	November 2025
Point Lepreau	September 2026

14 (i) (f) Assessment and resolution of CANDU safety issues

Comprehensive provisions for the assessment and verification of safety for Canadian NPPs have confirmed the ongoing safety of operating NPPs in Canada. These provisions have led to the identification and resolution of safety issues, some of which have been described in previous Canadian reports. Canada has a systematic approach to identify, prioritize and resolve safety issues to optimize the efforts for improving safety.

In 2009, the CNSC and the Canadian industry collaborated on a project to survey and rank generic safety issues related to CANDU NPPs and evaluate strategies for addressing them in a risk-informed manner. The CANDU safety issues (CSIs) were distributed into three broad categories according to the adequacy and effectiveness of the control measures implemented by the licensees to maintain safety margins.

- Category 1 represents issues that have been satisfactorily addressed in Canada.
- Category 2 represents issues that are a concern in Canada, but appropriate measures are in place to maintain safety margins.
- Category 3 issues are a concern in Canada and measures are in place to maintain safety margins, but the adequacy of these measures needs to be confirmed.

The continued operation of an NPP in the presence of these issues is judged to be permissible – none of the Category 3 issues involves a level of incremental risk that requires immediate corrective action. Issues with confirmed and immediate safety significance are addressed by other means on a priority basis, e.g., through enforcement.

A risk-informed decision-making process (as described in the sixth Canadian report) was applied to the Category 3 CSIs to identify, estimate and evaluate the risks associated with each issue and to recommend risk control measures. The risk assessment covered all possible combinations of events that could potentially lead to fuel damage, adverse effects to people or the environment, or any combination thereof.

The CNSC maintains regulatory control of the resolution of the CSIs by monitoring the path forward, established through a mutual agreement with the NPP licensees. Many of the previously designated Category 3 CSIs had been re-categorized for some or all NPPs in previous reporting periods. During the reporting period, no new Category 3 CSIs were opened. Some of the other issues were downgraded from Category 3 to Category 2 for some (but not all) of the NPPs.

Category 3 CSIs have been logically separated into two groups – those relevant to LBLOCAs and those that are not (referred to as non-LBLOCA issues) – so that they may be effectively addressed.

For the non-LBLOCA issues, work during the reporting period focused on two CSIs (CSI numbers in parentheses):

- computer code and model validation (AA3)
- high-energy line breaks (IH6)

CNSC staff assessed the AA3 status update on the computer code and plant model validation program for all licensees and determined that the CNSC comments on the code validation and accuracy estimation guidelines were addressed and implemented in the revised versions of both guidelines. CNSC staff re-categorized CSI AA3 to Category 2 in 2020. CNSC staff noted that some progress on the code applicability assessment was made; however, more validation work is needed to continue to evaluate the effect of modeling uncertainties and code accuracies on the analysis of postulated accident scenarios. This work is ongoing.

The CSI related to high-energy line breaks (IH6) remains at Category-3 only for Pickering. During the reporting period, CNSC staff completed the review of OPG's submission of piping inspection results for Pickering. Based on OPG's follow-up clarifications, CNSC staff were satisfied with OPG's inspection results obtained from additional inspection points in the 3 non-nuclear high-energy lines inside the reactor building. CNSC staff plan to monitor OPG's implementation of these new inspection points, through compliance verification activities for OPG's periodic inspection program. Furthermore, CNSC staff continued to use its oversight of Pickering's IIP to track OPG's completion of the conditions associated with the conditional re-categorization of this CSI from Category 3 to Category 2 for Pickering units 1 and 4. For Pickering Units 5 to 8, the CSI had been re-categorized from Category 3 to Category 2 in 2018.

In terms of issues related to LBLOCA, work during the reporting period focused on three CSIs that remained at category 3:

- analysis for void reactivity coefficient (AA9)
- fuel behaviour in high-temperature transients (PF9)
- fuel behaviour in fuel pulse transients (PF10)

In 2019, CNSC staff accepted Bruce Power's analysis methodology and results demonstrating that the frequency of pipe breaks larger than the threshold break size (TBS) for Bruce reactors is in the frequency band associated with BDBAs. CNSC accepted Bruce Power's request for the re-categorization of the three LBLOCA CSIs (AA9, PF9 and PF10) from Category 3 to Category 2, given the demonstrated low likelihood of the large breaks. Subsequently, in January 2020, Bruce Power submitted a revised LBLOCA safety analysis using realistic conditions for breaks above the TBS and requested that CNSC staff reclassify breaks above the TBS as BDBA events. CNSC staff determined that Bruce Power's submission established a generally acceptable approach for safety analysis of LBLOCA events above the TBS. In August 2020, CNSC staff accepted Bruce Power's request to reclassify breaks above the TBS from DBA to BDBA, given the demonstrated low likelihood of breaks above the TBS and the corresponding low risk. CNSC staff's review of Bruce Power's LBLOCA safety analysis is ongoing.

In 2023, the three LBLOCA CSIs were recategorized from Category 3 to Category 2 for the Darlington NGS. OPG did not however, request to reclassify breaks above the TBS to the BDBA category as Bruce Power did.

In addition to the above, the industry continues to develop the composite analytical approach (CAA) to address the LBLOCA CSI's. Through an industry-wide agreement, Bruce Power is taking the lead in the development and implementation of probabilistic analysis techniques for break frequency of large diameter heat transport piping. It continued to discuss the

development and implementation of the methodology during the reporting period with CNSC staff.

More detailed descriptions of the remaining Category 3 issues and the required risk control measures are provided in recent publications of the CNSC annual *Regulatory Oversight Report for Nuclear Power Generating Sites*.

14 (ii) Verification of Safety

This subsection describes the activities to verify – by analysis, surveillance, testing or inspection – that an NPP meets the appropriate design and safety requirements as well as its operational limits and conditions. While these activities are carried out primarily by the licensee, the CNSC also conducts various verifications of safety (as described in other articles of this report). For example, the CNSC maintains permanent staff members at each NPP (see subsection 8.1(b)) who monitor operations, verify safety in certain circumstances and conduct a wide range of inspections with the assistance of specialists from CNSC headquarters in Ottawa.

CNSC staff also review details in reports submitted by NPP licensees per REGDOC-3.1.1. These include event reports and quarterly/annual reports on matters such as safety performance indicators, fuel monitoring and inspection, pressure boundaries, radiation protection, environmental protection, and risk and reliability. The most safety-significant situations are pursued by reviews or focused inspections, which are often followed up through specific action items at individual NPPs. CNSC staff also review the safety analysis reports and safety system reliability studies that are submitted per REGDOC-3.1.1.

Furthermore, CNSC staff verify that proposed operational changes will be within the licensing basis (e.g., by confirming that they would not significantly erode the margin of safety for the NPP that was agreed upon at the time of licensing).

CNSC licences to operate the existing NPPs contain conditions governing the licensee's verification of safety through various fitness-for-service programs. The licensees' programs include testing (subsection 14(ii)(a)) and various aging management programs to address specific critical systems and aging mechanisms (subsection 14(ii)(b)).

14 (ii) (a) Testing - General

CNSC regulatory document [REGDOC-2.6.1, Reliability Programs for Nuclear Power Plants](#) includes general requirements for the reliability program for systems important to safety. REGDOC-2.6.1 addresses the roles of inspection, testing, modelling and monitoring in the identification of systems important to safety, their failure modes and their appropriate reliability targets, as well as confirmation that the targets are met (see sub-article 19(iii) for more information).

The NPP licensees execute periodic inspection programs for critical SSCs. The licensing bases for operating NPPs include standards with extensive requirements for testing and acceptance criteria, such as the following CSA Group standards:

- N285.4, *Periodic inspection of CANDU nuclear power plant components*
- N285.5, *Periodic inspection of CANDU nuclear power plant containment components*
- N285.7, *Periodic inspection of CANDU nuclear power plant balance of plant systems and components*
- N287.7, *In-service examination and testing requirements for concrete containment structures for CANDU nuclear power plants*

Portions of CSA N285.7 were developed using the methodologies and definitions for risk-informed, in-service inspection from publications of the Electric Power Research Institute (EPRI) and the American Society of Mechanical Engineers (ASME).

Thousands of safety-related tests are conducted annually at each NPP. These tests typically have a pass rate on the order of 99.9%.

14 (ii) (b) Aging management

All NPPs experience material degradation. Their SSCs are subjected to a variety of chemical, mechanical and physical influences during operation. In time, stressors such as corrosion, load variations, flow conditions, temperature and neutron irradiation cause degradation of materials and equipment. This time-dependent degradation is referred to as aging. Aging management is the set of engineering, operational, inspection and maintenance actions that control, within acceptable limits, the effects of physical aging and obsolescence on the SSCs.

Experience with several significant material degradation mechanisms during the life of currently operating NPPs in Canada has led to the development, formalization and documentation of a number of aging management programs. These programs provide for materials and component inspection and assessment techniques and intervals to ensure that all safety-significant SSCs are maintained within the safe operating limits allowed by the applicable codes and standards. Aging management programs are based on comprehensive methodologies involving surveillance, the production and monitoring of system health reports, inspections by qualified inspection personnel and preventive maintenance. They are regularly reviewed and updated, as required, to incorporate and allow for new information and findings. CNSC staff regularly review the results of activities covered by the aging management programs.

The expectations in CNSC regulatory document [REGDOC-2.6.3, Aging Management](#) emphasize the need for early and proactive consideration of aging management for all stages of an NPP's lifecycle: design, fabrication, construction, commissioning, operation, life extension, and decommissioning. It also provides requirements for the establishment, implementation and improvement of integrated aging management programs, through the application of a systematic and integrated approach. The approach includes organizational arrangements, data management, SSC selection, aging evaluation and condition-assessment processes, documentation and interfaces with other supporting program areas (such as the review and improvement of the program).

The main areas of focus under aging management include feeder pipes, fuel channels, flow-accelerated corrosion, steam generators, containment and general component replacement. The basic aging management programs for these areas are described in annex 14(ii)(b). The fuel channel lifecycle management project is particularly important in that its results help confirm the safety of ongoing operation of the existing NPPs as they approach their anticipated end of life, since the pressure tubes in the fuel channels are typically the major life-limiting component in the CANDU design. To support long-term operation, the CNSC has used licence renewals to update requirements related to monitoring, inspection and reporting related to the fitness for service of pressure tubes.

The original assumed pressure tube design life was based on 30 years of operation at 80% capacity factor (which corresponds to 210,000 equivalent full power hours (EFPH) per

reactor from the date of first criticality). As the reactors began approaching their operational lifetime target, licensees were able to demonstrate that the pressure tubes were not approaching the dimensional or material property design limits. This was the basis for extending the operating lives of the reactors beyond 210,000 EFPH. It was determined that pressure tube design life depends more on factors such as fracture toughness than on EFPH. Extending the operation of pressure tubes does not compromise safety as long as the limits of the material properties are not exceeded.

A key parameter that affects pressure tube fitness for service (such as fracture toughness) is equivalent hydrogen concentration. During the previous reporting period when measured equivalent hydrogen was observed to be higher, in isolated cases, than predicted values, the industry used the lifecycle management process (planning and completing inspection activities, comparing the results with predictive models, adjusting monitoring activities and updating models) to manage the issue. See sub-section 14(ii)(b) and annex C of the ninth Canadian report for details).

Through a joint fuel channel lifecycle management program that entails R&D activities in several key areas of fuel channel material degradation, industry developed refined engineering methodologies and models for predicting material properties over the full operational life of the fuel channel components (specifically, pressure tubes and annulus spacers that are made of Inconel X-750). NPP licensees routinely apply these methodologies and models to demonstrate the continued fitness for service of components operated beyond 210,000 EFPH and some have already been incorporated into CSA Group standard N285.8, *Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors*. Additionally, utilities updated their fuel channel life cycle management programs (which include routine inspection and maintenance activities as well as examinations and destructive tests on components that have been removed from the reactor) to ensure continued validation of the engineering assessments that are routinely performed to assess fitness for service. This work has also supported the demonstration of safe operation of fuel channels beyond the assumed design life of 210,000 EFPH.

The CNSC exercises regulatory control of the operation of reactors with older pressure tubes by identifying specific limits on operation. The limits are unique to each facility and depend, in part, on the information available at the time of licence renewal. At the end of the reporting period, the NPPs were authorised to operate up to the pressure tube service limits shown in table 10.

Table 10: Effective full-power hour limits for pressure tubes at Canadian NPPs

NPP	EFPH limit
Bruce A and B	300,000
Darlington	235,000
Pickering Units 1, 4	247,000*
Pickering Units 5-8	295,000
Point Lepreau	210,000 **

* Pickering Units 1 and 4 were shutdown in September and December 2024, respectively, prior to their pressure tubes reaching the EFPH limit

** Point Lepreau is not predicted to exceed the assumed design life of the pressure tubes during its current licence period

Summary of Significant Changes Since Previous Report

CNSC staff assessed the licence applications for DNNP (licence to construct) and DNGS (renewal of licence to operate). Both assessments concluded that the applicant (OPG in both cases) was qualified to undertake the proposed activity and would make adequate provisions for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

Licensees conducted and updated PSRs to assess ongoing safety and complete IIPs that bring their NPPs to a level of safety approaching that of modern standards.

NPP licensees continued to update both deterministic safety analysis and probabilistic safety assessments, based on updated regulatory requirements.

Notable Achievement(s)

NPP licensees have developed a series of periodic inspection programs and plans in support of aging management that expand the minimum inspection and testing program requirements to address operational and safety issues for critical components.

Future Focus

NPP licensees plan to continue enhancing and refining PSAs and deterministic safety analyses to support operational risk monitoring, design improvements, and long-term safety goals, including consideration of climate change and emerging hazards.

Article 15: Radiation Protection

Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

Summary Statement for Article

Canada fulfills the obligations of article 15.

Introduction and changes to requirements

A significant portion of Canada's R&D in the field of nuclear safety (see annex D) addresses the areas of radiation protection, radiation monitoring, environmental protection, environmental management and other related topics.

In Canada, high-level requirements related to controlling radiation exposure of nuclear energy workers¹⁰ (NEWs) and members of the public are found in the [General Nuclear Safety and Control Regulations](#). In particular, paragraph 12(1)(c) of the [General Nuclear Safety and Control Regulations](#) requires every licensee to take all reasonable precautions to protect the environment, and the health and safety of persons, and to maintain the security of nuclear facilities and of nuclear substances. Key requirements are also found in the [Radiation Protection Regulations](#) (RPR). The current RPR are informed by the International Commission on Radiological Protection (ICRP) Publication 103 (2007) and the IAEA's [GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards](#) (2014).

IRRS Recommendation R3

CNSC should ensure that the radiation protection requirements are consistent with the requirements of General Safety Requirements (GSR) Part 3.

As described in previous Canadian reports, the first major milestone in modernizing the RPR was the 2017 amendment. Additional amendments, which came into force with additional transitional provisions in January 2021, included a revision to the equivalent dose limit for the lens of an eye for a NEW from 150 mSv to 50 mSv in a one-year dosimetry period.

NPP licensees are in the process of implementing three CNSC regulatory documents that were published during the previous reporting period to support licensees in the implementation of the amended RPRs:

- [REGDOC-2.7.1, Radiation Protection](#)
- [REGDOC-2.7.2, Dosimetry, Volume I: Ascertaining Occupational Dose](#)
- [REGDOC-2.7.2, Dosimetry, Volume II: Technical and Management System Requirements for Dosimetry Services](#)

¹⁰ A NEW is a person who is required, in the course of the person's business or occupation in connection with a nuclear substance or nuclear facility, to perform duties in such circumstances that there is a reasonable probability that the person may receive a dose of radiation that is greater than the prescribed limit for the general public.

IRRS Recommendation R3 remains open, as the CNSC intends to review and analyze the RPRs (2030 timeframe). Proposals for amendments will include a five-year equivalent dose limit for the lens of the eye and dose limits for apprentices and students aged 16 to 18 years. Future revisions of the RPR may include updates to the dose limits for pregnant NEWs. This will be informed by CNSC's research project to review updates to the scientific understanding of the most current risk information related to exposure of embryos and fetuses to ionizing radiation.

To verify compliance with licence conditions and regulations, CNSC staff review documentation and operational reports submitted by applicants and licensees and, through technical assessments and compliance activities, evaluate the implementation of licensees' radiation protection and environmental protection programs. CNSC staff also monitor and evaluate the radiological and environmental impacts of licensed activities, verify compliance of licensed dosimetry services and review information on occupational exposures from the [National Dose Registry](#) (NDR).

Events related to potential and actual exposure to radiation or hazardous substances and releases to the environment of nuclear and hazardous substances (e.g., reaching an action level for radiation protection or environmental protection - see below) are reported to the CNSC in accordance with CNSC regulatory document [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants](#). CNSC staff review the event reports and the reporting, analysis, and corrective processes of licensees to verify their compliance with regulatory requirements and their effectiveness in correcting weaknesses. CNSC staff also investigate significant events related to radiation protection, if needed.

Paragraph 3(1)(f) of the [General Nuclear Safety and Control Regulations](#) requires that an application for a CNSC licence contain any proposed action levels. An action level is defined in subsection 6(1) of the RPR as a specific dose of radiation or other parameter that, if reached, may indicate a loss of control of part of a licensee's radiation protection program and triggers a requirement for specific action to be taken. When an action level is reached, whether for radiation protection or environmental protection, the licensee must notify the CNSC, conduct an investigation to establish the cause for reaching the action level and take action if needed to restore the effectiveness of the radiation or environmental protection program.

15 (a) Radiation protection for workers and application of the ALARA principle

General requirements and activities for radiation protection of workers

In addition to the requirements in the [General Nuclear Safety and Control Regulations](#) mentioned above, paragraph 12(1)(e) requires all persons at the site of a licensed activity to use equipment, devices, clothing and procedures in accordance with the NSCA, the regulations and the licence.

Paragraph 4(a) of the RPR requires that every licensee implement a radiation protection program and, as part of that program, keep the amount of exposure to radon progeny and the effective dose and equivalent dose received by and committed to persons as low as is reasonably achievable (ALARA), social and economic factors being taken into account, and below CNSC regulatory dose limits.

Section 13 of the RPR requires that every licensee ensure the following effective dose limits are not exceeded:

- 50 mSv in a one-year dosimetry period and 100 mSv over a five-year dosimetry period for a NEW
- 4 mSv for the balance of the pregnancy for a pregnant NEW
- 1 mSv per calendar year for a person who is not a NEW

Section 14 of the RPR prescribes the following equivalent dose limits:

- 50 mSv to the lens of an eye in a one-year dosimetry period for a NEW
- 15 mSv to the lens of an eye in a one calendar year period for any other person
- 500 mSv to the skin in a one-year dosimetry period for a NEW
- 50 mSv to the skin in a one calendar year period for any other person
- 500 mSv to the hands and feet in a one-year dosimetry period for a NEW
- 50 mSv to the hands and feet in a one calendar year period for any other person

Annex 15(a) provides additional information on the RPR, dosimetry requirements, and guidance related to the ALARA principle and the setting of radiation protection action levels.

To fulfill the related regulatory requirements, NPP licensees establish, maintain and document radiation protection programs to effectively manage and control radiological risk to workers, as well as the public. An objective of these programs is to ensure that licensees implement processes to ensure workers' radiological exposures are kept ALARA, through:

- management control over work practices
- personnel qualification and training
- control of occupational and public exposure to radiation
- planning for unusual situations

Examples of three specific licensee strategies to minimize the dose to workers are described below.

Increased use of technology

The effective use of technology is a key component of the ALARA program. Some licensees have installed remote monitoring equipment to improve radioactive work planning and reduce doses to workers. Remote monitoring and the use of robotics for radiological hazards have reduced doses by not requiring staff to enter certain areas to perform routine radiation surveys and have enabled workers to select protective equipment appropriate to the current and anticipated hazard conditions, as well as respond to changing conditions. Some licensees have used robotics to inspect and remove hot spots of elevated contamination, thereby minimizing doses to workers. The use of robotics for inspections and maintenance in high radiation dose fields is expanding, including using robots to test moisture detection equipment in high dose areas. In 2022, Bruce Power used 2 robots to reinstall and tighten a bolt that had backed off a component in the Unit 3 fuel handling system. This resulted in both worker dose savings and the avoidance of a forced outage for the repair. Remotely-operated cameras have been used to perform visual inspections and monitoring of inaccessible areas.

Radiography services at NPPs are implementing pulsed x-ray technology instead of gamma sources to reduce the dose that workers would normally receive from handling the sources. Bruce Power is using remote automated tooling for reactor face work during the major component replacement (MCR) outages. For the Unit 3 MCR, Bruce Power used first-of-a-kind remote tooling to install new calandria tubes. This resulted in significant dose savings due to the elimination of manual installation techniques. Additional new tooling for fuel channel installation will be introduced for the Unit 4 MCR and subsequent MCRs.

OPG has upgraded remote tooling used in Darlington refurbishment to allow for removal of both the pressure tube and calandria tube at the same time. This substantially reduced the time required for the operation and significantly reduced dose.

Source term control measures

Measures are in place to reduce doses to workers from exposure to various hazards. The measures include more frequent replacement of desiccant in dryer units and improvement of the material condition of dryer systems; some licensees also de-tritiate their heavy-water inventory. Several licensees have implemented shielding canopies and reactor-face shielding tiles to reduce gamma dose to workers. Licensees are also working to reduce the recurrence of hot spots through initiatives involving either reduction of the filter pore size or an increase in the flow rate of the heat transport purification system. Filter pore size reduction is being addressed through new technology such as new-generation nano-fibre media and cobalt-60 scavenging resins to improve efficiency at removing colloidal matter from the primary heat transport system. Finally, by applying OPEX, all licensees have enhanced their contamination control programs to better manage and control risks from alpha hazards.

Bruce Power has conducted chemical decontamination of reactor systems to reduce source terms for the Unit 3 and 4 MCR outages to great success, obtaining an 80% reduction in the source term resulting in significant worker dose savings.

Bruce Power and OPG have implemented a novel approach to in-station radiation safety that leverages 3-D printing techniques, using a tungsten-infused filament. The program began in March 2023, when advancements in 3-D printing technologies led to the viability of tungsten-infused filament for printing. Using this material marked a paradigm shift for in-station shielding approaches, allowing teams to use custom printed shielding for hard-to-reach areas, such as valves, camera equipment, or pipe bends, providing an additional protective barrier for workers. Custom shielding can be developed, modelled, printed and fitted to the target hot spot within 48 hours, reducing time and cost compared to traditional manufactured methods for custom shielding while increasing efficiency and precision.

OPG invested in an upgrade to closure plugs for CANDU fuel channels during Darlington refurbishment. This resulted in a significant reduction in vault airborne tritium and internal dose during a planned 2024 Darlington outage.

Training

Training is essential to keeping doses ALARA. Some licensees provide mock-up training for jobs with elevated radiological risk. In preparation for refurbishment, full-scale mock-ups for tool testing and worker familiarization have been or are in the process of being built. The use of mock-ups enables optimization of procedures that reduce time spent in the radiation field. Licensees have actively used dynamic learning activities (described in Annex 11.2(a)) to also prepare workers to efficiently work in the field under various and potentially changing conditions. To further limit tritium exposure, some licensees reinforce the need to plug in plastic suits at every opportunity to refill them with fresh air (thereby limiting unplugged periods to less than 60 seconds). Furthermore, mock-ups have also been used to give NEWs experience with a number of different respiratory protective equipment configurations, such as air-supplied plastic suits or negative pressure particulate respirators to acclimatize workers prior to performing the task in a radiation field.

Each year, licensees establish challenging radiation dose performance targets based upon the planned activities and outages for the year. They are analogous to the constraints recommended in the IAEA Safety Guide [GSG-7, Occupational Radiation Protection](#). CNSC staff verify that the NPP licensees monitor their performance against internal radiation dose performance targets and that this information is used to improve radiation protection performance.

IRRS Recommendation R2

The CNSC should establish or approve dose constraints for all Class I type facilities.

This finding was identified by the CNSC through its self-assessment carried out prior to the peer review mission. The CNSC imposes dose limits for public exposure for all facility types and requires the application of BATEA (best available technologies economically achievable) to be demonstrated as part of a licence application for new projects. The CNSC has previously identified inconsistent application of dose constraints for derived release limits for Class I facilities. This was addressed by the publication of [REGDOC-2.9.2, Controlling Releases to the Environment](#), in March 2024. REGDOC-2.9.2, which aligns with IAEA [GSG--9, Regulatory Control of Radioactive Discharges to the Environment](#), describes the role of dose constraints in the optimization of protection and establishment of discharge limits. NPP licensees are working to implement REGDOC-2.9.2, which is tied to the cyclical updates of the environmental risk assessment (every 5 years) and/or periodic safety review (every 10 years). The recommendation remains open - the implementation of the new requirements by Class I nuclear facilities is expected to be completed within 2 to 5 years.

Doses to workers

Health Canada maintains the NDR, which is Canada's national repository for dose records of workers who are monitored for occupational exposure to ionizing radiation. The NDR supports Health Canada and Canadian regulatory authorities in their mandates to protect the health and safety of Canadians exposed to ionizing radiation in the workplace. The NDR provides dose histories to individual workers and organizations for work planning and for compensation and litigation cases, and assists in regulatory control by notifying regulatory authorities of overexposures within their jurisdiction. The NDR has records for over half a million workers, including well over 100,000 workers who are currently monitored; it contains monitoring records back to the 1940's.

Doses to workers were below regulatory limits, as monitored during the reporting period (see annex 15(a) for full details). During the reporting period, the total collective dose at Canadian NPPs varied due to factors such as:

- the dose rates associated with the type of work being performed
- the number of outages each year
- the scope and duration of outage work
- the number of people involved in outage work

15 (b) Environmental protection

Requirements for protection of the environment

In Canada, the NSCA and its regulations include environmental protection provisions. For example, the purpose of the NSCA (paragraph 3), is to provide for the limitation, to a reasonable level of the risks to safety of persons and the environment that are associated

with the development, production and use of nuclear energy. The [General Nuclear Safety and Control Regulations](#) provide additional details on requirements for environmental protection. Paragraph 12(1)(c) of the [General Nuclear Safety and Control Regulations](#) includes a requirement for every licensee to take all reasonable precautions to protect, among others, the health and safety of persons and the environment. Paragraph 12(1)(f) requires every licensee to take all reasonable precautions to control the release of radioactive nuclear substances or hazardous substances within the site of the licensed activity and into the environment as a result of the licensed activity.

The general and specific requirements during operations of NPPs related to protecting people and the environment are found in the [Class I Nuclear Facilities Regulations](#). These regulations provide general requirements for the content of licence applications, as well as requirements for each stage of the lifecycle of an NPP (site preparation, construction, operation and decommissioning). The general environmental protection requirements for NPPs in the [Class I Nuclear Facilities Regulations](#) are as follows:

- Paragraphs 3 (g), (h), and (k) require licence applicants to submit their proposed environmental protection policies and procedures, effluent and environmental monitoring programs, as well as the proposed plan for the decommissioning of the NPP.
- Paragraph 3 (j) requires licence applicants to submit their program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment, and the health and safety of persons that may result from the activity to be licensed at all stages of its life cycle.

Using operations as an example of a lifecycle stage, the specific requirements of the [Class I Nuclear Facilities Regulations](#) for NPP licensees are that an application to operate a Class I nuclear facility shall describe:

- Paragraph 6 (h): the effects on the environment and the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effect
- Paragraph 6 (i): the proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, including their physical, chemical and radiological characteristics
- Paragraph 6 (j): the proposed measures to control releases of nuclear substances and hazardous substances into the environment
- Paragraph 6 (k): the proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of national security

The licensees of operating NPPs have implemented CNSC regulatory document [REGDOC-2.9.1, Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.2](#). The expectations in this document: are consistent with modern national and international practices; address issues and elements that control and enhance nuclear safety; and establish a modern, risk-informed approach to environmental protection.

REGDOC-2.9.1 requires NPP licensees to establish an environmental management system that includes environmental risk assessments (ERAs) as well as the monitoring programs (e.g., effluent, emissions, environmental and groundwater) used to verify the ERA

predictions. The cyclical nature of these measures, as described in REGDOC-2.9.1, is reproduced in figure 15(b).

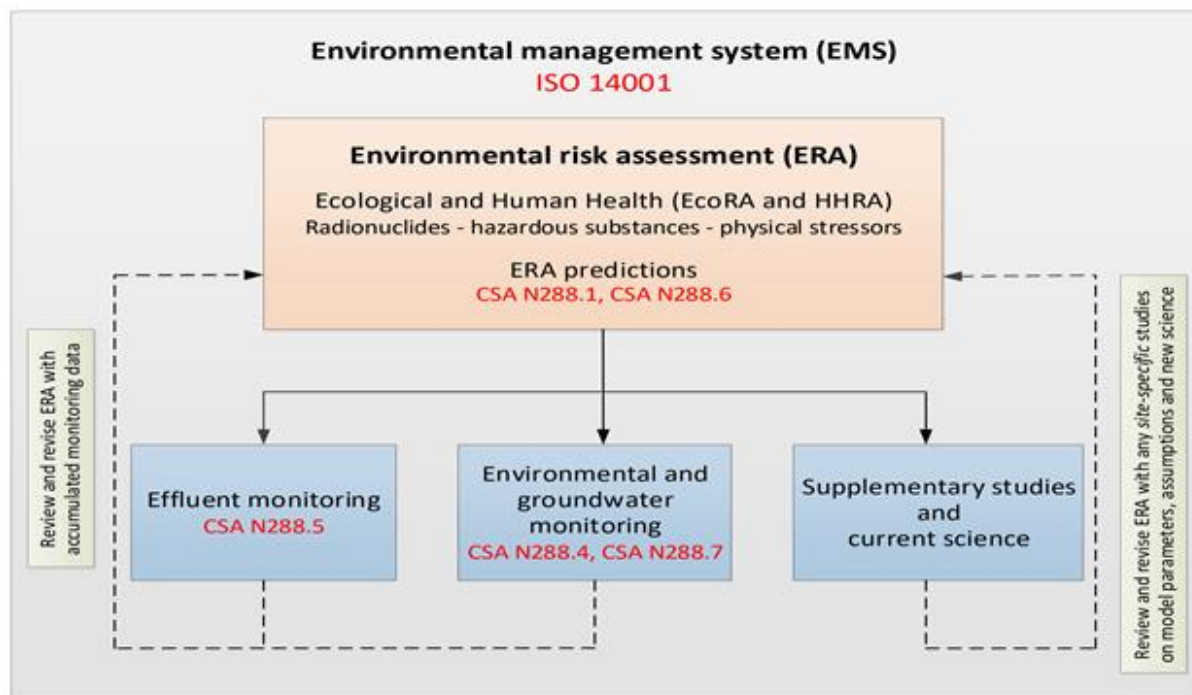


Figure 15(b) Framework for the protection of the environment

In addition to the monitoring activities, supplementary studies may be required to assess, for example, the impacts of thermal effluent on sensitive fish species. The environmental management systems have programs to control and monitor the effect of operations on people and the environment. These programs include an objective to maintain a low level of public risk to human health and the environment (both nuclear and hazardous) compared to other normal public risks that arise from industrial activity. In addition to ERA and monitoring, typical elements include management of releases and waste, worker training and informing the public.

The sections below discuss in more details the ERA and the effluent, emission and environmental monitoring programs.

CNSC staff review the information collected by the monitoring programs on an annual basis to verify that ERA predictions have been met.

Environmental risk assessment

NPP licensees use ERAs to predict radiological and hazardous risks to the environment as well as physical stressor effects (e.g., impingement and entrainment of fish) after ALARA and BATEA mitigation measures, as appropriate, are implemented to prevent or reduce environmental effects.

An ERA is a systematic process that identifies, quantifies and characterizes the risk posed by contaminants (nuclear or hazardous substances) and physical stressors in the environment. It provides science-based information to support decision-making and to prioritize the implementation of mitigation measures. The ERAs for Canadian NPPs are based on CSA Group standard N288.6-12, *Environmental risk assessment at Class I nuclear facilities and uranium mines and mills*. The ERA identifies specific characteristics and site-specific

environmental characteristics, identifies interactions between those characteristics and assesses the risk to the environment and the public. In particular, the ERA uses the NPP-specific estimates of physical stressors (e.g. impingement and entrainment of fish and shellfish) and releases (radiological and hazardous substances or thermal releases) to predict the:

- source terms of releases
- transport of radiological and hazardous substances through environmental pathways (e.g. atmosphere, surface water)
- subsequent public exposure and dose, exposure and effects on representative biota, and changes in habitat and effects on species that rely on that habitat

The ERA is updated on a five-year basis, or sooner should there be major facility changes, with the data collected from the effluent and environmental monitoring programs, special studies, and new science. In the event that ERA predictions are not met, adaptive management measures (e.g., mitigation or off-setting) can be implemented, if necessary.

Effluent and emission monitoring

Important measures in the environmental management system that support the monitoring programs include the establishment of environmental release limits and action levels. Although radioactive material released into the environment through gaseous emissions and liquid effluents from NPPs can result in radiation doses to members of the public through environmental exposure pathways, the doses received by the public from routine releases from NPPs are too low to measure directly. Therefore, to ensure that the public dose limit is not exceeded, the CNSC restricts the amount of radioactive material that licensees may release. These gaseous and effluent limits are derived from the public annual dose limit of 1 mSv and are called derived release limits (DRLs). A DRL for a given radionuclide or radionuclide group is a specific release limit for a route of release (exposure pathway) from an NPP. If the total of the measured releases for each gaseous emission or waterborne effluent, expressed as percentages of their respective DRLs, exceeds 100%, members of the public with the greatest exposure may exceed the public dose limit over the calendar year. The phrase “members of the public with the greatest exposure” refers to individuals who receive the highest doses from a particular source due to factors such as proximity to the release, dietary and behavioural habits, age and metabolism, and variations in the environment.

The calculation of DRLs is based on methodology in CSA Group standard N288.1-14, *Guidelines for modelling radionuclide environmental transport, fate, and exposure associated with the normal operation of nuclear facilities*. DRLs are also based on other developments in radiation protection (e.g., ICRP dose conversion factors). DRLs are unique to each facility and depend on several factors (e.g., assumptions, representative person characteristics, and site-specific data). The calculation of DRLs can vary from simple to exceedingly complex. As a result, DRLs are reviewed and, if necessary, updated approximately every five years. Note that the assessment of health risk to members of the public in ERAs utilizes the same methodology as the DRL calculations, except that public dose is estimated from measured effluent and emission monitoring data for specific routes of release.

For environmental protection, licensees set environmental action levels well below the DRLs. When exceeded, these action levels provide a warning of a possible loss of control in the emissions management systems and allow for prompt corrective action. This enables

licensees to keep liquid effluent and gaseous emission releases well below their respective DRLs.

All NPPs release small quantities of radioactive materials, in a controlled manner, into both the atmosphere (as gaseous emissions) and adjoining water bodies (as liquid effluents). NPP licensees monitor airborne emissions for tritium, iodine, noble gases, carbon-14 and particulates, as well as waterborne tritium, carbon-14 and gross beta-gamma radioactivity. The CNSC publishes data on these releases, along with the corresponding DRLs on the [Open Government Portal](#). During the reporting period, releases from Canadian NPPs were less than 1% of the DRLs. During the reporting period, there were two action level exceedances at Darlington: one exceedance in 2023 for tritium oxide in 2023 and elemental tritium in 2024. Both events were related to the Tritium Removal Facility.

The licensees' effluent monitoring programs are based on CSA group standards N288.5, *Effluent and Emissions Monitoring Programs at Nuclear Facilities*, N288.1, *Guidelines for modelling radionuclide environmental transport, fate, and exposure associated with the normal operation of nuclear facilities* and [REGDOC-2.9.1, Environmental Principles, Assessments and Protection Measures, Version 1.2](#).

Environmental Monitoring

In addition to tracking radiological emissions and effluents from the NPP, licensees have radiological environmental monitoring programs to monitor radioactivity and other interactions with the environment around the facilities. These programs specifically monitor the air, water and food chain products. The environmental monitoring programs aim to:

- assess the level of risk on human health and safety, and the potential biological effects in the environment of the contaminants and physical stressors of concern arising from the facility
- demonstrate compliance with the predictions made by the ERA on the concentration and/or intensity of contaminants and physical stressors in the environment or their effect on the environment
- check (independently of effluent monitoring), and provide public assurance of, the effectiveness of containment and effluent control
- refine models used in the ERA, or reduce the uncertainty in the predictions made by the ERA

The licensee environmental monitoring programs are based on CSA Group standards N288.4-10 *Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills*, and may also be informed by N288.7, *Groundwater protection at Class I nuclear facilities and uranium mines and mills* and N288.9-18, *Guideline for design of fish impingement and entrainment programs at nuclear facilities*. The results from these monitoring programs are used to confirm that the public legal limit in Canada for effective dose from the operation of NPPs is not exceeded and that the environment is protected based on the ERA predictions used to authorize the activity.

CNSC independent environmental monitoring program

The CNSC's [independent environmental monitoring program](#) (IEMP) complements CNSC staff reviews of elements of licensees' environmental management systems and confirms that licensees are adhering to the regulatory requirements, licence conditions and approved programs throughout the operation of nuclear facilities. The IEMP is performed by CNSC staff in public areas and consists of sampling environmental media and analyzing radiological

and non-radiological substances released from facilities in all areas of the nuclear fuel cycle: uranium mines and mills, processing facilities, NPPs, research reactors and waste management facilities.

Samples are analyzed at the CNSC's laboratory using industry best practices. Samples are analyzed for radiological and non-radiological contaminants related to the activities of the nuclear facility. Samples may be taken for air, water, soil, sediment, vegetation (e.g., grass) and foodstuffs (e.g., meat, fish, milk and produce). The results are compared to appropriate federal and/or provincial guidelines to support the determination that the public and the environment in the vicinity of the facility are safe and that there are no expected health impacts as a result of facility operations. Conclusions and data are then posted on a user-friendly map on the CNSC website. A full technical report is also available upon request by the public.

IEMP results for operating Canadian NPPs are available on the CNSC website for the following years:

- Bruce A and B 2013, 2015, 2016, 2019, 2022
- Darlington 2014, 2015, 2017, 2021, 2023
- Pickering 2014, 2015, 2017, 2021
- Point Lepreau 2014, 2015, 2016, 2017, 2021

Health Canada Canadian Radiological Monitoring Network and Fixed Point Surveillance Network

Health Canada undertakes environmental surveillance and monitoring activities through its [Canadian Radiological Monitoring Network](#) (CRMN) and [Fixed Point Surveillance](#) (FPS) network. Initiated in 1959 to monitor environmental releases of radioactivity from atmospheric nuclear weapons testing and accidents at nuclear facilities, the current surveillance activities of the CRMN and FPS serve to establish background radiation levels across Canada, as well as obtain information on levels of radioactivity near NPPs from routine operations, or from radioactivity that may result from a nuclear accident. This in turn provides a basis for accurate health assessments.

The CRMN is a national network comprising 34 sites that routinely collects air particulate, precipitation, external gamma dose, drinking water, atmospheric water vapour, and milk samples for radioactivity analysis at Health Canada's laboratories. Additional sites in the vicinity of nuclear reactors collect atmospheric water vapour and external gamma dose. The FPS network integrates 81 radiation detectors across Canada to monitor radiation dose to the public in real-time from radioactive materials in the terrestrial environment, whether they are airborne or on the ground. The FPS detectors are located in every province and territory of Canada with larger numbers near major Canadian nuclear facilities and ports where nuclear-powered vessels sometimes harbour.

Data from the CRMN is made available to the public semi-annually via the [Open Government Portal](#) and the Open Maps Portal. Data from the FPS network is made available in real-time to authorities through the IAEA's International Radiation Monitoring Information System, to the public through the European Radiological Data Exchange Platform, and as quarterly summaries on the Government of Canada website.

The objective of the Ontario Ministry of Labour's [Ontario Reactor Surveillance Program](#) (ORSP) is to establish, operate and maintain a radiological surveillance network to assess radiological concentrations around designated major nuclear facilities in the province. The



purpose of the ORSP is to assure the public living and working in the vicinity of nuclear facilities that their health, safety, welfare and property is not affected by emissions from those facilities. The ORSP monitors the air, water and food around NPPs in Ontario for radioactivity.

Summary of Significant Changes Since Previous Report

NPP licensees introduced new technologies, tools and methods, as well as enhanced training, to maintain doses to workers ALARA and reduce source terms.

Future Focus

CNSC will continue its review and analysis in preparation for an amendment of the RPRs in the 2030 timeframe.

NPP licensees will continue to implement [REGDOC-2.9.2, Controlling Releases to the Environment](#), which describes the role of dose constraints in the optimization of environmental protection and establishment of discharge limits.

Article 16: Emergency Preparedness

- 1 *Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.*
- 2) *Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.*
- 3) *Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.*

Summary Statement for Article

Canada fulfills the obligations of sub-articles 16.1 and 16.2. Sub-article 16.3 does not apply to Canada.

16.1 Emergency Plans and programs

16.1 (a) Highlights of general responsibilities and guidance for stakeholders

General responsibilities of the licensees and government authorities

Within Canada's constitutional framework, emergency management is a shared responsibility between the federal and provincial governments. On an operational level, federal, provincial and municipal governments take responsibility. Most emergencies are local in nature and are managed at the community or provincial/territorial level. The Government of Canada can become involved where it has primary jurisdiction or when its assistance has been requested due to the scope of the emergency. Canada has robust arrangements in place for the coordination of emergency preparedness and response between the operating organization and local, regional, provincial and national authorities, as well as at the international level.

In Canada, licensees of nuclear facilities are responsible for onsite emergency planning, preparedness and response. Onsite nuclear emergencies are those that occur within the physical boundaries of the facility.

Offsite nuclear emergencies are those that have an effect outside the boundaries of the facility. In the event of an accident at an NPP with potential offsite consequences, the offsite response would follow a process involving the following parties:

- the licensee
- municipal government
- provincial/territorial governments
- federal government

The provincial governments are the primary off-site authority having jurisdiction for the response and are responsible for:

- overseeing public health and safety and protection of property and the environment
- enacting legislation to fulfill the province's lead responsibility for public safety
- preparing emergency plans and procedures and providing direction to municipalities that they designate to do the same
- managing the offsite response and coordinating the efforts of organizations with responsibility in a nuclear emergency
- coordinating support from the NPP licensee and the Government of Canada during preparedness activities and response to a nuclear emergency

At the federal level, the [Emergency Management Act](#) sets out ministerial responsibilities for the prevention and mitigation of, preparedness for, response to and recovery from emergencies.

Federal government support and response for potential offsite impacts are required for addressing areas of federal responsibility, including an incident's effects that extend beyond provincial or national borders. Federal responsibility also encompasses a wide range of contingency and response measures to prevent, correct or eliminate accidents, spills, abnormal situations and emergencies, and to support provinces and territories in their responses to a nuclear emergency. The Government of Canada is also responsible for:

- liaison with the international community
- liaison with diplomatic missions in Canada
- the assistance of Canadians abroad
- coordination of the national response to a nuclear emergency occurring in a foreign country

Coordinated federal assistance may also be required when requested by an affected province or territory. Some provinces have agreements with the Government of Canada for the provision of specific types of technical support to manage the offsite radiological consequences of an emergency.

Under the Emergency Management Act, Public Safety Canada ensures coordination across all federal departments and agencies responsible for national security and the safety of Canadians, including during nuclear emergencies. It is the lead authority for the [Federal Emergency Response Plan](#) (FERP), which is Canada's all-hazards plan. The FERP outlines the processes and mechanisms to facilitate an integrated Government of Canada response to an emergency in support of the provinces and territories.

Health Canada has the responsibility for coordinating federal nuclear emergency preparedness and response. Health Canada is the lead authority for the [Federal Nuclear Emergency Plan](#) (FNEP), an event-specific annex to the FERP. The FNEP itself has provincial annexes to establish the link between federal and provincial nuclear emergency response plans. The FERP, FNEP and FNEP provincial annexes are aligned to prevent conflict in roles and responsibilities.

The FNEP is supported by two standing nuclear emergency preparedness advisory committees and the technical assessment group (TAG; see subsection 16.1(e) for details).

In addition to managing and being the lead authority of the FNEP, Health Canada has responsibilities related to radiation protection, including cross-Canada monitoring networks: the Fixed Point Surveillance Network, the Canadian Radiological Monitoring Network (see subsection 15(b)) and the radiation monitoring stations within the Canadian portion of the Comprehensive Nuclear Test-Ban Treaty International Monitoring System. See appendix C in [Canada's report](#) to the Second Extraordinary Meeting of the CNS for details. Health

Canada also operates radiological sample analysis laboratories (including fixed and mobile facilities), decision support systems, mapping and information-management platforms, contamination-monitoring capabilities (including portal monitors), and internal and external dosimetry programs for exposed individuals (including emergency workers). Health Canada provides radiation protection guidance and expertise, maintains a nuclear exercise calendar and supports emergency exercises.

Internationally, Health Canada and the CNSC serve as national competent authorities to the IAEA and represent Canada on the IAEA's Emergency Preparedness and Response Standards Committee.

In addition to Public Safety Canada, Health Canada and the CNSC, other federal organizations with responsibilities in nuclear emergency preparedness and response, as described in the FNEP, include:

- the Department of National Defence/Canadian Armed Forces, which are responsible for dealing with emergencies involving foreign nuclear-powered vessels entering Canadian waterways
- Transport Canada, which is responsible for the Canadian Transport Emergency Centre
- Environment and Climate Change Canada, which is responsible for providing atmospheric modelling services to the FNEP TAG, provincial science groups and the IAEA as part of its emergency response functions ranging from local to global atmospheric dispersion modelling capabilities, including dispersion and trajectory modelling, and forward/backward modelling, as a Regional Specialized Meteorological Centre under the World Meteorological Organization
- Natural Resources Canada (NRCan), which is responsible for providing aerial and ground radiation surveying and mapping, providing policy advice and coordinating federal actions in relation to nuclear liability
- the Public Health Agency of Canada, which is responsible for public health issues and is the national authority for reporting to the World Health Organization under the *International Health Regulations* (2005); as a signatory to the regulations, Canada is committed to help strengthen global health security by building capacities to detect, assess, report, and respond to public health events both domestically and internationally

Guidance to support emergency preparedness and response

In addition to governing legislation, the various stakeholders for nuclear emergency preparedness and response are supported by regulations, regulatory documents and standards and other guidance that are used to develop their various emergency plans and measures.

Challenge 9RM C-1 from Joint Eighth and Ninth Review Meeting

Update guidance document Generic Criteria and Operational Intervention Levels for Nuclear Emergency Planning and Response and include guidance on protection strategies and reflect guidance in provincial plans

To address 9RM C-1, Health Canada is updating and expanding its guidance document on nuclear emergency planning and response. This includes advice on developing integrated protection strategies, emphasizing the importance of anticipating, recognizing, and mitigating both radiological and non-radiological hazards. Generic criteria and operational intervention levels (OILs) from Health Canada's 2018 document have been reviewed against the full set of IAEA recommendations and are being revised where appropriate, considering the

Canadian context. In addition, Health Canada worked with Canadian Nuclear Laboratories to confirm that the OILs developed by the IAEA for light water reactors were appropriate for CANDU reactors. Work on the revision is ongoing and public consultation (usually 90 days) on the revision is delayed - it is currently planned to commence in the fall/winter of 2025. Document approval, following completion of the public consultation, typically takes another half year.

It is noted that the existing provincial emergency response plans reflect the existing guidance. New Brunswick plans to adopt the updated guidance document when it is available; Ontario plans to adopt it as part of a project to enhance the procedures at the Provincial Emergency Operations Centre for decision-making related to protective action.

As the follow-up activities are ongoing, Canada recommends that Challenge 9RM C-1 remain open, as of the end of the reporting period.

16.1 (b) Onsite emergency plans

While the CNSC would continue to have regulatory oversight of the NPP licensees in the event of a nuclear emergency, the licensees are responsible for onsite emergency preparedness and response. Paragraph 6(k) of the [Class I Nuclear Facilities Regulations](#) requires an application for a licence to operate a Class I nuclear facility to describe the proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons, and the maintenance of national security, including measures to:

- assist offsite authorities in planning and preparing to limit the effects of an accidental release
- notify offsite authorities of an accidental release or the imminence of an accidental release
- report information to offsite authorities during and after an accidental release
- assist offsite authorities in dealing with the effects of an accidental release
- test the implementation of the measures to prevent or mitigate the effects of an accidental release

The application should describe the proposed facility, activities, substances and circumstances to which its emergency plans apply. The emergency plans should also be commensurate with the complexity of the associated undertakings, along with the probability and potential severity of the emergency scenarios associated with the operation of the facility.

A condition in each licence to operate an NPP requires the licensee to implement an emergency preparedness program to ensure it is capable of executing its onsite emergency plan. Emergency preparedness plans and programs are updated and fine-tuned over the life of the NPP as new requirements are identified or to address changing conditions, OPEX and identified deficiencies. The CNSC assesses licensees' emergency preparedness programs and inspects their emergency drills and exercises. Although the programs have matured and are well maintained, CNSC staff have observed that NPP licensees in Canada proactively seek ways to continuously improve their emergency preparedness programs.

During the reporting period, the licensees completed the implementation of CNSC regulatory document [REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, Version 2](#). It sets requirements for the establishment of the planning basis for emergencies, emergency response plans and procedures and the maintenance of preparedness (e.g., training, testing,

etc). Additionally, CSA Group standard N1600, *General requirements for emergency management for nuclear facilities*, contains guidance regarding offsite provisions and specifically addresses lessons learned from the Fukushima accident. During the reporting period, CNSC commenced development of Version 3 of REGDOC-2.10.1, with publication planned in 2026. Among the changes include ensuring it will be applied to all Class I facilities, regardless of thermal output capacity and the novelty of the technology.

Each licensee's emergency plan is specific to its particular site and organization; however, all emergency plans typically cover:

- documentation of the emergency plan
- basis for emergency planning
- personnel selection and qualification
- emergency preparedness and response organizations
- staffing levels
- emergency training, drills and exercises
- emergency facilities and equipment
- emergency procedures
- assessment of emergency response capability
- assessment of accidents
- activation and termination of emergency responses
- protection of facility personnel and equipment
- interface arrangements with offsite organizations
- arrangements with other agencies or parties for assistance
- recovery program
- public information program
- public education program

Descriptions of the onsite emergency plans for each NPP are provided in annex 16.1(b).

16.1 (c) Emergency preparedness expectations for new-build projects

The CNSC is establishing requirements and expectations for emergency preparedness for new-build projects. CNSC regulatory document [REGDOC-1.1.1, Site Evaluation and Site Preparation for New Reactor Facilities](#) identifies the need to consider the following factors related to population and emergency planning when a proposed site is being evaluated against safety goals:

- the planning basis as described in CNSC regulatory document [REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, Version 2](#)
- population density, characterization and distribution within the emergency planning zone with particular focus on existing and projected population densities and distributions in the region including resident populations and transient populations (note: this data is to be updated over the lifecycle of the reactor facility)
- present and future use of land and resources
- physical site characteristics that could impede the development and implementation of emergency plans (for example, the ability to deliver fuel in a timely manner to backup generators)
- populations, including vulnerable populations, in the vicinity of the reactor facility that are, or may become, difficult to evacuate or shelter (e.g., schools, prisons, or hospitals)
- the ability to maintain population and land-use activities in the emergency planning zone at levels not impeding implementation of the emergency plans

Emergency planning zones are areas beyond the exclusion zone that should be considered with respect to implementing emergency measures. These zones are established by the province or territory and are under the control of the region or municipality.

Before submitting the application for a licence to prepare a site, the applicant must confirm with the surrounding municipalities and the affected provinces, territories, foreign states and neighbouring countries that the implementation of their respective emergency plans and related protective actions will accommodate the lifecycle of the proposed project.

Discussions around early plans shall include plans and consideration of the following:

- onsite response, including the capacity to bring offsite equipment onsite
- ability of offsite licensee staff to communicate with and access the site during a catastrophic event
- offsite response, and how it is coordinated between the licensee and the relevant federal, provincial and municipal government agencies
- how the licensee will coordinate with regulatory bodies
- how the licensee will respond and coordinate with emergency service providers (fire department, ambulance, hospital, fuel, food, etc)

The applicant is expected to document the strategy and process for effective, two-way, ongoing consultation with emergency management agencies affected by site operations throughout the project's lifecycle. Emergency management agencies include security agencies involved in the development of the site-selection threat assessment threat/risk report.

The CNSC extends these considerations of emergency preparedness into the requirements for the licence to construct and the licence to operate power reactors, for which the following CNSC regulatory documents also apply:

- [REGDOC-2.3.2, Accident Management, Version 2](#)
- [REGDOC-2.4.1, Deterministic Safety Analysis](#)
- [REGDOC-2.4.2, Probabilistic Safety Assessment \(PSA\) for Nuclear Power Plants](#)
- [REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants](#)
- [REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, Version 2](#)

The additional criteria in these regulatory documents that need to be considered at the design and construction phase include the following:

- The containment allows sufficient time for the implementation of offsite emergency procedures.
- The main control room, secondary control room and emergency response facilities reliably facilitate all operations and support required for onsite and offsite emergency measures.
- The design features and equipment to support post-accident environmental monitoring are robust and reliable.
- The hazard analysis defines the emergency planning and coordination requirements for effective mitigation of the hazards.
- The probabilistic safety assessment (PSA) is used to assess the adequacy of accident management and emergency procedures.

16.1 (d) Provincial and territorial offsite emergency plans

The provincial/territorial governments are responsible for overseeing public health and safety and the protection of property and the environment within their jurisdictions. Accordingly, they assume lead responsibility for the arrangements necessary to respond to the offsite effects of a nuclear emergency by enacting legislation and providing direction to the municipalities

where the NPPs are located. Typically, their administrative structures include an emergency measures organization (or the equivalent) to cope, in accordance with defined plans and procedures, with a wide range of potential or actual emergencies. The provinces maintain emergency operations centres to coordinate protective actions for the public and to provide the media with information. In addition, the provincial governments coordinate support from the licensees, the Government of Canada, and departments and agencies of all levels of government during their preparedness and response activities.

Every province/territory has its own unique emergency management structure and provincial nuclear emergency plans, which contain more information on specific areas under provincial responsibility and which detail components required to respond to a variety of radiological events. For Ontario, this is outlined in the [Provincial Nuclear Emergency Response Plan](#) (PNERP) and for New Brunswick in the [Point Lepreau Nuclear Off-Site Emergency Plan](#). Both plans were under review during the reporting period.

The provinces determine the need for, and direct the implementation of, protective actions, which include, among other areas:

- sheltering
- evacuation
- ingestion of potassium iodide (KI) pills
- ingestion control measures

Furthermore, the provinces also ensure arrangements are in place for:

- facilitating the availability of KI pills
- establishing reception and evacuation centres to accommodate evacuees (typically maintained at the municipal level)
- establishing centres to ensure radiation protection for emergency workers (typically managed at the municipal level)

The plans also identify responsibilities and broad measures to manage the recovery phase following an accident.

Challenge 9RM C-2 from Joint Eighth and Ninth Review Meeting

Approve and implement revision of Ontario's Provincial Nuclear Emergency Plan (PNERP)

The Province of Ontario typically reviews the PNERP on a 5-year cycle. In 2022, Ontario initiated a review of the PNERP, as well as the associated enhancements to the Nuclear Emergency Management Program (NEMP). The review of the PNERP was ongoing at the end of the reporting period. The NEMP enhancements are expected to be implemented by 2026 and will address preparedness (public education, training, etc), response (site-specific implementing plans), and recovery framework (including associated elements).

As the follow-up activities are ongoing, Canada recommends that Challenge 9RM C-2 remain open, as of the end of the reporting period.

To facilitate timely federal support to the provinces, provincial annexes to the FNEP have been developed by Health Canada and the relevant provincial authorities. These annexes describe the specific arrangements between the FNEP and provincial nuclear plans, including linkages between the federal and provincial/territorial emergency structures. Annexes are provided for those provinces that have operating NPPs or ports hosting foreign nuclear-powered vessels.

Highlights of the offsite nuclear emergency plans of the provinces that host NPPs are provided in annex 16.1(d). Additional details for each provincial plan, including a description of planning zones, event assessment, public alerting and protective measures, are provided in appendix B of Canada's report to the Second Extraordinary Meeting of the CNS.

Distribution of iodine thyroid-blocking agents

CNSC regulatory document [REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, Version 2](#) includes requirements for licensees to provide the necessary resources and support to provincial and regional authorities to ensure that a sufficient quantity of iodine thyroid-blocking agents (such as KI pills) are pre-distributed in the designated plume exposure planning zone and a sufficient quantity of KI is pre-stocked and ready for prompt distribution within the designated ingestion control planning zone. This involves both pre-distributing KI pills to all residences, businesses and institutions within the designated plume exposure planning zone (typically 8 to 16 km from the NPP) and pre-stockpiling KI pills within the designated ingestion control zone (typically 50 to 80 km from the NPP based on information in the planning basis). In New Brunswick, KI is pre-distributed out to 20 km and stockpiled in several locations within 50 km of Point Lepreau. In Ontario, KI is pre-distributed in the detailed planning zone (nominally 10 km from the NPP) and stockpiled within the ingestion planning zone (typically 50 km from the NPP). In 2019, the CNSC established a KI Pill Working Group and Advisory Committee to provide clarity on the existing plans and associated responsible authorities to distribute KI pills in the ingestion planning zone, in the event of an emergency at Pickering. During the reporting period, the Province of Ontario suspended the KIWG while it performed a technical study to update the PNERP.

The current status of KI distribution remains adequate. The procurement and pre-distribution of KI pills for the areas surrounding the OPG NPPs and Bruce A and B was completed in 2015. KI pills distributed in the areas surrounding OPG NPPs will not expire until 2027. Pre-distribution of NB Power redistributed new KI pills to residents within the specified area for Point Lepreau during the fall of 2021. Bruce Power plans to redistribute KI pills in 2025.

To date, Canadian NPP licensees have been responsible for the pre-distribution and stock piling of nearly 8.8 million KI pills in areas surrounding their facilities. Along with the pre-distribution, the NPP licensees launched a public education campaign with information for the public on the availability and use of KI pills through a combination of websites, pamphlets and various presentations to the public.

16.1 (e) Federal emergency plans

The Government of Canada's emergency planning, preparedness and response are based on an "all-hazards" approach. The Emergency Management Act sets out broad policy direction and general responsibilities for Public Safety Canada and all other federal ministers and their respective departments/agencies. It stipulates the scope of emergency preparedness at the federal level to include the four pillars of emergency management: mitigation, preparedness, response and recovery. The Minister of Public Safety has numerous responsibilities pertaining to the preparation, maintenance, testing and implementation of emergency plans. Among other things, these include:

- establishing policies
- providing advice to government institutions
- analyzing and evaluating emergency management plans prepared by government institutions

- monitoring potential, imminent and actual emergencies
- coordinating the Government of Canada's response
- coordinating federal and provincial responses; establishing arrangements with each province
- promoting public awareness of matters relating to emergency management
- conducting research related to emergency management

In support of this role, Public Safety Canada has prepared the all-hazards FERP to address governance and coordination issues for federal entities and to support the provinces and territories. The FERP is designed to harmonize federal emergency response efforts with those of the provinces and territorial governments, non-government organizations and the private sector, through processes and mechanisms that facilitate an integrated response. The FERP outlines the processes and mechanisms to facilitate an integrated Government of Canada response to an emergency and to eliminate the need for federal government institutions to coordinate a wider Government of Canada response. It has both national and regional-level components that provide a framework for effective integration of effort both horizontally and vertically throughout the federal government. The FERP identifies key emergency support functions, which are the functions most frequently used in providing federal support to provinces/territories or assistance from one federal government institution to another during an emergency. Governance for the FERP is provided by the Assistant Deputy Ministers Emergency Management Committee structure, which is led by Public Safety Canada. The FERP, last updated in 2011, is currently undergoing review for a new update.

While leadership for emergency management falls to the Federal Minister of Public Safety, the Emergency Management Act sets out responsibilities of other federal ministers. Coordination of federal nuclear emergency planning and response is specifically delegated to the Minister of Health. Because of the inherent technical nature and complexity of a nuclear emergency, hazard-specific planning, preparedness and response arrangements that supplement all-hazards arrangements are required. The Radiation Protection Bureau of Health Canada administers the comprehensive FNEP, which is integrated with and forms an annex to the FERP to coordinate the Government of Canada's technical response and support to the provinces/territories for managing the radiological consequences of any domestic, transboundary or international nuclear emergency. The FNEP complements the relevant nuclear emergency plans of other jurisdictions inside and outside Canada.

The FNEP undergoes periodic review to determine if updates are required. The last major update of the FNEP was published in 2014 and incorporated lessons learned from the Fukushima accident. The last minor update on the roles and responsibilities of participating organizations was in June 2019. The FNEP is currently being reviewed with the intention of incorporating lessons learned from various exercises, the Government of Canada's response to the COVID-19 pandemic that are applicable to nuclear emergency preparedness and response, as well as lessons learned from the response to the invasion of Ukraine. Health Canada plans to complete the revision of the FNEP by 2027.

The FNEP describes the roles, responsibilities and coordination of federal departments and agencies that support the scientific and technical response to manage the offsite radiological consequences of a nuclear emergency. There are 18 federal departments and agencies involved in the FNEP, including Health Canada, Public Safety Canada, the CNSC, Environment and Climate Change Canada, the Public Health Agency of Canada, Global

Affairs Canada, Natural Resources Canada (NRCan) and Transport Canada. Atomic Energy of Canada Limited (AECL) and Canadian Nuclear Laboratories (CNL) provide technical support to the FNEP. All departments and agencies are responsible for developing, maintaining and implementing their own organization-specific emergency response plans and operational procedures that align with and support the objectives of the FERP and FNEP. Some of these organization-specific plans are described below.

Health Canada supports the FNEP through the Federal Nuclear Emergency Management Committee and the Federal/Provincial -Territorial - Nuclear Emergency Management Committee. Both committees provide a forum for information exchange and the development of plans and joint projects to improve nuclear emergency management (e.g., updates to standard operating procedures and technical assessment products) at the federal level and within federal-provincial jurisdictions. They also provide advice and assistance to authorities responsible for nuclear emergency management.

During the reporting period, committee topics included the FNEP exercise and training program, the implementation of the nuclear exercise strategy developed in the previous reporting period, and the implementation of Canada's action plan that was developed following the June 2019 EPREV mission. The EPREV follow-up mission conducted in June 2023 concluded that Canada had completed or nearly completed all of the items in the action plan and all items were deemed closed by the review committee (see subsection 16.1(g) for details). During the reporting period, two exercises involving nuclear powered vessels were conducted, one on Canada's east coast and one on the west coast. Recovery was also discussed, with a workshop and table-top exercises conducted with participation from operators, all levels of governments and international organizations.

In terms of the provincial annexes to the FNEP during the reporting period, the Nova Scotia FNEP Annex was drafted following Exercise Maritime Integration to take into account lessons learned from the exercise. Concepts of operations to respond to a nuclear-powered vessel accident on the east and west coast were also developed and tested. See subsection 16.1(f) for details about exercises at operating NPPs. In all cases, lessons learned were addressed in follow-up actions focused on the development of more detailed operating procedures and arrangements.

Annex 16.1(e) describes the provisions of the FNEP in more detail.

In addition to managing the FNEP, Health Canada's Radiation Protection Bureau maintains a 24/7 duty officer service that receives notifications of any nuclear emergency, activates arrangements under the FNEP, and chairs the FNEP TAG.

Health Canada has a memorandum of understanding with Environment and Climate Change Canada – Canadian Centre for Meteorological and Environmental Prediction to provide a suite of atmospheric dispersion modelling capabilities for nuclear emergency management. For nuclear emergencies having transborder impact, arrangements have been developed with the United States. These bilateral agreements are established at the regional and national level. For instance, Health Canada has developed a statement of intent with the United States Department of Energy regarding nuclear and radiological emergency management and incident response capabilities. This bilateral arrangement promotes mutual assistance and collaboration between the two countries. See subsection 16.2(b) for details.

Emergency plans of federal departments and agencies

Per the Emergency Measures Act, individual federal organizations maintain their own all-hazards and event-specific plans that integrate with the FERP and FNEP, and support their mandates, roles and responsibilities in a nuclear emergency response.

Other federal organizations have specific primary functions for nuclear emergency preparedness and response under the FNEP: the Public Health Agency of Canada, the CNSC, Transport Canada, Environment and Climate Change Canada, NRCan, the Department of National Defence /Canadian Armed Forces, and the Canadian Food Inspection Agency. Several other federal organizations provide a supporting role. All organizations involved in the FNEP are expected to develop, maintain or update plans, procedures and capabilities consistent with their responsibilities detailed in the FNEP.

The CNSC has its own nuclear emergency response plan that clearly defines and enables its roles within the context of the FNEP. The CNSC participates directly in emergency planning activities with other FNEP core agencies. The CNSC also participates in some exercises to practice discharging its own emergency-related responsibilities. During an emergency, the CNSC continues its regulatory oversight of the affected licensee(s). The CNSC also provides expertise in an advisory capacity for the management of the emergency response. The CNSC has a well-developed and mature nuclear emergency management program that is based on its emergency response plan.

During the previous reporting period, the NPP licensees established links with the CNSC's Emergency Operations Centre (EOC) to enable online, automated transfer of plant data during an emergency; these measures have enhanced the CNSC's ability to execute its oversight and advisory responsibilities during a nuclear emergency. See annex 16.1(e) for more details on the CNSC's role in emergency preparedness.

Health Canada and the Public Health Agency of Canada maintain an all-hazards plan, the [Health Portfolio Emergency Response Plan](#), which describes its response framework to a range of emergencies that could impact public health. It includes a specific nuclear emergency annex to support the FNEP.

Other federal departments and agencies also develop their own nuclear emergency response plans. For example, Transport Canada administers the [Transportation of Dangerous Goods Act](#), 1992 and the [Transportation of Dangerous Goods Regulations](#) and operates the Canadian Transport Emergency Centre to ensure hazardous substances are transported safely and to help emergency response personnel handle related emergencies, including those involving nuclear substances. Transport Canada cooperates with the CNSC in emergencies and incidents involving nuclear substances, in accordance with the FNEP, relevant federal legislation and formal administrative arrangements.

16.1 (f) Emergency training, exercises and drills

All levels of government in Canada participate in nuclear emergency exercise programs with recurring cycles. These exercise programs incorporate a continuous improvement process, whereby response organizations at the federal, provincial and local level produce reports following each exercise and develop management action plans to incorporate lessons learned into future exercises and planning updates.

Emergency exercises confirm adequate implementation of onsite and offsite provisions in nuclear emergency response plans. Emergency drills are designed to provide training

opportunities for enhancing the abilities of involved parties to respond to emergency situations and to protect public health and safety during an event at a nuclear facility. Emergency exercises serve to test the sharing of information and to ensure all response efforts are coordinated and communicated effectively.

The frequency of emergency exercises at NPPs is defined in CNSC regulatory document [REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, Version 2](#).

REGDOC-2.10.1 states that licensees are directly responsible for training their personnel and involving them in emergency exercises and for appointing qualified personnel to their emergency teams. A schedule for both emergency drills and emergency exercises is established every year to ensure all responders, including alternates, have the opportunity to practice the required skills on a regular basis. All emergency exercise objectives are addressed over a seven-year period, with a full-scale emergency exercise conducted every three years. Full-scale emergency exercises involve, at minimum, several onsite and provincial and regional offsite stakeholders.

CNSC staff evaluate the full-scale emergency exercises at the NPPs to ensure licensees are effectively managing and implementing their emergency responses (specifically, the onsite provisions). Details of these exercises are provided in annex 16.1(f).

The municipalities, provinces, CNSC and other federal organizations may also participate in the exercises with NPP licensees (to a certain degree), depending on scope and objectives. The CNSC participates in some emergency exercises to practice discharging its own emergency-related responsibilities and to ensure communication lines are in place and in a state of readiness. Health Canada frequently participates in exercises with offsite components to provide support to the province in accordance with the FNEP's provincial annexes. Other federal departments may also participate.

The FNEP committees developed a seven-year exercise strategy to include different types of radiological/nuclear exercises. The strategy is integrated with Public Safety Canada's national exercise program as well as with provincial exercise programs. One major principle of the strategy is to hold a national priority exercise once every seven years involving multiple organizations from all jurisdictions and the participation of senior management in order to exercise decision-making at all levels. Smaller-scale exercises occur routinely between the national-priority exercises. The first priority exercise within this strategy was Synergy Challenge 2021 at Point Lepreau.

During the reporting period, Canada collaborated on the planning and execution of Exercise Cobalt Magnet 2025, a six-day, full-scale nuclear emergency response exercise led by the United States that focused on cross-border collaboration. The exercise simulated the consequences of a spent fuel pool accident on the shores of Lake Erie in Michigan. Given that the Canadian border lies within the 10-mile (16 km) automatic action zone, it was critical to ensure a coordinated response between Canadian and U.S. government organizations. Details of this exercise are also provided in annex 16.1(f).

16.1 (g) EPREV

During the previous reporting period, Health Canada had invited the IAEA to undertake an [Emergency Preparedness Review](#) (EPREV) for Class I facilities (NPPs) in Canada. The mission took place in June 2019 and presented Canada with 6 suggestions and 6 recommendations (and 5 good practices), which are listed in table 11. Canada accepted all

the findings and developed an action plan to address them. The EPREV report and Canada's response is available on the [Government of Canada's website](#). A follow-up mission took place in 2023, which noted that all recommendations and suggestions that were formulated in 2019 were closed, either on the basis of completed actions, on the basis of progress made and confidence in effective completion, or on the basis that it is no longer relevant.

Table 11: Recommendations and Suggestions from the EPREV report

Recommendations	
1	The government should ensure that the results of the nuclear security threat assessment are incorporated in a hazard assessment (closed).
2	The government should ensure that the protection strategy includes provisions for justification and optimization of the individual protective actions and the overall strategy. Once completed, the existing set of generic criteria should be expanded to cover the full set of protective actions (including the early response phase and transition phase as defined in the IAEA safety standards), and operating organizations should review the existing EALs to ensure consistency (closed).
3	The government should revise and further develop its arrangements for the protection of emergency workers and helpers and clarify how helpers in an emergency would be utilized (closed).
4	The government should ensure that there is a detailed monitoring strategy or strategies in place for emergency response and that sufficient resources are available in a suitable time to implement the strategy throughout the emergency response (closed).
5	The government should document and fully develop roles and responsibilities and arrangements for the safe management of off-site radioactive waste arising from an emergency (closed).
6	The government should develop detailed arrangements to terminate a nuclear or radiological emergency, including criteria and procedures for making a formal decision (closed).
Suggestions	
1	New Brunswick should consider conducting a comprehensive hazard assessment to ensure that emergency arrangements are fully in line with the hazards identified and potential consequences, including other facilities and activities concurrently with Point Lepreau Nuclear Generating Station (closed).
2	The government should consider revising arrangements for nuclear or radiological emergencies initiated by nuclear security events, including conducting exercises to test the arrangements (closed).
3	Ontario should consider designating medical personnel trained in the clinical management of radiation injuries (closed).
4	The government should consider continuing the current initiative to review the federal governance system for emergency preparedness and response and should consider any implications for national (federal-provincial-territorial) governance (closed).
5	The government should consider conducting an analysis of minimum resource requirements and training qualification for response organizations at all levels (closed).
6	The government should consider continuing the implementation of the strategy to ensure regular participation of senior officials with strategic decision-making authority in drills and exercises (closed).

16.2 Information of the Public and Neighbouring States

16.2 (a) Measures for informing the public during a national nuclear emergency

As described in subsection 9(c), the NPP licensees have implemented public disclosure programs that meet the requirements of CNSC regulatory document [REGDOC-3.2.1, *Public Information and Disclosure*](#). The information to be disclosed would include the impact of natural events (such as earthquakes), routine and non-routine releases of radiological and hazardous materials to the environment and unplanned events, including those exceeding regulatory limits. These requirements therefore cover severe accidents. For emergencies occurring at licensed nuclear facilities, the licensee/operator and the CNSC provide information about onsite conditions.

For domestic nuclear emergencies, each level of government and the nuclear facility are responsible for providing emergency public information to the media on their own jurisdiction's aspect of the emergency response. The provinces, however, are responsible for providing detailed protective action messages to affected parties. The provinces inform all relevant stakeholders prior to issuing the emergency bulletins to the public, which is done via broadcast and social media.

The FERP contains an emergency support function for communications at the federal level. The Federal Public Communications Coordination Group, led by Public Safety Canada and in collaboration with the provinces/territories, coordinates the federal government's communication response to the public, media and affected stakeholders (including private sector stakeholders). Federal government institutions contribute information to this group according to their mandates. The Government of Canada also provides communications in areas of federal jurisdiction (e.g., information to federal workers in affected areas). The Chief Public Health Officer of the Public Health Agency of Canada is the lead spokesperson for federal communications concerning offsite public health consequences.

To support the activities of the federal communications group, the FNEP has a support group to develop and/or provide technical input into communications products during a nuclear emergency. These products address topics such as technical information on the emergency, monitoring results and assessment of impacts. FNEP federal spokespersons also present the federal position on the nuclear emergency according to the specific issues at hand and in coordination with the provincial information centres.

In addition to the federal spokesperson, other federal public affairs staff may be dispatched to the provincial/territorial information centres, when the latter are established, to help coordinate information to the media and the public. For international communications, Global Affairs Canada (GAC) will provide advice and input into whole-of-government messaging regarding any international dimensions of a crisis as per GAC's emergency response function under the FERP. GAC will also act as the central channel for official communications with foreign states and international organizations resident in Canada, including with foreign diplomatic missions.

16.2 (b) International arrangements, including those with neighbouring countries

Canada participates in the IAEA [International Nuclear Event Scale](#) (INES) reporting system. Canada has excellent working relationships with the United States for the exchange of

emergency preparedness expertise. In addition, Canada has signed the following international emergency response agreement and ratified the two conventions noted.

Statement of Intent between Health Canada and United States Department of Energy

Health Canada and the National Nuclear Security Administration of the United States Department of Energy developed a statement of intent supporting joint Canada–U.S. nuclear emergency preparedness and response capabilities. It is supported through annual coordination meetings between Health Canada and the U.S. Department of Energy, to identify areas where coordination and cooperation, including information sharing and mutual assistance, would be beneficial to nuclear emergency management programs and capabilities and to elaborate strategies for moving forward with these interests.

Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency

Canada is a signatory of the IAEA's [Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency](#) (1986), which sets out an international framework for cooperation among countries and with the IAEA to facilitate prompt assistance and support in the event of nuclear accidents or radiological emergencies. It requires countries to notify the IAEA of the available experts, equipment or other materials they could offer in assistance. In case of a request for assistance from an affected country, each country decides whether it can offer the requested assistance. The IAEA serves as the focal point for such cooperation by channeling information, supporting efforts and providing its available services. The agreement sets out how assistance is requested, provided, directed, controlled and terminated. In 2012, Health Canada registered its radiological biodosimetry capabilities with the IAEA's [Response and Assistance Network](#) (RANET) in support of this convention. In 2016 and 2021 respectively, Canada registered its NPP accident-analysis and source search and recovery capabilities under RANET.

During the reporting period, Health Canada registered the following capabilities: Alpha spectrometry, beta counting, gamma spectrometry, cytogenetics-based biodosimetry, optical stimulated luminescence/electron paramagnetic resonance, and in-vitro/indirect bioassay; Environment and Climate Change Canada registered atmospheric dispersion.

During the reporting period, Canada continued to contribute to the request for assistance from Ukraine.

Health Canada participates in RANET technical meetings to review and update the RANET guidelines as necessary and to exchange experience on the practical arrangements for activating/deploying national assistance capabilities, such as radiological monitoring in response to nuclear or radiological incidents and emergencies.

Convention on Early Notification of a Nuclear Accident

Canada is a signatory to the IAEA's [Convention on Early Notification of a Nuclear Accident](#) (1986), which establishes a notification system for nuclear accidents having the potential for international transboundary release that could be of radiological safety significance for another country. The accident's time, location, radiation releases and other data essential for assessing the situation must be reported, both directly to the IAEA and to other countries (either directly or through the IAEA). In support of this convention, Health Canada provides real-time data from its Fixed Point Surveillance (FPS) radiation monitoring network to the

IAEA's [International Radiation Monitoring Information System](#) (IRMIS). During the reporting period, Canada participated in various IAEA organized Convention Exercises (ConvEx) organized in support of this convention as detailed in annex 16.1(f), as well as in development and implementation activities related to the IRMIS platform.

16.3 Emergency Preparedness for Contracting Parties Without Nuclear Installations

This part of article 16 does not apply to Canada.

Summary of Responses to Applicable Challenges and Suggestions

Challenge 9RM C-1 from Joint Eighth and Ninth Review Meeting

Update guidance document Generic Criteria and Operational Intervention Levels for Nuclear Emergency Planning and Response and include guidance on protection strategies and reflect guidance in provincial plans

Health Canada is updating and expanding its guidance document on nuclear emergency planning and response, adapting IAEA recommendations as appropriate. This includes advice on developing integrated protection strategies, emphasizing the importance of anticipating, recognizing, and mitigating both radiological and non-radiological hazards. Public consultation on the revision of this document is planned to commence in the fall/winter of 2025. The provincial plans of Ontario and New Brunswick reflect the current guidance, and they are scheduled for further adjustment following the approval of the updated guidance, which is expected in the next reporting period. Canada recommends that Challenge 9RM C-1 remain open.

Challenge 9RM C-2 from Joint Eighth and Ninth Review Meeting

Approve and implement revision of Ontario's Provincial Nuclear Emergency Plan (PNERP)

The Province of Ontario's review of the PNERP and associated NEMP enhancements were ongoing at the end of the reporting period. The NEMP enhancements are expected to be implemented by 2026. Canada recommends that Challenge 9RM C-2 remain open.

Notable Achievement(s)

Canada hosted the IAEA EPREV follow-up mission (2023), which confirmed the closure of all recommendations and suggestions for nuclear emergency preparedness from the 2019 mission.

Future Focus

Following the update of *Generic Criteria and Operational Intervention Levels for Nuclear Emergency Planning and Response*, Health Canada and the provinces will reflect the guidance in provincial nuclear emergency plans.

Bruce Power plans to redistribute KI pills in the vicinity of the Bruce site.

The Province of Ontario plans to approve changes to its PNERP and implement the associated NEMP enhancements.

CNSC plans to publish Version 3 of [REGDOC-2.10.1, Nuclear Emergency Preparedness and Response](#), which is being revised to ensure it will be applied to all Class I facilities, regardless of thermal output capacity and the novelty of the technology.



Health Canada plans to complete the review of the FNEP by 2027.

Canada will continue to complete any corrective actions identified through the emergency exercises conducted during the reporting period.



PART D: Safety of installations

Part D consists of three articles:

Article 17 Siting

Article 18 Design and construction

Article 19 Operation

Article 17: Siting

Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

- (i) for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;*
- (ii) for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;*
- (iii) for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;*
- (iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.*

Summary Statement for Article

Canada fulfills the obligations of article 17.

Introduction

In Canada, the term “siting” comprises site evaluation and site selection. The applicant’s selection of a site is not a regulated activity. However, the resultant site selection case is assessed as part of the application for a licence to prepare a site. The framework and process for issuing a licence to prepare a site for an NPP are described in sub-article 7.2(ii), with further details in subsection 7.2(ii)(b). As noted in subsection 7.2(ii)(b), during the reporting period, NB Power submitted an application for a licence to prepare site for one ARC-100 SMR at the existing Point Lepreau site.

The proposed location of a NPP and its thermal output will influence the type of environmental review(s) conducted to inform a licensing decision. For example, requirements for an integrated impact assessment (IA) under the *Impact Assessment Act* (IAA) are imposed if the proposed NPP meets the IAA project list threshold¹¹. Alternatively, the proposed NPP may require an environmental assessment within another jurisdiction (e.g., province/territory/area with a land claim agreement). The various environmental review types are described in more detail in subsection 17(ii)(a).

CNSC regulatory document [REGDOC-2.9.1, Environmental Protection: Environmental Principles, Assessments and Protection Measures](#), outlines the CNSC’s environmental protection principles and describes the different types of environmental reviews and environmental protection measures.

¹¹ The IAA replaced the older *Canadian Environmental Assessment Act*, 2012 during the reporting period, as noted in subsection 7.1(b). Any environmental assessments that commenced while the previous legislation was still in force continued under that legislation.

Level of NPP design information expected to demonstrate site suitability

Under the NSCA, the decisions made by the Commission on an application for a licence to prepare a site for a new NPP may be made with general facility design information from a range of reactor design considerations that might be deployed later at the site.

In order to obtain a licence to construct, sufficient and adequate information must be provided to describe the NPP-site interface and take into consideration the characteristics of the proposed site. The underpinning of the bounding approach is that the environmental effects of the reactor design eventually selected for construction must fit within the bounding envelope established in the environmental assessment and licensing process.

An applicant may choose to pursue a licence to prepare a site without selecting a reactor technology. In such a case, the activities permitted under the issued licence to prepare the site would be limited to site preparation activities that are independent of any specific reactor technology. Such activities include clearing and grading the site or building support infrastructure such as roads, power, water and sewer services, but do not include excavation for the purposes of establishing the facility footprint.

Regardless of the approach used by an applicant to its site selection case, a fundamental expectation of the CNSC is that the applicant will demonstrate the capability of an “intelligent customer”. This means that the applicant will be expected to demonstrate a clear understanding of the technologies it is proposing to use and the basis on which the site selection case is developed. See article 13 for additional information.

Site evaluation criteria – general

The information provided in an application for a licence to prepare a site is assessed against the criteria described in CNSC regulatory document [REGDOC-1.1.1, *Site Evaluation and Site Preparation for Nuclear Reactor Facilities*](#). REGDOC-1.1.1 guides the applicant to use a robust process to characterize proposed sites over the full lifecycle of the facility and then develop a fully-documented defence of the site selection. It adapts the tenets set forth by the IAEA safety requirements document [NS-R-3, *Site Evaluation for Nuclear Installations*](#) and its associated guides. REGDOC-1.1.1 addresses some Canadian expectations that are not addressed in NS-R-3, such as protection of the environment, security of the site, and protection of prescribed information and equipment.

REGDOC-1.1.1 elaborates upon the criteria for evaluating the effect of the site on the safety of the NPP (see subsection 17(i)) and the impact of the NPP on the surrounding population and the environment (see subsection 17(ii)(b)). Specifically, REGDOC-1.1.1 articulates the CNSC’s expectations with respect to the evaluation of site suitability over the life of a proposed NPP, and includes:

- the potential effects of external events (such as earthquakes, tornadoes and floods) and human activity on the site
- the characteristics of the site and its environment that could influence the transfer to persons and the environment of radioactive and hazardous material that may be released
- the population density, population distribution and other characteristics of the region, insofar as they may affect the implementation of emergency measures and evaluation of risks to individuals, the surrounding population and the environment

REGDOC-1.1.1 also identifies the need to consider certain aspects, such as security and decommissioning requirements, projected population growth in the vicinity of the site, and possible future life extension activities, when evaluating the site.

Additional details related to site evaluation criteria are provided under sub-articles 17(i) and 17(ii).

17 (i) Evaluation of Site-Related Factors

The safety case for the licence to prepare a site includes an assessment of hazards or bounding analysis and should address the impact of site-specific factors on the safety of the NPP. Such factors include the site's susceptibility to flooding (e.g., storm surge, dam burst), hurricanes, tornadoes, ice storms or other severe weather, and earthquakes. The return periods for severe weather, flood or wind are not prescribed. However, the applicant is expected to propose adequate periods based on criteria identified in the IAEA documents that are referenced in REGDOC-1.1.1.¹²

The applicant or licensee also has to perform a site-specific external hazards screening to identify other hazards. Furthermore, the applicant or licensee must consider combinations of events, including consequential and correlated events. Examples of consequential events include external events (such as a cooling water intake blockage caused by severe weather, a tsunami caused by an earthquake or a mud slide caused by heavy rain) and internal events (such as a fire caused by an earthquake). Examples of correlated events include heavy rainfall concurrent with a storm surge or high winds caused by a hurricane.

REGDOC-1.1.1 requires the applicant to consider climate change when evaluating the potential impact of these phenomena.

Site-related factors also include the proximity of the site to one or more of the following:

- railroad tracks (possibility of derailments and the release of hazardous material)
- flight paths for major airports (possibility of airplane crashes)
- toxic chemical plants (possibility of toxic releases)
- propane storage facilities or refineries (possibility of industrial accidents)
- military test ranges (possibility of stray missiles)

The above concerns are further affected by projected land use near the site, present and predicted population growth in the vicinity of the site, access to the site, emergency preparedness and security.

Additional factors that may be important to the safety of the proposed NPP include principal water sources, movement of water and water usage.

The applicant addresses these criteria during the application process for a licence to prepare site under the NSCA (and in the IA process, described in the next sub-article), the results of which are integrated into the safety case.

¹² specifically, IAEA safety guides NS-G-1.5, NS-G-3.2, NS-G-3.4 and NS-G-3.5

17 (ii) Impact of the Installation on Individuals, Society and the Environment

17 (ii) (a) Environmental reviews

CNSC staff conducts environmental reviews for any proposed projects or licensing actions that may have potential environmental effects. As noted at the beginning of this article, the type of environmental review that is conducted on a new reactor proposal depends on the proposed location of the reactor and its energy output, among other considerations.

When a proposal is listed in the IAA's [Physical Activities Regulations](#), it is considered a "designated project" and an integrated IA is required. The goal of an integrated IA is to help identify and assess the possible impacts of the project prior to any decision to build new nuclear and considers a wide range of factors including protecting the environment, ensuring respect for the rights of Indigenous Peoples and proposing measures to mitigate a project's anticipated adverse effects. This process considers the requirements of both the IAA and the NSCA in a single review.

If the proposal is below the IAA regulatory thresholds, an environmental protection review under the NSCA would be conducted and CNSC staff would present their findings to the Commission to inform its licensing decision.

The outcome of two other environmental review processes help inform the Commission's licensing decision, if applicable: a federal lands review to meet IAA requirements if an NPP is proposed on federal Crown lands, or an environmental assessment if required by a province or area subject to a land claim agreement (such as the territories and parts of Quebec and Newfoundland and Labrador).

The Commission uses the information gathered in the IA process in its licensing decision under the NSCA.

Challenge 9RM C-4 from Joint Eighth and Ninth Review Meeting

Ensure an effective approach between federal departments to provide proponents with certainty related to process and timelines for environmental impact assessments

CNSC staff are currently involved in multiple initiatives to meet the challenge of ensuring an effective approach between federal departments to provide proponents with certainty related to processes and timelines for environmental reviews, such as IAs. Integrated IAs consider the requirements under the IAA and the NSCA with the objective of "one project, one review." The Impact Assessment Agency of Canada (IAAC) collaborates with CNSC in the conduct of integrated IAs.

CNSC and IAAC established a memorandum of understanding on Integrated Impact Assessments Under the *Impact Assessment Act*. To ensure readiness for future integrated IAs, eleven joint working groups were established for CNSC and IAAC to work collaboratively to ensure that integrated IAs are conducted in an efficient and predictable manner and that processes are well aligned to reduce duplication. The key objective of these working groups is to discuss and document the integrated IA process at all stages, including: cooperation with other jurisdictions (including other federal and provincial departments and agencies), information management considerations, joint public and Indigenous engagement activities, and other topics.

CNSC and IAAC are updating their memorandum of understanding to incorporate a seamless experience for proponents that includes a three-year target.

In addition, CNSC is conducting work as part of its SMR readiness project to ensure its readiness to licence and regulate SMRs. This work includes more than 50 objectives to further explore areas for regulatory efficiency and optimize CNSC's regulatory framework for licensing new project proposals. One of the objectives under the SMR readiness project was to consider how a 'fleet' application (multiple SMRs located at one site) would be assessed within CNSC's environmental review framework. This work explored how an environmental review of a SMR fleet application would be addressed from a legislative and policy perspective, as well as developed and documented any impacts, efficiency gains, or challenges. It also included the identification and documentation of areas where the CNSC can promote domestic harmonization (federal, provincial, jurisdictional collaboration), as it relates to environmental reviews. This policy objective was completed in December, 2024. However, additional work may be required to implement the recommendations of the objective.

The planned activities to address Challenge 9RM C-4 are well established and progressing according to schedule. However, discussions at the working level continue and it is noted that the integrated IA process has yet to be completed. Canada recommends that this challenge remain open.

REGDOC-1.1.1 and REGDOC-2.9.1 highlight the applicant's environmental risk assessment (ERA; see subsection 15(b)) as a key input to environmental reviews.

During the reporting period, licence applicants initiated environmental reviews for new-build projects. NB Power submitted an application in 2023 for a licence to prepare site for an SMR at the Point Lepreau site. NB Power's site preparation licence is currently undergoing regulatory review and the project is completing a provincial-led environmental assessment. Bruce Power submitted an initial project description to the IAAC for its Bruce C project. See Section D.3 in the Introduction for additional details on these and other new-build projects at, or approaching, the stage of environmental review.

17 (ii) (b) Criteria for evaluating the safety impact of the NPP on the surrounding environment and population

As stated above, REGDOC-1.1.1 stipulates that the evaluation of site suitability includes consideration of specific factors relevant to the impact of the proposed NPP on the environment and population:

- site characteristics that could have an impact on the public or on the environment
- population density, distribution and other characteristics of the emergency planning zone that may have an impact on the implementation of emergency measures

The safety impact on the population examines the population dose from postulated events. Given that the NPP will perform as designed under accident conditions, it is important to consider population-related factors to meet radiation dose limits set by regulations. Such factors include the size, nature (e.g., subdivision, rural, industrial, school or hospital), distribution and demographics of population around the facility. Other factors include: local weather, seismicity, neighbouring facilities, and air and rail transport corridor activity. The applicant addresses these criteria in the safety case, which calculates the population doses and verifies that the NPP design meets its safety targets.

Before submitting an application for a licence to prepare site, the applicant should confirm with the surrounding municipalities and the affected provinces, territories, foreign states and neighbouring countries that the implementation of their respective emergency plans and related protective actions will accommodate the lifecycle of the proposed project.

Outreach to stakeholders and the local populace of the potential site – in particular, explaining the safety impact and how it is evaluated – is an important activity related to understanding the impact of a proposed NPP on the population and the environment.

More information on public information and disclosure and outreach activities related to new-build projects that were conducted by the CNSC and the applicants/licensees during the reporting period is provided in subsection 8.1(f) and annex 9(c), respectively.

17 (iii) Re-evaluation of Site-Related Factors

17 (iii) (a) Licensee activities to maintain the safety acceptability of the NPP, taking into account site-related factors

The continued acceptability of the NPP against the criteria mentioned in sub-articles 17(i) and 17(ii) is periodically verified against appropriate standards and practices. Possible changes to the site's demographics or significant changes to the understanding of the local environment must be examined through activities that include, for example; regular reviews of the licensee's emergency response and security measures, as well as revised external hazard analysis, which is an input to deterministic and safety analysis and probabilistic safety assessment (PSA).

Such changes include:

- environmental changes, including climate change (e.g. flood risk)
- changes to neighbouring man-made facilities (such as a newly constructed oil refinery, rail corridor, airport flight path or chemical plant)

Historical data assessment (for the past century) and future climate change prediction (for the next century) were performed in support of the original DNNP site preparation licence application. OPG considered key climatic parameters such as temperature, precipitation and wind speed. The impact on the extreme conditions due to climate change was addressed in the evaluation of meteorological events. Overall, the changes in extreme conditions did not go beyond the review level conditions for the environmental assessment; the ones that posed any hazard will be mitigated through designed barriers. OPG submitted detailed hazard analysis and safety assessment with respect to climate change to the CNSC in support of its application for a licence to construct an NPP. CNSC staff reviewed the submitted documents and confirmed that they comply with the associated CNSC regulatory guidance as well as the most up-to-date guidance from Environment and Climate Change Canada. The issued DNNP power reactor construction licence includes the completion of any remaining activities within the scope of the previous site preparation licence.

CNSC regulatory document [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants](#), requires licensees to regularly submit to the CNSC certain reports describing the effects of the NPP on the environment:

- updates to facility descriptions and final safety analysis report
- probabilistic safety assessment (PSA)
- environmental risk assessment (ERA)

These reports are to be submitted within five years of a previous submission or when requested by the CNSC. They include consideration of any relevant new techniques or information, which could include new data or insights related to external events.

Deterministic safety analysis and PSAs are described in subsections 14(i)(b) and 14(i)(c), respectively. ERAs are described in subsection 15(b).

REGDOC-3.1.1 also requires an annual report detailing the results of environmental monitoring programs, together with an interpretation of the results and estimates of radiation doses to the public resulting from NPP operations. See subsection 15(b) for details.

17 (iv) Consultation with other Contracting Parties likely to be affected by the installation

The [Espoo Convention](#), an international environmental convention developed under the auspices of the United Nations Economic Commission for Europe, requires the parties to the Convention to assess the environmental impacts of certain activities at an early stage of planning; provide to the government and public of an affected country an opportunity to participate in the assessment; and ensure that the results of the assessment are taken into account in the final decision about the project.

Canada shares borders with the United States, Denmark (Greenland), and France (Saint Pierre and Miquelon). All four countries are signatories of the Espoo Convention. However, the USA is the only country that has not ratified the Convention and is, therefore, not bound by its terms. Consequently, the Espoo Convention does not apply to projects that could have potential transboundary effects between Canada and the United States.

Although there are no transboundary notification requirements, the CNSC can use existing communication mechanisms through formal arrangements to notify and keep interested parties outside of Canada informed. Canada and the United States have a longstanding practice of cooperation with respect to transboundary impacts through such treaties as the [Boundary Waters Treaty](#) of 1909, the [Great Lakes Water Quality Agreement](#) of 1978 and the [Canada-United States Air Quality Agreement](#) of 1991. In addition, the CNSC and the United States Nuclear Regulatory Commission have an administrative arrangement for the exchange of technical information and cooperation in nuclear safety matters, including the siting of any designated nuclear facility in either country.

Canada would use the IAA processes to implement the requirements of the Espoo Convention if an NPP proposal had the potential for transboundary impacts for other parties to the convention. The IAA requires that effects to the environment that may occur outside of Canada (transboundary effects) be included in the environmental review for proposals requiring an impact assessment or a federal lands review, including proposed NPPs.

Furthermore, public participation opportunities (such as public hearings) are an important component of the CNSC's licensing process. The CNSC emphasizes public engagement and participation; members of the public, including people from outside Canada, are provided the opportunity to review licensing documentation and participate as intervenors in public hearings.

Summary of Responses to Applicable Challenges and Suggestions

Challenge 9RM C-4 from Joint Eighth and Ninth Review Meeting

Ensure an effective approach between federal departments to provide proponents with certainty related to process and timelines for environmental impact assessments

CNSC staff are currently involved in multiple initiatives to meet the challenge of ensuring an effective approach between federal departments to provide proponents with certainty related to process and timelines for environmental/impact assessments. Primarily, CNSC staff have been collaborating with the Impact Assessment Agency of Canada (IAAC) to ensure readiness for future integrated impact assessments (IAs). In addition, CNSC is conducting work as part of CNSC's SMR readiness project to ensure CNSC's readiness to licence and regulate SMRs. This work includes more than 50 objectives to further explore areas for regulatory efficiency and optimize CNSC's regulatory framework for licensing new project proposals.

Notable Achievement(s)

OPG systematically carried out historical data assessments and climate predictions for the DNNP to confirm that extreme conditions will remain within review level limits.

Future Focus

Canada plans to complete the work to ensure predictable processes and timelines for integrated IAs.

CNSC will continue to optimize the regulatory framework for licensing new project proposals.

Canada will continue the environmental reviews for new-build projects initiated during the reporting period (Point Lepreau SMR and Bruce C project).

Article 18: Design and construction

Each Contracting Party shall take the appropriate steps to ensure that:

- (i) the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defense in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;*
- (ii) the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;*
- (iii) the design of a nuclear installation allows for dependable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.*

Summary Statement for Article

Canada fulfills the obligations of article 18.

Introduction and developments related to new-build

Requirements for the submission of information in the application for a licence to construct an NPP are found in Paragraph 5 of the [Class I Nuclear Facilities Regulations](#). They include:

- a description of the proposed design of the nuclear facility, including the manner in which the physical and environmental characteristics of the site are taken into account in the design (paragraph 5(a))
- a description of the environmental baseline characteristics of the site and the surrounding area (paragraph 5(b))
- a description of the structures proposed to be built as part of the nuclear facility, including their design and their design characteristics (paragraph 5(d))
- a description of the systems and equipment proposed to be installed at the nuclear facility, including their design and their design operating conditions (paragraph 5(e))
- the proposed quality assurance program for the design of the nuclear facility (paragraph 5(g))

The general CNSC framework and process for issuing a licence to construct a Class IA nuclear facility are described in sub-article 7.2(ii).

As noted in subsection 7.2(ii)(b), during the reporting period, NB Power submitted an application for a licence to prepare a site at Point Lepreau. NB Power has partnered with ARC Clean Energy Canada to develop an SMR based on a non-water cooled design. The ARC-100 being proposed is a 100 MW(th), sodium-cooled fast reactor.

As noted in subsection 7.2(ii)(c), at the end of the reporting period, the Commission granted OPG a licence to construct one BWRX-300 reactor for the DNNP. This was a major achievement, as it was the first approval of construction of the BWRX-300 design (as well as the first approval of SMR construction in the G7). OPG is working with GE Hitachi Nuclear Energy on the design of the 300 MWe, water-cooled BWRX-300 reactor. The BWRX-300 is based on GE Hitachi's 1,520 MWe Economic Simplified BWR¹³. As a "10th generation boiler

¹³ Certified by the United States Nuclear Regulatory Commission

water reactor,” the BWRX-300 uses natural circulation and passive cooling isolation condenser systems to promote simplicity and inherent safety characteristic.

In response to existing, and in preparation for potential, additional new-build licence applications, the CNSC continues to update its design requirements for NPPs, participate in relevant international efforts and conduct pre-licensing vendor design reviews. These activities are described in the following subsections.

Canada sponsors significant R&D that addresses the area of design and construction (see annex D for details), with a major focus on R&D related to new technologies (subsections D.3, D.4, and D.5).

Specific design requirements and licensee provisions related to defence-in-depth, proven technologies, and reliable and manageable operation are described in sub-articles 18(i), 18(ii) and 18(iii), respectively, for the currently operating NPPs and potential new-build projects.

Updating design requirements for new-build projects

CNSC criteria for evaluating designs of new NPPs have been updated to be technology-neutral and to allow for the licensing various reactor technologies, sizes and uses, including non-water-cooled technologies.

CNSC regulatory document [REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants](#), sets out expectations for the design of new, water-cooled NPPs. To a large degree, REGDOC-2.5.2 represents the CNSC’s adoption of the tenets set forth in the IAEA safety standards [SSR-2/1, Safety of Nuclear Power Plants: Design](#), and the adaptation of those tenets to align with Canadian practices. Annex 7.2(i)(b) describes in greater detail how REGDOC-2.5.2 reflects various IAEA safety standards. To the extent practicable, REGDOC-2.5.2 sets technology-neutral requirements related to defence-in-depth, the use of proven technology and easily manageable operation of NPPs (e.g., reliability, human factors). Similar to SSR-2/1, REGDOC-2.5.2 requires the concept of defence-in-depth to be applied to all organizational, behavioural and design-related safety and security activities to ensure they are subject to overlapping provisions. Defence-in-depth is to be applied throughout the design process and operation of an NPP. The scope of REGDOC-2.5.2 addresses the interfaces between NPP design and other topics, such as environmental protection, safeguards, and accident and emergency response planning. Additional details on REGDOC-2.5.2 are provided in annex 18.

The CNSC published REGDOC-2.5.2. Version 2.1 in May 2023, which aligns with the latest IAEA safety standards and international best practices and is technology-neutral to the extent practicable for water-cooled reactors. A design other than a water-cooled reactor would be subject to the safety objectives, high-level safety concepts and safety management requirements associated with Version 2.1.

Upgrading designs of existing NPPs

For existing NPPs, the licensees have continuously made design improvements even though many of the updated design requirements were established after the NPPs were built. For example, design changes have been made to address new standards, on an ongoing basis, when the operating licences are renewed or amended. In addition, PSRs have been implemented, which require the licensee to determine reasonable and practical modifications

to enhance the safety of the facility to a level approaching that described in modern standards. Integrated implementation plans (IIPs) identify strengths and shortcomings for each of the safety factors identified in the PSR, rank the shortcomings in terms of safety significance, and prioritize corrective measures, including design and other safety improvements. The general regulatory approach to licence renewal and the use of PSR are described in subsection 7.2(ii)(d).

NPP licensees have successfully completed, and are completing, major refurbishment projects that safely extend the operational lifetime of a reactor beyond its originally assumed design life. Refurbishment projects are supported by PSRs and involve the replacement of major components and many other design upgrades that, to the extent practicable, bring the refurbished reactor to a level of safety comparable to that of a new facility.

Although the risk of an accident is very low, NPP operators have implemented several specific modifications to improve defence-in-depth and enhance their ability to withstand prolonged losses of power and other challenges, such as the loss of all heat sinks. See annex 18(i) of the ninth Canadian report for examples.

The following lists various examples of safety upgrades at the operating NPPs during the reporting period. These (and other improvements not listed) have addressed the factors discussed in sub-articles 18(i), (ii) and (iii).

- replacement of turbine controls (Bruce Units 4, 5 and 8, with other units planned)
- replacement of main output transformer (Bruce Units 2, 5, 6, 8)
- replacement of maintenance cooling heat exchanger (Bruce Units 3, 5, 6, 7, 8)
- replacement of digital control computer (Bruce)
- replacement of moderator heat exchanger (Bruce Unit 3)
- upgrades of the very early smoke detection systems (Bruce A and B control equipment rooms) and other fire protection upgrades such as detection upgrades and cable wrapping
- replacement of irradiated fuel bay heat exchangers (Pickering)
- commissioning of third emergency power system generator (Darlington)
- installation of additional auxiliary shutdown cooling system pumps to provide outage back-up heat sink function during common-cause events (Darlington)
- installation of feeders less resistant to flow-accelerated corrosion (Darlington)
- installation of an auxiliary shutdown cooling system (Darlington)
- implementation of a containment filtered venting system (Darlington)
- enhancements to powerhouse steam ventilation systems (Darlington)
- replacement of primary heat transport pumps and motors (Point Lepreau)
- replacement of emergency core cooling pump motors (Point Lepreau)
- replacement of shutdown cooling pump motors (Point Lepreau)

It is also noted that the CANDU reactor design is adaptable to the safe and reliable production of medical isotopes. Modifications have been made, or are planned, at the existing NPPs to produce a variety of isotopes, such as cobalt-60, molybdenum-99, and lutetium-177.

As an example, in 2020, OPG initiated production modifications to enable Co-60 production at Darlington. The work included detailed design of site modifications, equipment and tooling, procurement and installation. The Darlington site modifications will include the replacement of the 16 in-core stainless steel adjuster rods with Co-59 adjuster rods that, during operation, will activate to Co-60. The Co-60 adjuster rods will then be removed during an appropriate planned outage, placed in a shielded flask and discharged into the wet cask handling bay for

storage, packaging, and transported off site. As another example, OPG also initiated modifications to produce molybdenum-99 at Darlington. The installation of a target delivery system (Unit 2) made it possible to introduce and retrieve precursor materials and daughter radionuclides, respectively, to/from the reactor core through containment while on-power.

See subsection D.4 of the Introduction for other design and production-related details for isotope production at Darlington, Bruce, and Pickering. Note that the production of a medical isotope must be explicitly identified as a permitted activity in the operating licence for the NPP. To introduce the production of an isotope in an existing licence to operate requires an appropriate amendment; see sub-section 7.2(ii)(d).

International Coordination Related to Reactor Design

Canada supports the IAEA's Nuclear Harmonization and Standardization Initiative (NHSI). By the end of the previous reporting period, Canada had terminated its participation in the [Multinational Design Evaluation Program](#) (MDEP). See previous Canadian reports for a description of Canada's contributions.

Pre-licensing vendor design reviews

The CNSC has established an optional pre-licensing process to assess reactor facility designs based on a vendor's reactor technology. This service does not certify the reactor design or involve the issuance of a licence under the NSCA and it is not required as part of the licensing process for a new NPP. The conclusions of any pre-licensing vendor design review do not bind or otherwise influence decisions made by the Commission.

A pre-licensing vendor design review is an assessment by CNSC staff at the request of the vendor. The objective is to verify, at a high level, the acceptability of a reactor design with respect to Canadian regulatory requirements and expectations. This includes identification of fundamental barriers to licensing a new design in Canada. The process also assesses whether the vendor is developing the expected detailed evidence to support the adequacy of the proposed design.

CNSC regulatory document [REGDOC-3.5.4, Pre-licensing Review of a Vendor's Reactor Design](#), describes the process to interested parties and stakeholders. The CNSC assessment process is divided into three distinct phases. Typically, the CNSC provides a confidential report to the vendor at the end of each phase and an executive summary is posted on the CNSC website. The phases of pre-licensing vendor design reviews are described in annex 18, which also describes the status of pre-licensing vendor design reviews for SMRs conducted during the reporting period.

The CNSC has found the pre-licensing vendor design reviews to be extremely valuable – not only as part of preparing for future licence submissions but also providing an early understanding of the new design and its features, and their potential impacts on the regulatory framework. This process has contributed significantly to the CNSC's readiness for future licensing activities. Potential applicants may find that the pre-licensing vendor design reviews are helpful for informing applications for a licence to prepare site or construct of an NPP.

The CNSC also offers another optional pre-licensing service through the mechanism of preliminary regulatory design assessment should a vendor seek a focused review related to design novelty. This mechanism enables CNSC staff to provide feedback early in the design

process for individual elements of a vendor's technology, using aspects of the pre-licensing vendor design review process but without assessing the full reactor design.

18 (i) Implementation of Defence-in-Depth in /Design and Construction

REGDOC-2.5.2 describes five levels of defence-in-depth, which would ensure a low probability of failures or combinations of failures that would result in significant radiological consequences:

- preventing deviation from normal operation as well as failures of SSCs
- detecting and intercepting deviations from normal operation to prevent anticipated operational occurrences from escalating to accident conditions and to return the NPP to a state of normal operation
- minimizing accident consequences by providing inherent safety features, fail-safe design, additional equipment, and mitigating procedures
- ensuring radioactive releases from severe accidents are kept as low as practicable
- mitigating the radiological consequences of potential releases of radioactive materials during accident conditions

Design for the defence-in-depth approach considers the following:

- conservative design and high quality of construction to minimize abnormal operation or failures
- provision of multiple physical barriers (e.g., the fuel, pressure boundary and containment) that prevent the release of radioactive materials to the environment
- provision of multiple means for each of the basic safety functions (e.g., reactivity control, heat removal, confinement of radioactivity)
- use of reliable, engineered protective devices in addition to the inherent safety features
- supplementation of the normal control of the NPP by automatic activation of safety systems or by operator actions
- provision of equipment and procedures to detect failures, along with backup accident prevention measures to control the course and limit the consequences of accidents

The Canadian approach to NPP safety evolved from the recognition that even well-designed and well-built systems may fail. However, when the defence-in-depth strategy is properly applied, no single human error or mechanical failure has the potential to compromise the health and safety of persons or the environment. Emphasis has been placed on designs that incorporate “fail-safe” modes of operation that can be used should a component or a system failure occur. The approach also recognizes the need for separate, independent safety systems that can be tested periodically to demonstrate their availability to perform their intended functions.

The CANDU design and defence-in-depth strategy allows the currently operating Canadian NPPs to safely operate and, when necessary, safely shutdown their reactors, even for low-probability or rare internal and external events.

Some of the criteria that have guided the design of the currently operating NPPs in Canada and contributed to defence-in-depth are described in conjunction with the safety analysis criteria (described in subsection 14(i)(c)). Specific design criteria and requirements are found in some of the CSA Group standards included in the licensing basis for existing NPPs, such as:

- N285.0, *General requirements for pressure retaining systems and components in CANDU nuclear power plants*
- N293, *Fire protection for CANDU nuclear power plants*

As well, REGDOC-2.5.2 contains updated requirements related to defence-in-depth that will be applied to new-build projects and considered as part of PSRs for existing NPPs.

During the reporting period, CNSC staff deemed the level of defence-in-depth at all operating Canadian NPPs to be acceptable. It was also concluded that the risk to the Canadian public from beyond-design-basis accidents (BDBAs) at the existing NPPs was very low. Given the design features and defence-in-depth for Canadian NPPs, adequate time would be available for long-term mitigation of abdba.

The SMR designs being proposed for DNNP and Point Lepreau are intended to provide for safe shutdown and passive cooling in all scenarios.

The BWRX-300 design at DNNP has been developed with strict adherence to a philosophy that follows the IAEA defence-in-depth guidelines. The BWRX-300 defence-in-depth concept uses four fundamental safety functions (control of reactivity, fuel cooling, long-term heat removal and containment of radioactive materials) to define the interface between the defence lines and the physical barriers. In a given plant scenario, if the functions are performed successfully, then the corresponding physical barriers will remain effective.

The defence-in-depth of SMR designs proposed for the DNNP and NB Power (and other possible SMR projects) will continue to be assessed as the projects move forward.

18 (ii) Incorporation of Proven Technologies

In the regulatory framework, novel and innovative approaches can be implemented, provided that sufficient evidence exists, along with adequate provisions, to show that they can be implemented safely. In each phase of licensing, documents have to be submitted that describe, verify and validate the technology employed. These include the design and safety analysis information contained in the safety analysis report and the quality assurance program(s) for design and safety analysis.

REGDOC-2.5.2 includes expectations related to proven engineering practices and qualifying designs (see annex 18). These would apply to new-build projects and to the existing reactors through the application of PSR – specifically, for any design enhancements or safety analyses identified in the IIP.

CNSC regulatory document [REGDOC-2.4.1, *Deterministic Safety Analysis*](#) also includes expectations related to the use of methods and inputs that have been proven by validation. Specifically, it requires applicants and licensees to demonstrate how safety analysis computer codes meet the requirements of CSA Group standard N286.7, *Quality assurance of analytical, scientific and design computer programs for nuclear power plants*. REGDOC-2.4.1 is applicable to new-build projects, and the licensees of existing NPPs are applying it for new and revised safety analyses.

Most SMR concepts, although based on technological work and OPEX from older NPPs, employ a number of novel approaches. As noted above, CNSC licensing reviews will assess the potential effect of novel approaches, or proven approaches used in different ways, by applying the safety objectives, high-level safety concepts and safety management requirements outlined in REGDOC-2.5.2. Specifically, CNSC staff will assess the impact of alternate approaches on the certainty of plant performance under both normal operation and accident conditions. The application of expectations in documents such as REGDOC-2.5.2 and REGDOC-2.4.1, which are technology-neutral and non-prescriptive, in a risk-informed

and graded manner, is intended to ensure that the technologies associated with SMRs will be sufficiently proven without unnecessarily impeding innovation.

For the existing operating reactors, the CANDU design criteria and requirements dictate that the design and construction of all SSCs follow the best applicable code, standard or practice and be confirmed by a system of independent audit.

In particular, for pressure boundaries, the CNSC reviews the design against the requirements of the NSCA and the associated regulations and approves the classification using the expectations in CSA Group standard N285.0, *General requirement for pressure-retaining systems and components in CANDU nuclear power plants*. The licensee then registers the design with an authorized inspection agency, which audits the fabrication of the design, inspects the construction, installation and tests, and countersigns the pressure test results.

Licensees use safety analysis computer codes that have been validated in accordance with CSA N286.7. The tools and methodologies used in the safety analysis report are proven according to national and international experience and reflect the modern state of knowledge.

The licensees of operating NPPs update their safety analysis reports at least once every five years or when requested to do so by the CNSC. REGDOC-2.4.1 sets the expectation for updates of the safety analysis report to incorporate new information, address new issues that have been identified, use current tools and methods, and address the impact of modifications to the design and operating procedures. Revisions to the safety analysis report incorporate experimental data and R&D findings. As a result, some of the events in the safety analysis report are re-analyzed when necessitated by advances in science and technology.

Furthermore, REGDOC-2.4.1 stipulates the selection of computational methods or computer codes, models and correlations that have been validated for the intended applications. The requirements in REGDOC-2.4.1 will be gradually addressed for existing NPPs, as explained in subsection 14(i)(c).

AtkinsRéalis continues to pursue advancements in technologies through various initiatives including, advancements in the toolset for the removal and installation of reactor components for the CANDU refurbishment (retube) projects. One example is the successful deployment of tooling that simultaneously removes the pressure tube and calandria tube, which results in a reduction in worker dose while achieving a significant reduction in critical path time on retube projects. The prototype tool was designed, developed, tested, and qualified in the large-scale laboratory at AtkinsRéalis. The tool was successfully deployed for the Darlington refurbishment project.

Environmental qualification programs at operating Canadian NPPs also help to prove that safety systems and safety-related systems will operate as intended, insofar as they are relied upon to help prevent, manage and mitigate accidents. The NPP licensees have ongoing programs to systematically sustain (and, if necessary, update) the environmental qualification of safety and safety-related systems in accordance with CSA Group standard N290.13, *Environmental qualification of equipment for CANDU nuclear power plants*. To ensure environmental qualification technical issues are managed in a timely way, these programs typically involve a governance mechanism, a list of equipment to be maintained in the environmental qualification state, staff training, technical basis documents, and processes for

dealing with emerging issues. The CNSC monitors the progress of these programs, in addition to conducting ongoing inspections of the systems.

18 (iii) Design for Reliable, Stable and Manageable Operation

Consideration is given to human factors and human-machine interfaces throughout the entire life of an NPP to make sure the NPP is tolerant of human errors.

The consideration of human factors in design and the application of human factors in engineering are described in subsection 12(e). Details in REGDOC-2.5.2 that are related to reliability, operability, human factors and the human-machine interface are provided in annex 18.

Additionally, CNSC regulatory document REGDOC-2.3.2, *Accident Management*, Version 2 takes into account personnel needs, including aspects such as information, procedures, training and habitability of facilities required to manage accidents.

The requirements for safety parameter display illustrate how human factors and human-machine interface are considered in the design of Canadian NPPs. REGDOC-2.5.2 specifies a safety parameter display system that presents sufficient information on safety-critical parameters for the diagnosis and mitigation of design-basis accidents and design extension conditions. The safety parameter display system must be integrated and harmonized with the overall control room human-system interface design. The panel displays for existing CANDU NPPs can all show post-accident monitoring parameters (parameters that monitor when process or safety limits are being approached and the status of safety systems).

Notable Achievement(s)

The Commission granted OPG a licence to construct one BWRX-300 reactor for the DNNP.

NPP licensees modified existing NPPs to safely produce a variety of medical isotopes, including cobalt-60, molybdenum-99, and lutetium-177.

CNSC utilized pre-licensing vendor design reviews for a variety of reactor designs prior to engaging in formal licensing activities. The reviews have enhanced CNSC staff's readiness to review applications involving novel nuclear technologies and have familiarized proponents with the regulatory requirements and expectations.

Canada conducted significant R&D related to design and construction of new nuclear technologies.

CNSC updated [REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants](#), to align with the latest IAEA safety standards and international best practices, while remaining technology-neutral.

NPP licensees executed numerous safety upgrades that enhanced defence-in-depth, incorporated proven technology, and facilitated reliable operation.

Future Focus

Ongoing confirmation of defence-in-depth and the proof of reliable and safe technologies technology employed in existing and proposed designs.

Article 19: Operation

Each Contracting Party shall take the appropriate steps to ensure that:

- (i) the initial authorization to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;*
- (ii) operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;*
- (iii) operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;*
- (iv) procedures are established for responding to anticipated operational occurrences and to accidents;*
- (iv) necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;*
- (v) incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;*
- (vi) programmes to collect and analyze operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies.*
- (viii) the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.*

Summary Statement for Article

Canada fulfills the obligations of article 19.

Introduction

Although sub-article 19(i) covers initial authorization to operate an NPP, the Canadian regulatory regime also entails set durations for licences to operate, as described in subsection 7(ii)(d), leading to renewals of the licences to operate the NPPs.

Overall, this reporting period continued the trend of efficient and safe operation of NPPs in Canada. There were very few events of any significance, limited forced outages and, consequently, relatively long, event-free production runs. This can be attributed to the operators' focus on equipment reliability, with specific focus, for example, on reducing maintenance backlogs, eliminating operator challenges and work-arounds, human performance training, eliminating single point vulnerabilities and reducing the number of deferrals of preventative maintenance.

As noted in subsection 7.2(ii)(d), during the reporting period, the Commission renewed NB Power's licence to operate Pt Lepreau. As also noted in subsection 7.2(ii)(d), during the reporting period, OPG applied for a renewal of its licence to operate Darlington. The Commission's licensing decision will be made in the next reporting period.

19 (i) Initial Authorization

There were no initial licensing activities related to operating a new NPP during the reporting period.

The CNSC's consideration of an application for an initial licence to operate an NPP is predicated on the applicant having already demonstrated conformance with the requirements for siting, design and construction (as outlined in subsections 7.2(ii)(b) and 7.2(ii)(c) and in articles 17 and 18). The information that an applicant is expected to submit with an application for a licence to operate is outlined in CNSC regulatory document [REGDOC-1.1.3, Licence Application Guide: Licence to Operate a Nuclear Power Plant](#) (it reflects the requirements in the regulations for information to be included in the application; see subsection 7.2(ii)(d) for additional details). The granting of an initial licence to operate is based upon an appropriate safety analysis and a proposed commissioning program to demonstrate that the NPP will meet its design and safety requirements.

General requirements related to deterministic safety analysis and probabilistic safety assessment (PSA) are described in subsections 14(i)(c) and 14(i)(d), respectively. The final safety analysis report submitted with an application for a licence to operate a new NPP will be assessed against CNSC regulatory documents [REGDOC-2.4.1, Deterministic Safety Analysis](#), [REGDOC-2.4.2, Probabilistic Safety Assessment \(PSA\) for Nuclear Power Plants](#), and [REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants](#).

Several CNSC staff members are located at the NPP site to observe the commissioning and start-up processes and activities. The objectives of regulatory oversight of the NPP commissioning program are to determine that:

- the commissioning program is comprehensively defined and implemented to confirm that the structures, systems and components (SSCs) important to safety and the integrated plant will perform in accordance with the design intent, safety analysis and applicable licensing requirements
- the operating procedures covering all operating and abnormal states have been validated to the maximum extent practicable
- the commissioning and operating staff have been trained and qualified to commission the NPP and operate it safely in accordance with the approved procedures
- the management system has been adequately defined, implemented and assessed to provide a safe, effective and high-quality working environment to perform and support the conduct of the commissioning program

As part of its review of an application for an initial licence to operate, CNSC staff conduct desktop reviews of processes in the licensee's commissioning program. Additionally, once a licence is issued, CNSC staff perform inspections at any time to confirm that procedures are followed, the test results meet expectations, and appropriate decisions are made. CNSC staff witness major commissioning tests of special safety systems, such as functional tests of the shutdown systems where the reactor is tripped and the rate of power reduction is measured (and compared to the rate assumed in safety analyses). For these tests, CNSC staff review the proposed execution of the test, including detailed commissioning specifications, to confirm that the test's acceptance criteria are consistent with the system's safety design

requirements. Following completion, CNSC staff review the test results and commissioning reports. CNSC staff may attend licensee meetings to review the commissioning work on particular systems.

Detailed commissioning specifications define the acceptance criteria to be used in inspections and tests performed as part of the commissioning program. Typically, the licensee's procedures require the designers to verify that the commissioning program identifies appropriate tests and acceptance criteria to prove that the equipment can perform the safety functions intended in the design. Any failure to meet the acceptance criteria must be referred back to the design organization, which will decide if design changes are required.

In some cases, partial tests are done if complete tests are not practical. For example, in the past, commissioning tests were done that involved injection of emergency coolant into the reactor core. However, tests in which cold water is injected into a hot core were not attempted, because such tests could lead to high stresses in the primary coolant system components. The components are designed to withstand these stresses during a limited number of emergencies, but exposing them to such high stresses simply for testing purposes could not be justified.

Commissioning tests are to be performed in phases and in a logical progressive sequence as detailed in CNSC regulatory document [REGDOC-2.3.1, Conduct of Licensed Activities: Construction and Commissioning Programs](#). There are at least four phases:

- Phase A prior to fuel load
- Phase B prior to leaving reactor guaranteed shutdown state
- Phase C approach to critical and low-power tests
- Phase D high-power tests

It should be noted that licensees may incorporate additional phases in a project; and that SMRs could have entirely different phases. There is a regulatory hold point at the end of each phase and, depending on the situation, the CNSC may request additional regulatory hold points. The selection of regulatory hold points will generally be agreed by the licensee and the CNSC and incorporated into the licence to operate the NPP.

Before proceeding to the next commissioning phase, the licensee demonstrates to the CNSC that all prerequisites established between the licensee and the CNSC necessary for proceeding beyond the current phase are met. In addition, before transitioning to the subsequent phase, the licensee ensures that SSCs credited in the safety case for that phase have been installed and confirmed to the extent practicable to meet their designed safety function.

Per REGDOC-2.3.1, the following steps should be undertaken at the end of each commissioning phase:

- Documents should be prepared and issued to certify the performance of tests and provide phase clearances for the continuation of the commissioning program.
- Test certificates should be issued by the commissioning organization to certify that the tests have been completed in accordance with authorized procedures, stating any reservations about departures from or limitations of the procedures.
- Phase completion certificates should be issued by the commissioning organization to certify that all the tests in the respective commissioning phase have been satisfactorily completed (listing all deficiencies and non-conformances, if any). Phase completion certificates should also list associated test certificates, even if they are not prerequisites for the approval being sought.

- It should be ensured that succeeding phases can be conducted safely and that the safety of the reactor facility is never dependent on the performance of untested SSCs.

As there is a regulatory hold point at the end of each phase, the written request to the CNSC for approval to proceed beyond a commissioning phase should confirm that:

- all related project commitments tied to the phase have been completed
- all systems required for safe operation beyond the phase are available
- all specified operating procedures have been formally verified and validated
- specified training has been completed and staff are qualified
- all non-conformances and unexpected results identified leading up to the next phase have been addressed

In its decision for an initial licence to operate, the Commission may delegate (e.g., to a member of CNSC staff) its decision-making authority for any or all regulatory hold points (the Commission has made such delegations for regulatory hold points associated with refurbishment projects).

19 (ii) Operational Limits and Conditions

19 (ii) (a) Identification of safe operating limits

Paragraph 6(b) of the [*Class I Nuclear Facilities Regulations*](#) states the requirement to describe, in an application for a licence to operate, the facility's systems and equipment, including their design and operating conditions.

The safe operating limits satisfy regulatory requirements, standards and guidelines related to NPP design and operation, including defence-in-depth principles. Historically, these are implemented in operating manuals and impairment manuals (see sub-article 19(iv)).

The full set of requirements for safe operation of a CANDU NPP includes:

- requirements on special safety systems and safety-related standby equipment or functions (e.g., set points and other limiting parameters, and availability requirements)
- requirements on process systems (e.g., limiting parameters, testing and surveillance principles and specifications, and performance requirements under abnormal conditions)
- prerequisites for removing special safety systems and other safety-related or process standby equipment from service

These requirements are derived from design-basis safety analyses that are described in the safety analysis report. The safety analysis examines the NPP's responses to disturbances in process functions, system failures, component failures and human errors. Other requirements (e.g., those identified through design support analysis or PSA) could include limitations related to equipment and materials, operational requirements, equipment aging, instrumentation and analysis uncertainties, and more. Assessments of failure modes and effects analysis can also identify requirements that form part of the safe operating envelope (SOE). In principle, the analysis considers all allowable power levels; however, it is not feasible to analyze in advance every potential state that could occur throughout the life of an NPP. Therefore, the analysis attempts to consider sufficient situations to define operating limits that encompass the expected variations in conditions at a reasonable level of system/equipment performance detail. Operating limits for Canadian NPPs are identified in the SOE documentation. Changes to these limits that may negatively affect safety require appropriate justification by operations support staff and are reviewed by the CNSC.

19 (ii) (b) Safe operating envelope

The purpose of the SOE program is to clearly define the safe operating limits for NPPs so that they can be readily monitored by or on behalf of the operations staff. In the past, the licensees primarily used the operating policies and principles (OP&Ps) to define relevant operational limits. However, because the OP&Ps represented only a subset of the relevant limits, during previous reporting periods the licensees established a comprehensive set of limits, which are documented in operational safety requirements. The limits were based on deterministic safety analysis in accordance with CSA Group standard N290.15-10, *Requirements for the safe operating envelope of nuclear power plants*.

With SOEs now implemented, all licensees of operating NPPs commenced the maintenance phase and periodically review document changes resulting from revisions to design, operation, safety analysis or licence requirements against the SOE documents.

19 (iii) Procedures for Operation, Maintenance, Inspection and Testing

Operation, maintenance, inspection and testing of SSCs at the NPPs are conducted in accordance with approved governance and procedures that are incorporated in the NPP's management system (see subsection 13(a)). The governance defines the organizational and administrative requirements for the establishment and implementation of operations, preventive, corrective and predictive maintenance; periodic inspections; tests; repairs and replacements; training of personnel; procurement of spare parts; provision of related facilities and services; and generation, collection and retention of operating and maintenance records.

CNSC regulatory document [REGDOC-2.6.2, Maintenance Programs for Nuclear Power Plants](#) sets the requirements for policies, processes and procedures for maintaining the SSCs of each NPP. The range of maintenance activities specified includes monitoring, inspecting, testing, assessing, calibrating, servicing, overhauling, repairing and replacing parts – all intended to ensure that the reliability and effectiveness of all equipment and systems continue to meet the relevant requirements.

CNSC regulatory document [REGDOC-2.6.1, Reliability Programs for Nuclear Power Plants](#) states that a reliability program for an NPP must:

- identify all systems important to safety
- specify reliability targets for those systems
- describe the potential failure modes of those systems
- specify the minimum capabilities and performance levels of those systems needed to satisfy regulatory requirements and the safety targets of the NPP
- provide input for the maintenance program to maintain the effectiveness of those systems
- provide for inspections, tests, modelling, monitoring and other measures to assess the reliability of those systems
- include provisions to assure, verify and demonstrate that the program is implemented effectively
- document the elements of the program
- report the results of the program

The identification of systems important to safety is done using input from PSAs, deterministic analyses and expert panels.

NPP's have requirements for the maintenance and testing procedures for special safety systems to ensure that no safety function is ever compromised by maintenance activities.

Safety system testing is required at a frequency that demonstrates each safety function is operating correctly and meets availability limits (typically, greater than 99.9% in the currently operating NPPs). Each component of a special safety system is subject to regular testing. Specific requirements for testing to confirm the availability/functionality of safety and safety-related systems are described in subsection 14(ii)(a).

Procedures used by NPP staff during routine operation of the NPP and its auxiliary systems are located in the operating manuals. The operating manuals contain:

- system-based procedures that assist the operators during normal operations, such as system start-up and shutdown and minor malfunctions limited to individual systems
- overall unit-control procedures that coordinate major evolutions such as unit start-up and shutdown and major plant transients
- alarm response manual procedures that provide the operations staff with information regarding alarm functions; typical information provided includes set points, probable causes of alarms, pertinent information, references and operator responses

To aid the safe and consistent operation of the NPPs, the licensees write detailed station condition records or event reports. These documents provide information on undesirable events considered significant in the operation of NPPs. They are reviewed to confirm safe operation and help identify necessary corrective actions or opportunities for improvement (see sub-article 19(vii) for more details). Less significant issues are also reported for trending purposes.

The NPP licensees implemented several improvements during the reporting period that will positively affect various aspects of operation, maintenance, inspection, testing and reliability. Improvements to surveillance hardware and software were also implemented to improve component and system surveillance and trending capabilities. For example, Bruce Power created efficiencies in its processes through the use of data analytics and AI tools to reduce duplication and automate processes. This helped Bruce Power to reduce its corrective non-critical maintenance backlog by over 64% and deficient non-critical maintenance backlog by 35% in 2024.

At Darlington, the shutdown system (SDS) monitoring computers for each unit were replaced in 2015 with a modern platform and software to address hardware obsolescence and implement operator interface improvements, as well as to sustain shutdown system reliability and plant safety for extended Darlington operations. Similarly, OPG is replacing the trip and display/test computers for both computerized SDSs during refurbishment. The SDS computer replacement is complete on three units and the last unit replacement is planned for completion in 2025. Although all OPG NPPs have always had digital control and monitoring for reactor control and fuel handling, OPG is transitioning other control room instrumentation from analog to digital at all its NPPs to improve monitoring and control capabilities.

At OPG, the monitoring and diagnostics centre offers a comprehensive suite of data analytics services to support engineering, operations, and maintenance by harnessing AI and emerging technologies. Since its inception in 2018, the centre has successfully developed and deployed approximately 1,300 AI models to enhance the reliability of equipment within the nuclear fleet. These models are designed to simulate the healthy behavior of components and equipment, enabling the comparison with real-time data to detect early signs of degradation. Notably, the majority of these models are applied to the conventional side of operations.

In addition to AI model deployment, the monitoring and diagnostics centre provides analytical services and tools that assist engineering and operations in monitoring trends and receiving notifications regarding their components and systems of interest under diverse operational conditions. By utilizing online data, the centre has transitioned approximately 3,000 hours of annual preventive maintenance to a condition-based maintenance approach. Furthermore, the centre employs thermodynamic modeling of the steam cycle to identify generation losses attributable to steam bypasses, leaks, or other conditions.

Procedures are also enhanced to ensure that new technologies do not inadvertently introduce new hazards or increase risk. For example, the COG fire protection peer group observed that fire hazards were changing due to increased use of lithium-batteries (e.g., larger batteries in vehicles such as tow-motors, forklifts, as well as storage of significant quantities of smaller batteries for handheld tools in a single location). The group reviewed international OPEX and best practices from NPPs and other industries, battery manufacturers, insurers, and Canadian Government regulations. The group then developed comprehensive fire safety guidelines and best practices for the procurement, use, storage, handling, and onsite disposal of lithium-ion batteries.

19 (iv) Procedures for Responding to Operational Occurrences and Accidents

The *Class I Nuclear Facilities Regulations* require each NPP licensee to have measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances, as well as measures to assist offsite authorities in emergency preparedness activities. CNSC regulatory document [REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, Version 2](#) provides the detailed requirements for onsite emergency plans and response capability. Emergency plans and programs, including accident management provisions, are submitted to the CNSC as part of the licence application (see subsection 16.1(b) for details). The CNSC also observes emergency training, exercises, drills and on-site severe accident management to confirm adequate implementation of the licensees' onsite provisions in their emergency response plans.

The consequences of reactor accidents can be minimized by sound onsite and offsite accident management. This is achieved by developing operating procedures in advance to assist and guide operators in responding to accidents. Each NPP licensee maintains a minimum staff complement (MSC) to make sure there are always sufficient numbers of appropriately qualified staff available to respond to emergencies (for details, see annex 11.2(a)). All Canadian NPPs have a comprehensive, hierarchical set of manuals and procedures – covering normal plant operation, anticipated operational occurrences and accident conditions – that are routinely tested in onsite drills. Although procedures vary among NPPs, the system generally contains:

- an abnormal incident manual
- a special safety system impairments manual (which may be a subset of the abnormal incident manual)
- a radiation protection manual (or radiation protection directives)

The suite of abnormal incident manual procedures directs the operations staff following safety system impairment, process system failure or a common-mode event (anticipated operational occurrences). These are typically event-based procedures and have as their end points the safe shutdown of the unit. Critical safety parameter procedures provide support for

all procedures but are especially useful during transients. They provide structure for the augmented monitoring of critical NPP operating parameters during specific accident conditions and in cases when the specific event cannot be determined. They also provide symptom-based frameworks for controlling the reactor, cooling the fuel and containing radioactivity.

Radiation protection manual procedures are provided to protect the safety of the operators and the general public under normal conditions and in the event of a significant radiation incident. These procedures:

- direct event classification and categorization
- provide for offsite notification
- direct protective actions and monitoring during accident conditions

Significant events are followed up by formal determination of root causes and with corrective actions that are commensurate with the situation.

Examples of safety-significant operational events occurring at Canadian NPPs during the reporting period are described in annex C. They illustrate how the licensees responded to the events and how the CNSC conducted regulatory follow-up. The licensees' efforts to address these operational events were effective in correcting deficiencies and preventing recurrence. None of the events posed a significant threat to persons or the environment. For example, there were no serious process failures⁴ at any NPP during the reporting period. This contributed to the trend, noted above, of overall efficient and safe operation of NPPs in Canada.

Severe accident management

Severe accident management (SAM) focuses on preventing the progression of an accident into a severe accident or mitigating a severe accident when the preventive means have failed. It relies on the design, guidance and procedural provisions used by NPP staff as well as appropriate training activities. Response to severe accidents can be enhanced by external resources that supplement or replace the onsite resources, including fuel, water, electric power or equipment such as pumps or generators. The CNSC's expectations are found in CNSC regulatory document REGDOC-2.3.2, *Accident Management*, version 1 but are also found in CNSC regulatory document [REGDOC-2.3.2, *Accident Management*, version 2](#). Furthermore, REGDOC-2.10.1 requires licensees to perform emergency plant drills or large-scale emergency exercises that simulate severe accident scenarios where SAM guidelines (SAMGs) and emergency mitigating equipment guidelines (EMEGs) are exercised.

SAM provisions may differ among NPPs, depending on the location and nature of the NPP (single-unit facilities in relatively remote rural locations versus multi-unit facilities close to major urban centres).

Severe accident management guidelines

The licensees have implemented plant-specific SAMGs that consider plant-specific designs, operation, equipment, instrumentation and organizational structure. This includes roles and responsibilities of the personnel involved in SAM and emergency response, guidelines for control room and technical support group operations, specific staff training requirements and appropriate drills and exercises.

The post-Fukushima review of procedural guidance and design capabilities of operating NPPs to cope with accidents, including those involving significant core damage, confirmed that SAMGs were adequate. During the reporting period, the licensees completed the implementation of the post-Fukushima updates to SAMGs and the demonstration of SAMG effectiveness through exercises and plant drills.

Licensees also have EMEGs to guide the deployment of emergency mitigating equipment as an additional onsite capability to provide water and electricity to cope with accidents. EMEGs and SAMGs are integrated with plant procedures (e.g., abnormal incident manuals and emergency operating procedures). NPP licensees have deployed SAMG kits at strategic locations to allow for rapid implementation of SAMG measures. The kits include the tools, materials and equipment needed to carry out SAMG actions in a timely fashion.

The licensees verify SAMG/EMEG documentation and training and validate the SAM program mainly through table-top exercises, plant drills or large-scale emergency exercises that simulate severe accident scenarios.

During the reporting period, CNSC staff completed an integrated assessment of the licensees' SAM programs and concluded that SAMGs and EMEGs were effectively implemented. The ongoing validation of the SAM program and integration of SAMGs and EMEGs with other plant procedures and manuals is achieved through routine oversight and review conducted by CNSC staff. This includes conducting technical assessments, program evaluations, desktop inspections, participating in site inspections, reviewing inspection reports, and conducting analytical simulations of severe accident progression with and without SAMG-specified actions. In addition, CNSC staff initiate R&D projects related to SAM to support CNSC's oversight.

19 (v) Engineering and Technical Support

Necessary engineering and technical support in all safety-related fields must be available throughout the lifetime of an NPP, including during accident conditions or in the decommissioning phase.

Article 11 addresses licensee financial and human resources, which are planned throughout the NPP's life, including decommissioning. Budgets are also available to hire external service providers and establish contracts for support in areas outside the technical or engineering expertise of full-time staff. All NPP licensees have service contracts with other Canadian companies that include R&D, engineering, analysis, assessment, maintenance, inspections and design support. The CANDU R&D program, which supports the operating NPPs, is described in annex D.

As per the requirements of CSA Group standard N286, *Management system requirements for nuclear facilities*, Canadian NPP licensees have supply chain processes to ensure that the services rendered to them serve the purpose and meet the relevant requirements. For example, OPG's supply chain process identifies a number of key attributes to enable recognition of the quality of outputs provided by outside organizations that might affect safety:

- sufficient staff to maintain specialized expertise in the required discipline (e.g., thermal hydraulics)
- in-depth knowledge of past and present regulatory issues
- rapport with regulatory staff specialists

- in-depth knowledge of NPP design and operation
- ability to provide leadership on technical issues within the Canadian nuclear industry

General information on the licensees' provisions for supply chain management is provided in article 13.

The NPP licensees utilize a design authority function to ensure that the integrity of approved designs and the design process is maintained. The design authority, executed by the Chief Engineer, encompasses overall responsibility for the design process, approval of design changes, and assurance that the requisite knowledge of the reference design is maintained as defined and implemented in the management system. The scope of accountability ensures that:

- a knowledge base of relevant aspects of the facility and products is established and kept up to date, while experience and research findings are taken into account
- all design information required for a safe facility is available
- the requisite security measures are in place
- design configuration is maintained for approved designs
- appropriate design verification is applied
- all necessary interfaces are in place
- all engineering and scientific skills are maintained
- appropriate design rules and procedures, including codes and standards, are used
- engineering work is executed by qualified staff using appropriate methods in compliance with procedures

All Canadian licensees of operating NPPs have generally the same reactor design. Therefore, licensees work closely with their partners (e.g., through COG). Additionally, licensees can easily share technical and engineering resources. The licensees presently share the same contractors, including specialists, in such areas as:

- emergency response organizations
- technical support groups that include contractors to provide support during accident response for SAMG

Further, there are mutual assistance agreements within industry. Membership in organizations such as WANO and COG also provides access to assistance between member organizations.

19 (vi) Reporting Incidents Significant to Safety

Licensees use station condition records or event reports to provide information on undesirable events that are considered significant in the operation of NPPs. The licensees determine the significance of these events using specific operational procedures. Licensees rate the significance of discoveries other than incidents (e.g., unexpected degradation of equipment, management issues raised through various means including WANO peer reviews, design weaknesses) using criteria in their corrective action program.

During the reporting period, the licensees reported safety-significant events to the CNSC in a timely manner and in accordance with the requirements of CNSC regulatory document [REGDOC-3.1.1, Reporting Requirements for Nuclear Power Plants](#). Additional information on the requirements and the work of CNSC staff to track and follow-up on safety-significant events at NPPs is provided in subsection 7.2(iii)(b).

The CNSC submits the descriptions of events that meet International Nuclear Event Scale (INES) thresholds to the IAEA Nuclear Events Web-based System.

Canada is also committed to reporting significant events occurring at Canadian NPPs to the International Reporting System (IRS) - a database of international events that is jointly operated by the IAEA and the NEA. Canada appoints a member of CNSC staff as a national coordinator to collect, analyze and submit information on events occurring in Canada. Actions taken in Canada to address events reported internationally are presented annually by Canada through its delegates to the appropriate fora, such as the IRS Technical Committee and/or the NEA Expert Group on Operating Experience.

19 (vii) Operating Experience

The NPP licensees conduct analysis and trending of events with relatively small safety significance to help prevent the occurrence of events with more significant consequences. The licensees have active internal OPEX programs embedded within their corrective action programs. These programs directly interface with organizations such as COG, WANO, and Electric Power Research Institute (EPRI) where internal events are shared with peers, and external events are assessed for applicability to their respective stations.

These mechanisms are used to share important OPEX throughout the CANDU industry and with international bodies and other operating organizations and regulatory bodies.

The process of collecting, analyzing and disseminating lessons learned from information arising from OPEX is normally part of the licensees' quality assurance programs. CSA Group standard N286, *Management system requirements for nuclear facilities* includes measures to ensure OPEX is documented, assessed and incorporated into the operation of the NPP and its quality assurance programs, as appropriate. It also calls for sharing this information with personnel in the other phases of the NPP's lifecycle.

The primary sources of OPEX are station condition records, corrective action reports and event reports. Other licensee reports include the licensees' quarterly and annual reports, in-service reports, internal audit reports and focused area self-assessments.

The licensees integrate OPEX into all aspects of NPP operation and management. For example, Bruce Power, OPG and NB Power have fully integrated OPEX into their corrective action programs, including OPEX intranet pages that provide their staff with convenient access to the WANO, COG and Institute of Nuclear Power Operations (INPO) websites, as well as other OPEX resources.

COG provides an information exchange program and chairs a weekly OPEX screening meeting teleconference that serves as a CANDU screening committee of industry OPEX representatives to review event reports from CANDU NPPs and nuclear industry sources. This screening meeting allows for timely exchanges of OPEX, with the goal of reducing risks of related events/learnings to other NPPs.

Additionally, the CNSC has established the OPEX Clearinghouse program to systematically review domestic and international events and to leverage the integrated expertise of CNSC staff to ensure that relevant events are followed up in a timely manner. The OPEX Clearinghouse draws information from several sources including the:

- Central Event Reporting and Tracking System, a database used to collect and categorize reported events at Canadian NPPs and track follow-up
- The IRS
- NEA Expert Group on Operating Experience

Problems or issues that arise from event reviews and that may be applicable to other NPPs are identified and brought to the attention of CNSC site inspectors and different CNSC specialist groups.

CNSC staff incorporate the results of root-cause analyses in their reviews and assessments of a licensee's corrective actions in response to a certain event. Further actions are requested if the corrective actions undertaken by the licensee are considered inadequate. In addition, the CNSC site inspectors review the status of corrective actions to make sure they have been completed expeditiously.

CNSC inspection teams consult the OPEX in the Central Event Reporting and Tracking System when planning strategies for their inspections and in identifying problem areas in operation or maintenance (such as procedural non-compliance, procedural deficiencies and the use of non-standard components). Similarly, CNSC assessments often utilize the OPEX recorded in this database. As part of the baseline inspection program, CNSC inspectors check the licensee's station condition records or event reports, along with system health reports, to ensure OPEX and the findings from extent-of-condition reviews have been applied to the systems by the licensees

19 (viii) Management of Spent Fuel and Radioactive Waste Onsite

Responsibility and regulatory framework

The Government of Canada has established a comprehensive radioactive waste policy framework that consists of a set of principles governing the institutional and financial arrangements for disposal of radioactive waste by waste producers and owners. The Government of Canada will ensure that radioactive waste disposal is carried out in a safe, environmentally sound, comprehensive, cost-effective and integrated manner. The federal government has the responsibility to develop policy, to regulate and to oversee producers and owners to ensure that they comply with legal requirements and meet their funding and operational responsibilities in accordance with approved waste disposal plans. The waste producers and owners are responsible, in accordance with the principle of "polluter pays", for the funding, organization, management and operation of disposal and other facilities required for their wastes.

CNSC regulatory document [REGDOC-2.11, Framework for Radioactive Waste Management and Decommissioning in Canada](#) describes the overall framework.

Under the CNSC's performance-based approach to regulation, the licence applicant proposes a waste management approach supported by scientifically defensible benchmarks. The CNSC then assesses the proposal against existing regulatory requirements to ensure the health, safety, and security of the public and the protection of the environment.

Paragraph 3(1)(j) of the [General Nuclear Safety and Control Regulations](#) requires all licence applicants who perform waste management activities to provide the name, quantity, form, origin and volume of any radioactive waste or hazardous waste that may result from the activities to be licensed. This information includes waste that may be stored, managed, processed or disposed of at the site of the activities to be licensed, and the proposed method for managing and disposing of that waste.

The [Class I Nuclear Facilities Regulations](#) specify that an application for a licence to operate any Class I nuclear facility, including a waste management facility (that manages the waste

prior to disposal), must contain the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility as well as the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances.

CNSC regulatory documents with expectations relevant to waste management include:

- [REGDOC-2.11.1, Waste Management, Volume I: Management of Radioactive Waste](#)
- [REGDOC-2.11.1, Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste, Version 2](#)

Additionally, the CSA Group has published the following standards relevant to waste management activities:

- N292.0:24, *Radioactive waste management: Common requirements of the CSA N292 series of Standards*
- N292.4:23, *Storage of radioactive waste and irradiated fuel*
- N292.8:21, *Characterization of radioactive waste and irradiated fuel*
- N294:25, *Decommissioning of facilities containing nuclear substances*

Oversight of radioactive waste management

The CNSC is responsible for licensing the management of radioactive waste, including, as applicable, its transport, storage and disposal. Since all nuclear substances associated with licensed activities will eventually become radioactive waste, the safe long-term management of all radioactive waste is considered during the licensing review process for any CNSC-licensed facility or activity.

When making regulatory decisions about the management of radioactive waste, the CNSC considers the extent to which the owners of the waste have addressed the following six principles, stipulated in REGDOC-2.11:

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

Waste minimization is also a key principle of CSA N292.0. For example, CSA N292.0 states that the generation of radioactive waste shall be considered at all stages of a facility's lifecycle, including design, construction and installation, commissioning, operation and decommissioning.

The CNSC requires licensees to implement and maintain a waste management program. Licensee waste management programs must consider the waste hierarchy (i.e., reduce,

reuse and recycle) and include strategies to minimize the production of waste and to reduce the overall volume of waste requiring long-term management, while taking into consideration the health and safety of workers and the environment in accordance with CSA N292.0.

Canada is a signatory to the [*Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*](#) (Joint Convention). Similar in nature to the *Convention on Nuclear Safety*, it is a legally-binding, international agreement governing all aspects of the management of spent fuel and radioactive waste. The Joint Convention represents the participating countries' commitment to achieving and maintaining a consistent high level of safety in the management of spent fuel and radioactive waste as part of the global safety regime for ensuring the protection of people and the environment. The Joint Convention allows for the international peer review of a signatory's radioactive waste management programs. Prior to the peer review, Canada submits a national report demonstrating the measures taken to implement the agreement's obligations. Canada's national reports to the Joint Convention are published every three years and are available on the CNSC ([Canada's National Reports to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management](#)) and IAEA websites.

Radioactive waste management

Canadian NPP licensees manage radioactive waste using methods similar to those practiced in other countries. The steps involved in the management of radioactive waste include: generation and control, handling (collecting, sorting, segregating, packaging, loading, transferring), processing (pre-treatment, treatment and conditioning), storage, transport, and disposal.

As final disposal options for radioactive waste disposal facilities are not yet available, primary emphasis is placed on: managing waste management; finding safe, practicable and environmentally acceptable solutions for the long-term management of radioactive waste to avoid imposing an undue burden on future generations; and controlling and minimizing the generation of radioactive waste.

NPP licensees minimize radioactive waste through:

- preventing the generation of radioactive waste, for example, through:
 - o material control procedures to ensure materials do not unnecessarily enter radioactive areas
 - o enhanced waste monitoring capabilities to reduce the inclusion of non-radioactive wastes with radioactive wastes
 - o launderable personal protective equipment instead of single-use items
 - o employee training and awareness
- reducing the volume (compaction, incineration, shredding, etc.) and radioactivity content of radioactive waste
- reusing and recycling materials and components

The CNSC expects the licensee to perform characterization to determine, or verify, the properties of the waste to assist with determining or finalizing conditioning, processing and disposition options, and verifying the suitability of the intended disposition path.

Radioactive wastes generated from NPP operations are classified as low-, intermediate-, or high-level radioactive waste. All wastes generated at NPPs are characterized and classified at their point of origin and segregated as likely clean or radioactive. Low- and intermediate-level radioactive wastes are further sorted into distinct categories, such as incinerable,

compactable or non-processible. Sorting the wastes helps to facilitate their subsequent handling, processing, storage, transport and future disposal. The low- and intermediate-level wastes are then processed, if applicable, and placed into safe storage until a final disposal option becomes available.

The handling, processing, storage and transport of radioactive waste may be contracted out to other CNSC licensees. For example, this could include the decontamination of parts and tools, laundering of protective clothing and the refurbishment and rehabilitation of equipment.

Spent fuel is classified as high-level radioactive waste and is stored in interim storage at the site where it was generated in either wet or dry storage. When the fuel first exits the reactor, it is transferred to water-filled irradiated fuel bays for cooling and radiation shielding. After the minimum amount of time in the bays – six to ten years (the exact cooling period is site-specific) – the spent fuel can be transferred to an onsite, interim dry storage facility where the fuel is stored in containers or modules. The spent fuel will be stored on site in dry storage until a final disposal option becomes available.

The use of natural uranium in CANDU reactors results in fuel bundles – either fresh or irradiated – that cannot lead to a critical state either in air or light water. Therefore, a criticality accident cannot occur when CANDU fuel is stored in an irradiated fuel bay or dry storage facility. This is an inherent safety design of the CANDU system.

Summary of Significant Changes Since Previous Report

NPP licensees furthered the implementation of AI-driven predictive maintenance and data analytics, while addressing potential hazards introduced by new technology.

Notable Achievement(s)

NPP licensees reduced maintenance backlogs while improving reliability, safety, and operational efficiency through AI and other technological advances, data analytics, and design enhancements.

NPP licensees completed the implementation of the post-Fukushima updates to SAMGs and the demonstration of SAMG effectiveness through exercises and plant drills.

The industry and CNSC utilized extensive and effective mechanisms to share OPEX within Canada and internationally.



Annexes

Annex A

Relevant Websites

Table 12: Relevant Websites

Document or organization	Web site
<i>Nuclear Safety and Control Act</i>	laws-lois.justice.gc.ca/eng/acts/N-28.3
<i>Canadian Environmental Assessment Act, 2012</i>	laws-lois.justice.gc.ca/eng/acts/C-15.21
<i>General Nuclear Safety and Control Regulations</i>	laws-lois.justice.gc.ca/eng/regulations/SOR-2000-202
<i>Class I Nuclear Facilities Regulations</i>	laws-lois.justice.gc.ca/eng/regulations/SOR-2000-204
<i>Radiation Protection Regulations</i>	laws-lois.justice.gc.ca/eng/regulations/SOR-2000-203
<i>Canadian Nuclear Safety Commission Cost Recovery Fees Regulations</i>	laws-lois.justice.gc.ca/eng/regulations/sor-2003-212
<i>Administrative Monetary Penalties Regulations (Canadian Nuclear Safety Commission)</i>	laws.justice.gc.ca/eng/regulations/SOR-2013-139
<i>Nuclear Liability and Compensation Act</i>	laws.justice.gc.ca/eng/acts/N-28.1
Atomic Energy of Canada Limited	aecl.ca
Bruce Power	brucepower.com
Impact Assessment Agency of Canada	canada.ca/en/impact-assessment-agency.html
Canadian Nuclear Laboratories	cnl.ca
Canadian Nuclear Safety Commission	nuclearsafety.gc.ca
CANDU Owners Group (now Conexus Nuclear Inc)	www.candu.org
CANTEACH (CANDU)	canteach.candu.org
Environment and Climate Change Canada	ec.gc.ca
Global Affairs Canada	international.gc.ca/international
Health Canada	hc-sc.gc.ca
Impact Assessment Act	https://laws.justice.gc.ca/eng/acts/I-2.75/index.html
Institute of Nuclear Power Operations	inpo.info



Document or organization	Web site
International Atomic Energy Agency	iaea.org
Natural Resources Canada	nrcan.gc.ca
NB Power	nbpower.com
Ontario Power Generation	opg.com
Open Government Portal	Open.gov.ca
Public Health Agency of Canada	phac-aspc.gc.ca
Public Safety Canada	publicsafety.gc.ca
AtkinsRéalis	www.atkinsrealis.com
Transport Canada	tc.canada.ca/en
University Network of Excellence in Nuclear Engineering	unene.ca
Ontario Tech University	https://ontariotechu.ca/
World Association of Nuclear Operators	www.wano.info

Annex B

Nuclear power plants in Canada

Table 13 provides details for the power reactors that are located at each NPP in Canada, including those that are in construction, permanently shut down while progressing toward safe storage, and in safe storage. Reactors in decommissioning are omitted.

Table 13: List and status of reactors at nuclear power plants

Reactor	Licensee	Gross capacity (MW)	Construction start	First criticality	First Grid Connection	Operating status
Bruce A, Unit 1	Bruce Power	836	Jun. 1, 1971	Dec. 17, 1976	Jan. 14, 1977	Operating
Bruce A, Unit 2		836	Dec. 1, 1970	Jul. 27, 1976	Sep. 4, 1976	Operating
Bruce A, Unit 3		836	Jul. 1, 1972	Nov. 28, 1977	Dec. 12, 1977	Operating
Bruce A, Unit 4		836	Sep. 1, 1972	Dec. 10, 1978	Dec. 21, 1978	Operating
Bruce B, Unit 5	Bruce Power	872	Jul. 1, 1978	Nov. 15, 1984	Dec. 2, 1984	Operating
Bruce B, Unit 6		872	Jan. 1, 1978	May 29, 1984	Jun. 26, 1984	Operating
Bruce B, Unit 7		872	May 1, 1979	Jan. 7, 1986	Feb. 22, 1986	Operating
Bruce B, Unit 8		872	Aug. 1, 1979	Feb. 15, 1987	Mar. 9, 1987	Operating
Darlington, Unit 1	OPG	934	Apr. 1, 1982	Oct. 29, 1990	Dec. 19, 1990	Operating
Darlington, Unit 2		934	Sep. 1, 1981	Nov. 5, 1989	Jan. 15, 1990	Operating
Darlington, Unit 3		934	Sep. 1, 1984	Nov. 9, 1992	Dec. 7, 1992	Operating
Darlington, Unit 4		934	Jul. 1, 1985	Mar. 13, 1993	Apr. 17, 1993	Operating
DNNP	OPG	300	Apr. 4, 2025			Construction
Gentilly-2	Hydro-Québec	675	Apr. 1, 1974	Sep. 11, 1982	Dec. 4, 1982	Safe storage
Pickering, Unit 1	OPG	542	Jun. 1, 1966	Feb. 25, 1971	Apr 4, 1971	Shut-down
Pickering, Unit 2		542	Sep. 1, 1966	Sep. 15, 1971	Oct. 6, 1971	Safe storage
Pickering, Unit 3		542	Dec. 1, 1967	Apr. 24, 1972	May 3, 1972	Safe storage
Pickering, Unit 4		542	May 1, 1968	May 16, 1973	May 21, 1973	Shut-down
Pickering, Unit 5	OPG	540	Nov. 1, 1974	Oct. 23, 1982	Dec. 19, 1982	Operating
Pickering, Unit 6		540	Oct. 1, 1975	Oct. 15, 1983	Nov. 8, 1983	Operating
Pickering, Unit 7		540	Mar. 1, 1976	Oct. 22, 1984	Nov. 17, 1984	Operating
Pickering, Unit 8		540	Sep. 1, 1976	Dec. 17, 1985	Jan. 21, 1986	Operating
Point Lepreau	NB Power	705	May 1, 1975	Jul. 25, 1982	Sep. 11, 1982	Operating



Annex C

Significant events during reporting period

Table 14: Significant events during reporting period

Location/date ³	Description	Corrective action by licensee	Regulatory action
Heat transport purification system heavy water leak at Bruce A April 25, 2023	Bruce Power detected elevated heavy water leakage from the heat transport system in Bruce A Unit 4 (a faulty moisture detector ("beetle") had prevented early leak identification). Unit shutdown, which was initiated when leak rates rose to 600–700 kg/h, was successfully completed. Bruce Power traced the leak to a failed purification system hose outside containment, which was then isolated. Bruce Power initiated radiological protocols and restricted access due to the spread of tritium vapour to adjacent areas. The response to the cleanup prevented environmental release. A total of 135 Mg leaked. The failed hose, over 20 years old, is under investigation for aging-related failure.	Bruce Power replaced Unit 4's Bank A and B hoses before returning it to service on May 1, 2023, and assessed similar hoses on Units 1 and 2, initiating replacements by July 2023. Unit 3 hoses were scheduled to be replaced during its outage for major component replacement (MCR). Bruce B hoses did not indicate similar issues but they were also scheduled to be replaced. Bruce Power reviewed and repaired the leak detection systems as needed. A root cause analysis confirmed the hose failure and identified detection issues. Bruce Power noted preventive maintenance and detection methods for improvement. Bruce Power shared event information online, and through OPEX fora and informed local Indigenous communities and municipalities.	CNSC dispatched a site inspector to monitor Bruce Power's response and also monitored it remotely. CNSC shared event information online and informed local Indigenous communities. Staff monitored recovery efforts, attended Bruce Power's Event Review Board, and reviewed the preliminary event report. An environmental inspection was conducted due to the presence of an unplugged drain. CNSC required a review of emergency procedures and is planning further inspections focused on maintenance, radiation protection, and safety culture.
Improper disposal of tritium	Bruce Power shipped 84 drums containing 4,037 kg of charcoal filter waste from Bruce B Unit 0's exhaust	Bruce Power verbally informed CNSC staff of the tritium-contaminated charcoal filter waste in the first shipment. The	In addition to attending the Event Review Board, CNSC staff met with Bruce Power staff to gather more



Location/date ³	Description	Corrective action by licensee	Regulatory action
contaminated waste at Bruce February 2, 2023	system for disposal. This was the first such shipment. While preparing for a second shipment, it was discovered that the first shipment may have exceeded the unconditional clearance level for tritium of 100 Bq/g, per the <i>Nuclear Substances and Radiation Devices Regulations</i> . Lab results showed tritium levels between 185 and 511 Bq/g. The elevated tritium levels were missed due to a review and communication failure.	waste management company was also notified and confirmed that the waste had already been processed and disposed of in an industrial landfill. Bruce Power cancelled the next planned shipment, implemented mandatory Health Physics reviews of lab results, and updated relevant procedures and forms. Bruce Power discussed the event at an Event Review Board meeting with CNSC staff present, and submitted a preliminary report and later a detailed report. Bruce Power submitted calculations to support a, showing the shipment's tritium levels (max 511 Bq/g) posed low public risk, but noted CNSC approval is required for releases based on a conditional clearance level. An event update was posted online. Bruce Power shared event information online, and through OPEX fora and informed local Indigenous communities and municipalities.	information. CNSC requested conditional clearance level data for tritium exposure and posted an event update online. Indigenous Nations and communities near Bruce A and B were notified. CNSC staff conducted a field inspection of an unrelated hazardous waste shipment and confirmed compliance with the <i>Nuclear Substances and Radiation Devices Regulations</i> , procedure updates, and Health Physics review. While the tritium-contaminated waste release did not meet the regulations or licence requirements, no health or environmental impacts are expected. CNSC was satisfied with Bruce Power's actions and continued oversight. Another inspection and review of the detailed event report was planned.
Partial loss of class IV power and heavy water leak at Point Lepreau	Point Lepreau experienced a partial Class IV power loss due to a fault on a cable from the unit service transformer. The protection system disconnected a bus and blocked	NB Power followed upset response procedures and transitioned to a guaranteed shutdown state after the reactor trip. NB Power isolated containment and notified the CNSC. NB	Following timely notification, the CNSC partially activated its Emergency Operations Centre to monitor NB Power's response. CNSC staff, including on-site



Location/date ³	Description	Corrective action by licensee	Regulatory action
December 14, 2022	system service transformer input to avoid a full loss of Class IV power. This led to the trip of two primary heat transport pumps, triggering shutdown systems SDS1 and SDS2, which safely shut down the reactor. Two hours later, NB Power detected a heavy water leak, subsequently declared a radiation alert, and initiated the heavy water recovery system. NB Power identified the source as a 3/8" instrument line in the primary heat transport system, which was then crimped. During the event, cooling, control, and containment were maintained. NB Power determined the cause of the leak to be high-cycle fatigue.	Power activated its emergency organization, restored Class IV power by repairing the unit service transformer cable, and cleaned up the heavy water spill. The radiation alert was lifted, containment was unboxed, and outage activities began. Key tasks included inspections and repairs to the unit service transformer, cables, and instrumentation lines, reactor building cleanup, and restoration of primary heat transport system inventory. Three similar lines were also capped. NB Power informed Indigenous communities and the public and submitted a preliminary report to the CNSC. NB Power provided a detailed report to the Commission in January 2023.	inspectors, verified compliance with procedures through discussions, meeting observations, and database reviews and confirmed the safety of workers, the public, and the environment. CNSC communicated updates to government representatives, Indigenous communities, and the public. The Emergency Operations Centre remained active until the radiation alert ended. CNSC continued to monitor the outage, reviewed the detailed event report and causal analysis, and adjusted inspection scopes to include related verification activities. Related oversight was completed during the reporting period.
Fish impingement event at Bruce February 13, 2025	A significant increase in fish impingement led to reduced flow in the component cooling water system. This prompted a manual shutdown of Unit 2 and a derating of Unit 1 to 87% power. (Units 3 and 4 were offline due to ongoing MCR work.) The situation raised concerns about insufficient heat recirculation into the forebay,	Bruce Power partially activated its Emergency Management Centre, which was later transitioned to an issue resolution team. Bruce Power took action to ensure Unit 1 could continue operating safely and effectively discharge heat into the forebay, helping to prevent the formation of frazil ice. Efforts to remove fish and mitigate further	CNSC staff increased regulatory oversight, including field inspections, to verify fish removal efforts and overall site conditions. CNSC staff continued to track the progress of ongoing cleanup activities.



Location/date ³	Description	Corrective action by licensee	Regulatory action
	which, under cold weather conditions, could result in frazil ice formation. Such ice buildup could further restrict cooling water flow to the units, compromising heat removal from both the reactors and the irradiated fuel bay.	ingress were undertaken. Bruce Power provided updates on the situation to the Saugeen Ojibway Nation, Métis Nation of Ontario Region 7, and Historic Saugeen Métis. Relevant information was also shared with federal agencies, including Natural Resources Canada and Fisheries and Oceans Canada. Bruce Power's corrective actions over time led to a significant reduction in the amount of fish observed and minimized further fish ingress into the forebay.	

Annex D

Nuclear research and development in Canada related to nuclear power plants

D.1 Introduction and context

Canada holds the view that nuclear safety research is important in supporting the safe design and operation of NPPs. To obtain licensing approval in Canada, applicants (with the aid of the NPP designer) must be able to provide adequate safety justification. Fulfilling this responsibility includes the provision of adequate experimental data to support analytical models and safety analyses. As practice shows, ongoing experimental research is needed to address emerging issues for operating NPPs and for plant life extension. New reactor design requires substantial investment in research and development (R&D) to adequately demonstrate the safety of new technologies.

R&D supporting NPPs in Canada is conducted by many organizations, including Atomic Energy of Canada Limited (AECL), Canadian Nuclear Laboratories (CNL) and the CANDU Owners Group (COG), as well as utilities, universities and private-sector laboratories and other organizations. The following subsections describe the key elements of R&D supporting NPPs in Canada.

D.2 CANDU Owners Group R&D program (existing NPPs)

To support the safe, reliable and economic operation of CANDU reactors, the COG R&D program addresses current and emerging operating issues in the areas of:

- fuel channels
- safety and licensing
- health, safety and the environment
- chemistry, materials and components
- the Industry Standard Toolset (software for design, safety analysis, and operational support)
- strategic R&D and reduced outages

While this work generally supports operation of existing NPPs, COG also has initiatives related to small modular reactors (SMRs); see subsection D.3.2 for details.

The COG R&D program is co-funded by domestic CANDU licensees, CNL, the Romanian Societatea Nationala Nuclearelectrica, the Korea Hydro and Nuclear Power Company, China National Nuclear Operations Management and Candu Energy Inc, (AtkinsRealis) with current funding of about \$42 million annually, benefiting from a stable multi-year commitment. In addition, COG's Joint Projects & Services supports domestic and international CANDU NPPs with co-funded, collaborative joint projects totaling \$15 million to \$20 million annually. COG holds an EPRI membership on behalf of the domestic CANDU licensees and the Romanian Societatea Nationala Nuclearelectrica.

In 2016, COG embarked on a strategic R&D program that focuses on developing technologies and other solutions to keep CANDU reactors operating safely, reliably and competitively for an extended plant life.

The COG member organizations also provide significant financial support to the Canadian [University Network of Excellence in Nuclear Engineering](#) (UNENE), an alliance of

universities, nuclear power utilities, and research and regulatory agencies. Established as a not-for-profit corporation in 2002, UNENE supports and develops nuclear education, and R&D capability in Canadian universities.

COG members along with CNSC are also members of the [Halden Human Technology and Organization Program](#).

Fuel channels

The strategic objective of the fuel channels R&D program is to develop and support adequate models for the following phenomena and potential degradation mechanisms:

- crack initiation
- fracture toughness through the full operating range over the full operating life
- leak-before-break
- pressure tube rupture frequency
- deuterium ingress
- deformation including pressure tube to calandria tube gap predictions in support of blister avoidance
- fitness for service of Inconel X-750 fuel channel annulus spacers

Safety and licensing

The COG safety and licensing R&D program is focused on the following areas:

- plant aging
- safety design basis and safe operating envelope of existing facilities
- resolution of outstanding generic safety and licensing issues
- post-Fukushima enhancements and regulatory issues

This program comprises working groups and task teams covering containment, fuel and fuel channels, normal operating conditions for fuel, reactor physics, thermal hydraulics and probabilistic risk assessment (i.e., PSA).

Health, safety and the environment

R&D on health, safety and the environment aim to:

- improve plant performance with respect to radiation protection and emissions reduction (both radiological and conventional)
- develop technologies to address issues associated with future refurbishment and decommissioning of aging facilities
- address regulatory issues associated with radiation dose management and with generating the required databases and models to address new and emerging regulations on the environmental impacts to non-human biota
- maintain R&D capability to address current and future industry issues in the areas of health physics and environmental impacts
- ensure future expertise will be available to deal with industry problems, by encouraging funding of R&D in Canadian universities to train future scientists and technologists for the industry
- leverage COG funding through undertaking collaborative R&D with other organizations that have common interests

Chemistry, materials and components

The chemistry, materials and components R&D program:

- covers a diverse range of issues that can affect the safe, reliable and efficient operation of major CANDU systems and their auxiliaries
- is focused to support long-term operation and plant life extension
- is integrated with the EPRI R&D program to maximize synergies and minimize duplication

It comprises working groups and task teams covering:

- chemistry
- concrete
- steam generator material integrity
- steam generator non-destructive inspection
- steels
- valves
- cables
- buried piping

Industry Standard Toolset

R&D for the Industry Standard Toolset – computer programs for CANDU reactor design and analysis – addresses:

- qualification, development and maintenance activities on computer codes
- computer code training to safety analysts

Strategic R&D

The Strategic R&D program focuses on developing the technologies and solutions needed to keep the current and refurbished fleet of CANDU reactors operating safely, reliably and competitively for an extended plant life (i.e., 60 to 90 years).

Strategic focus areas in progress:

- reduced outages: Develop technology to reduce maintenance effort during outages. This includes built-in inspection and monitoring provisions to minimize work during outages and possibly avoid or shorten outages.
- updated/enhanced computer codes: Provide updated/enhanced computer codes to better characterize safety margins.
- improved understanding of material properties: Develop an improved understanding of material properties of reactor core components (pressure tubes, calandria tubes, end fittings, feeders, spacers, etc.) to provide longer overall reactor life.
- decommissioning and long-term waste management: Develop technology and infrastructure to support decommissioning and long-term waste management, including processes and procedures to minimize all forms of radioactive wastes and to reduce dose. This may include alternative fuel cycles to minimize high level waste.
- low dose radiation: Advance knowledge and public acceptance.

D.3 Development and deployment of reactor designs

D.3.1 CANDU designs

AtkinsRéalis, in addition to providing services related to the operation of existing CANDU® reactors, has six CANDU reactor designs:

- The CANDU SMR (CSMR): Generation III, 300 MWe class, heavy water moderated and cooled reactor utilizing natural uranium fuel and on-power refueling.
- The CANDU 6® reactor: Generation II+, 700 MWe class, heavy water moderated and cooled reactor utilizing natural uranium fuel and on-power refueling

- The Enhanced CANDU 6® (EC6®): Generation III, 700 MWe class, heavy water moderated and cooled reactor based on the successful CANDU 6 model
- The Advanced CANDU Reactor® (ACR-1000®): Generation III+, 1,200 MWe class heavy-water-moderated, light-water-cooled reactor
- The Advanced Fuel CANDU Reactor®: Generation III+, 700 MWe class, heavy water moderated and cooled reactor designed to use alternative fuel sources such as recovered uranium from the reprocessing of used light-water reactor fuel, in addition to the conventional natural uranium)
- The CANDU MONARK™ reactor: Generation III+, 1000 MWe class, heavy water moderated and cooled reactor utilizing natural uranium fuel and on-power refueling

Various companies in Canada and elsewhere are actively evaluating one or more of these designs for deployment. In addition, AtkinsRéalis has entered into an agreement with the CNSC to perform familiarization and planning for a future preliminary regulatory design assessment of the CANDU MONARK reactor.

AtkinsRéalis has an active program to advance the CANDU design and technologies including the above-mentioned reactor designs and to support reactor operations. In addition, these developments include advancements in retube tooling designs such as the retube removal tooling to simultaneously remove the pressure tube and calandria tube during a retube project, which resulted in a reduction in worker dose while achieving a significant reduction in critical path time on the retube (refer to sub-article 18(ii)). AtkinsRéalis continues to maintain and further develop qualified analytical software used in the design and analysis of various reactors, and support reactor operations. The Canadian industry, through COG, has an active program on advanced analysis codes, and both Canadian universities and CNL are active in this area.

D.3.2 Other Reactor Designs

Research and development is ongoing in support of the licensing of the Darlington New Nuclear Project (DNNP), for which, OPG has partnered with GE Hitachi Nuclear Energy. In addition, Moltex continues to perform research to support the ongoing development of their Stable Salt Reactor – Wasteburner to consume used fuel. Moltex published a report in October 2024 which demonstrates that this reactor can consume the vast majority of transuranic elements present in used fuel bundles from CANDU reactors, and can recycle the used fuel indefinitely, thereby reducing nuclear waste and closing the fuel cycle. In November 2024, CNL began conducting used fuel tests for Moltex, with test results expected to be released in 2025.

In 2023, the Government of Canada announced two new programs to fund research and development related to SMR deployment objectives:

- The establishment of the “Enabling Small Modular Reactors Program”. This program funds R&D to support provinces and territories as they work to develop and deploy SMRs as part of their respective decarbonisation and economic development plans. This program has provided funding to applicants to support their efforts to address waste generated from SMRs and develop supply chains for SMR manufacturing and SMR fuel supply
- The partnership between NRCan and NSERC to fund research on SMRs. Research projects that are being funded by this program address one or more of the following objectives specific to SMR technologies being pursued in Canada: robust supply chains for SMRs, SMR fuel supply, and radioactive waste management and minimization for SMRs.

The Atlantic Canada Opportunities Agency has also provided funding to SMR related projects since 2021. Since the last reporting cycle, the agency provided \$950,864 to the Organization of Canadian Nuclear Industries to help New Brunswick suppliers transition to the nuclear industry. Additionally, it was announced in March 2023 that the University of New Brunswick's Centre for Nuclear Energy Research could receive \$1,928,005 million from the Atlantic Canada Opportunities Agency and \$173,595 from the New Brunswick Innovation Foundation to support the upgrading of key scientific equipment, improving the centre's R&D capabilities for current and next-generation nuclear power generation. In March 2024, this funding was increased to \$2,919,287 and extended until March 2025.

D.4 AECL R&D program

AECL, through the [Federal Nuclear Science and Technology \(FNST\) Work Plan](#), provides CNL with approximately \$76 million annually to perform nuclear-related science and technology research that supports core federal roles and responsibilities in the areas of energy, health, safety and security and the environment, while maintaining necessary capabilities and expertise at CNL. CNL also supports the nuclear industry through access to science and technology facilities and expertise on a commercial basis.

AECL is responsible for the management and oversight of the FNST Work Plan. The FNST Work Plan serves the collective interests of 15 federal departments and agencies that inform the program of work and budget in four theme areas:

1. Supporting the development of biological applications and understanding the implications of radiation on living things
 - This theme area supports science and technology activities to further understanding of the biological applications of nuclear research, including the understanding of the effects of exposure to ionizing radiation on the health of Canadians. The theme area comprises three sub-themes: 1) understanding the health effects of ionizing radiation; 2) quantifying exposure to ionizing radiation; and 3) developing medical applications.
2. Enhancing national and global security, nuclear preparedness and emergency response
 - This theme area supports the Government of Canada's national and international security and policy objectives in the areas of nuclear non-proliferation and counter-terrorism and the ability to respond in the event of a nuclear emergency and would include all preparedness and response responsibilities. The theme area comprises three sub-themes: 1) nuclear forensics and detection; 2) cyber security; and 3) emergency response and preparedness.
3. Supporting safe, secure and responsible use and development of nuclear technologies
 - This theme area supports maintenance and improvement of the viability, competitiveness, safety and security of nuclear technologies in Canada and abroad, and provides scientific-based information for regulations, codes, standards and licensing. The theme area comprises three sub-themes: 1) advanced reactors and hybrid energy systems; 2) reactor sustainability; and 3) hydrogen and tritium.
4. Supporting environmental stewardship and radioactive waste management
 - This theme area supports environmental stewardship and responsible nuclear waste management. The theme area comprises two sub-themes: 1) understanding of the effects of radiation on the environment; and 2) providing science and technology to support radioactive waste management.

More information on AECL's FNST Work Plan and its projects can be found at [Federal Nuclear Science & Technology Work Plan - AECL](#).

CNL's [Canadian Nuclear Research Initiative](#) (CNRI) is a program to support collaborative research projects with third-party proponents in Canada. The program was initiated in 2019 with the goal to accelerate the deployment of safe, secure, clean, and cost-effective advanced reactors in Canada. CNRI allows participants to optimize resources, share technical knowledge and gain access to CNL's expertise and the unique capabilities of the AECL-owned Chalk River Laboratories, helping to close the innovation gap and enable technology readiness for a new generation of SMR and other advanced designs in Canada. New to the program this year is the expansion of CNRI to include other forms of clean energy, including a larger focus on fusion-based R&D, which has been a growing focus of CNL in recent years. Annually, CNRI issues a call for proposals; based on a review of the results, CNL enters into joint R&D projects. Examples of focus areas stemming from the 2024 CNRI call for proposals for advanced reactors include advanced nuclear fuels, advanced materials and chemistry, reactor safety, application of nuclear capabilities to emerging technologies, and fusion.

D.5 CNSC research program

The CNSC funds extramural research to obtain knowledge and information needed to support the CNSC's regulatory mission. The program provides access to independent advice, expertise, experience and information through contracts placed with the private sector or through grants or contributions to other organizations in Canada and elsewhere. CNSC has high-level research goals which in turn are aligned to the CNSC's SCAs. These include:

- human performance management
- safety analysis
- physical design
- fitness for service
- radiation protection
- environmental protection
- waste management

The CNSC research program issues grants and contributions to non-profit organizations, academic institutions and both domestic and foreign governments. Examples include:

- UNENE
- IAEA
 - International Generic Ageing Lessons Learned
 - International Regulatory Cooperation Forum
 - Small Modular Reactor Regulators Forum
- OECD/NEA
 - Component Operational Experience, Degradation and Ageing Programme
 - Support for OECD Fire Incident Records Exchange Project Phase V
 - Support for the International Common-Cause Data Exchange Phase VIII
 - HALDEN Human, Technology and Organization Program
- United States Nuclear Regulatory Commission
 - Cooperative Agreement of Thermalhydraulic Code Applications and Maintenance Program
 - Cooperative Severe Accident Research Program
 - Radiation Protection Code Analysis and Maintenance Program
 - International Steam Generator Tube Integrity Program

- CSA Group
- ICRP

The annual budget of the CNSC research program is approximately \$4 million, which is spread across 10 research goals. The newest added research goal aims to prepare the CNSC to regulate activities using new technologies (e.g., AI, drones, virtual reality) and explore their potential use by CNSC staff.

The CNSC also partnered with NSERC to fund (\$15M over 5 years) a new community of research on SMRs and novel technologies by investing across various university research projects. This is separate from UNENE, which is industry-funded and generally focuses on CANDU-related research projects. Just over \$9M has been disbursed to projects since 2022, and another call for applications will be launched in 2025.

D.6 Generation IV International Forum

Generation IV International Forum (GIF) is a multinational effort to develop the next generation of nuclear energy systems with enhanced safety, security, and economics, while addressing waste, proliferation, and public perception concerns. Currently, the GIF brings together ten countries (Australia, Canada, China, France, Japan, Korea, South Africa, Switzerland, the United Kingdom, and the United States), as well as Euratom – representing the 27 European Union members – to co-ordinate R&D on Generation IV systems.

In 2024, a new GIF Framework Agreement¹⁴ valid for ten years was successfully negotiated, which Canada signed in January 2025 and is currently ratifying. Under the GIF Framework Agreement, NRCAN is the designated implementing agent for the Government of Canada.

Canada participates in three of the six reactor systems which are being developed: the supercritical water-cooled reactor, the very high temperature reactor, and the molten salt reactor. Canada is active in all GIF working groups and is aligning its participation to the advanced reactor technologies being considered for potential deployment by the Canadian provinces. Canada is engaging to improve industry participation in the GIF. Noted working groups include those related to risk and safety, proliferation resistance and physical protection, economic modeling, non-electric applications and cogeneration, advanced manufacturing and materials engineering, and education and training.

¹⁴ a treaty-level agreement that was originally signed in 2005

Annex E

Description of the CNSC's assessment of performance for nuclear power plants

The CNSC's rating system uses information from regulatory activities to assess and summarize the performance of NPP and other licensees across the 14 CNSC SCAs. The CNSC uses three rating categories:

- SA Satisfactory
- BE Below expectations
- UA Unacceptable

The definitions of these categories are as follows.

Satisfactory - Licensee meets all 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 - 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 - 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

The CNSC's annual assessment of NPPs

The CNSC prepares an annual staff report for the Commission and the public on all Canadian NPPs. It includes any waste management facility on the same site as one of the NPPs. The [Regulatory Oversight Report for Canadian Nuclear Power Generating Sites](#) integrates information gathered through CNSC staff licensing and compliance verification activities. The activities include inspections (Type I, Type II, desktop and field), compliance technical assessments of licensee submissions, and surveillance and monitoring.

The report uses the rating system to summarize the SCA performance assessments for each NPP. The document makes comparisons where possible, shows trends and averages, and highlights significant issues in the industry at large. It uses a variety of CNSC safety performance indicators to illustrate safety performance. The report describes major developments, initiatives, issues and challenges during the year and major revisions to licence conditions handbooks (LCHs).

Table 15 shows the specific areas that comprise each SCA. Table 16 compares the IAEA safety factors to the SCAs.

Table 15: CNSC functional areas, SCAs, and specific areas

Functional area	SCA	Specific area
Management	Management system	Management system
		Organization
		Performance assessment, improvement and management review
		OPEX
		Change management
		Safety culture
		Configuration management
		Records management
		Management of contractors
		Business continuity
	Human performance management	Human performance program
		Personnel training
		Personnel certification
		Work organization and job design
		Fitness for duty
	Operating performance	Conduct of licensed activities
		Procedures
		Reporting and trending
		Outage management performance
		Safe operating envelope
		Severe accident management and recovery
		Accident management and recovery
Facility and equipment	Safety analysis	Deterministic safety analysis
		Hazard analysis
		Probabilistic safety assessment
		Criticality safety
		Severe accident analysis
		Management of safety issues (including R&D programs)
	Physical design	Design governance
		Site characterization
		Facility design
		Structure design
		System design
		Components design
	Fitness for service	Equipment fitness for service/equipment performance
		Maintenance



Functional area	SCA	Specific area
Core control processes		Structural integrity
		Aging management
		Chemistry control
		Periodic inspections and testing
	Radiation protection	Application of ALARA
		Worker dose control
		Radiation protection program performance
		Radiological hazard control
	Conventional health and safety	Performance
		Practices
		Awareness
	Environmental protection	Effluent and emissions control (releases)
		Environmental management system
		Protection of people
		Assessment and monitoring
		Environmental risk assessment
	Emergency management and fire protection	Conventional emergency preparedness and response
		Nuclear emergency preparedness and response
		Fire emergency preparedness and response
	Waste management	Waste characterization
		Waste minimization
		Waste management practices
		Decommissioning plans
	Security	Facilities and equipment
		Response arrangements
		Security practices
		Drills and exercises
		Cyber security
	Safeguards and non-proliferation	Nuclear material accountancy and control
		Access and assistance to the IAEA
		Operational and design information
		Safeguards equipment, containment and surveillance
		Import and export
	Packaging and transport	Package design and maintenance
		Packaging and transport
		Registration for use

Table 16: Comparison of IAEA safety factors to CNSC SCAs

IAEA safety factor	Related CNSC SCAs
Plant design	Management system, operating performance, safety analysis, physical design, fitness for service, radiation protection, conventional health and safety, environmental protection
Actual condition of structures, systems and components important to safety	Management system, safety analysis, physical design, fitness for service, radiation protection, conventional health and safety, environmental protection
Equipment qualification	Management system, safety analysis, physical design, fitness for service, radiation protection, conventional health and safety, environmental protection
Ageing	Management system, human performance management, operating performance, safety analysis, physical design, fitness for service, radiation protection, conventional health and safety, environmental performance
Deterministic safety analysis	Management system, safety analysis, physical design, fitness for service, radiation protection, emergency management and fire protection
Probabilistic safety assessment	Safety analysis, physical design, fitness for service
Hazard analysis	Management system, operating performance, safety analysis, physical design, fitness for service, radiation protection, conventional health and safety, environmental protection, emergency management and fire protection, security, safeguards and non-proliferation, transport and packaging
Safety performance	Management system, operating performance, safety analysis, fitness for service, radiation protection, conventional health and safety, environmental protection, waste management
Use of experience from other plants and research findings	Management system, human performance management, operating performance
Organization, the management system and safety culture	Management system, human performance management, operating performance
Procedures	Management system, human performance management, operating performance, radiation protection, conventional health and safety, emergency management and fire protection
Human factors	Management system, human performance management, operating performance, fitness for service, radiation protection, conventional health and safety



IAEA safety factor	Related CNSC SCAs
Emergency planning	Management system, human performance management, operating performance, conventional health and safety, emergency management and fire protection
Radiological impact on the environment	Management system, operating performance, environmental protection

Note: The 14 IAEA safety factors listed above are from IAEA Specific Safety Guide [SSG-25, Periodic Safety Review for Nuclear Power Plants](#).

Annex 7.2 (i)(a)

Regulation-making process

As a Canadian federal regulator, the CNSC must abide by the Government of Canada's [Cabinet Directive on Regulation](#).

The process to make, amend or repeal regulations under the [Nuclear Safety and Control Act](#) can be broken into 11 steps.

1. The CNSC conducts an analysis for the development of regulatory proposals.
2. The CNSC seeks permission from the Treasury Board Secretariat to make or repeal regulations.
3. Once Treasury Board Secretariat has approved the regulatory proposal, the CNSC engages Canadians including interested parties to seek views on possible policy approaches.
4. After consideration of comments received, the regulatory proposals are further refined. Interested parties are invited to provide further comments.
5. The CNSC works with the Department of Justice to draft the regulations. The draft regulations are written in accordance with the written instructions provided by the CNSC.
6. After the draft regulations are written, they are reviewed by the Commission. If the Commission supports the draft regulations, it recommends them for Treasury Board's review.
7. Treasury Board reviews the proposed regulations for pre-publication. If approved, the proposed regulations are pre-published in the *Canada Gazette*, Part I. The *Canada Gazette* is the official newspaper of the Government of Canada. The standard pre-publication times is 30 days and 70 days for proposals with international trade impacts. The comments received are published on the Canada Gazette website.
8. CNSC considers the comments and finalizes the draft regulations.
9. The Commission reviews the proposed regulations and approves them for submission.
10. The Minister of Natural Resources reviews the regulations and recommends them to the Governor in Council.
11. If the Governor in Council approves the regulations, the Governor General signs the regulations' Order in Council. The final regulations are then published in the *Canada Gazette*, Part II, and come into force on the day or days set out in the regulations.

Annex 7.2 (i)(b)

Regulatory framework documents

Development of CNSC regulatory documents - outline

CNSC develops REGDOCs using a lifecycle approach, from: identification of a regulatory issue or concern through analysis to determine the best regulatory approach; development and publication of the document; and finally to regular review and continuous improvement of the document. In developing REGDOCs, CNSC staff apply lessons learned from industry OPEX and from international standards and guides, such as those published by the IAEA. Requirements and guidance for NPPs are technology-neutral and performance-based where practicable, take a risk-informed approach, and apply to SMRs or other (non-CANDU) power reactor technologies.

Interested parties are provided the opportunity to comment on the proposed contents of each REGDOC through a rigorous public consultation process. Draft documents are published on the CNSC website and interested parties are informed through various vehicles, including email notifications, the CNSC's social media accounts and the Government of Canada's central consultation website. In addition, the CNSC uses newsletters and targeted mail-outs to ensure affected parties are aware of the consultation. Interested parties are encouraged to provide their comments. As the work proceeds to address the comments received, the CNSC provides updates on the progress, e.g., by posting document histories including consultation reports on its website.

Regulatory framework developments for small modular reactors

The regulatory framework is generally articulated to be technology-neutral and, where possible, permits the use of the graded approach. The graded approach enables applicants to propose the stringency of design measures, safety analyses and provisions for conduct of their activities commensurate with the level of risk posed by the reactor facility. The factors to be considered in the graded approach include.

- reactor power
- source term
- amount and enrichment of fissile and fissionable material
- spent fuel, high-pressure systems, heating systems and the storage of flammables, all of which may affect the safety of the reactor
- type of fuel elements
- type and the mass of moderator, reflector and coolant
- amount of reactivity that can be introduced (and its rate of introduction), reactivity control, and inherent and additional features
- quality of the confinement structure or other means of confinement
- utilization of the reactor

- siting, which includes proximity to population groups or extent of isolation from emergency responders

During the reporting period, CNSC continued to ensure that the regulatory framework would be suitable for licence application involving SMR technology. In doing this, CNSC staff have consulted with technology developers and held outreach activities with the public at conferences and academic institutions. Recently developed or revised REGDOCs of interest include [REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities*](#), [REGDOC-1.1.2, *Licence Application Guide: Licence to Construct a Nuclear Power Plant*](#), and [REGDOC-1.1.3, *Licence Application Guide: Licence to Operate a Nuclear Power Plant*](#). They communicate CNSC expectations with regards to the licensing of activities related to new reactor facilities. Additionally, the CNSC developed [REGDOC-1.1.5, *Licence Application Guide: Supplemental Information for Small Modular Reactor Proponents*](#). This document is to be used in conjunction with other licence application guides and existing regulatory documents to assist proponents in developing risk-informed proposals that take into account CNSC expectations regarding all safety and control measures to support the safety case for the proposed site.

Many of the CSA Group standards were originally written for CANDU reactors, but their requirements are being adapted to other reactor types – most are now considered to be technology-neutral.

CNSC regulatory framework documents and CSA Group standards related to NPPs (with IAEA references)

The CNSC REGDOCs are available on the CNSC website. All CSA Group nuclear standards may be viewed through the CNSC website or on the CSA Group website directly.

Table 17 includes published CNSC regulatory documents ('REGDOC') and CSA Group standards ('N' prefix) that are relevant to NPPs (existing NPPs and new-build). The table indicates the year of publication, thus illustrating the relatively large number of REGDOCs and standards published during the reporting period by the CNSC and CSA Group, respectively. Although older versions of these documents may still be in use (i.e., cited in LCHs) for some NPPs, for simplicity this table only includes the latest documents and versions. Some of these more recently-published documents or versions are not yet implemented by any NPP licensee (and hence not in an LCH) because a transition period is typically needed for licensees to align programs and other safety and control measures with the new documents (this distinction is illustrated for CNSC REGDOCs in the second table in this annex).

The table is organized according to the CNSC SCAs, although note that some SCAs are outside the scope of the CNS (e.g., those related to security). The last column lists the IAEA documents that are cited as references in each regulatory document or standard, although note that many more IAEA documents are indicated as "additional reading material" in the Canadian regulatory documents and standards.

Table 17: REGDOCs and IAEA references

Doc number	Document title	Referenced IAEA documents
General		
REGDOC-1.1.1	<i>Site Evaluation and Site Preparation for New Reactor Facilities</i> , Version 1.1 (2022)	• International Atomic Energy Agency (IAEA), NS R 3 (Rev 1), Site Evaluation for Nuclear Installations, 2016 • IAEA, Safety Standards Series No. NS G 3.2, Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants, Vienna, Austria,2002 • IAEA, Safety Standards Series No. SSG 9, Seismic Hazards in Site Evaluation for Nuclear Installations, Vienna, Austria,2010 • IAEA, Safety Standards Series No.NS G 1.5, External Events Excluding Earthquakes in the Design of Nuclear Power Plants, Vienna, Austria,2003 • IAEA, Safety Standards, Series No.NS G 3.6, Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants, Vienna, Austria,2004 • IAEA, Safety Standards Series, Specific Safety Guide No. SSG 18, Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations, Vienna, Austria,2011 • IAEA, Safety Standards Series No. SSG-21, Volcanic Hazards in Site Evaluation for Nuclear Installations, Vienna, Austria,2012 • IAEA, Safety Standards Series No.NS G 3.1, External Human Induced Events in Site Evaluation for Nuclear Power Plants, Vienna, Austria,2002 • IAEA, Safety Series No.GSR Part2, Leadership and Management for Safety, Vienna, Austria,2016 • IAEA, Safety Standards Series No.GS R 2, Preparedness and Response for a Nuclear or Radiological Emergency, Vienna, Austria,2002 • IAEA, INFCIRC/164, Agreement between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons,1972 • IAEA, Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, IAEA INFCIRC/164/Add1,2000



Doc number	Document title	Referenced IAEA documents
		- IAEA, Safety Standards Series RS G 1.8, Environmental and Source Monitoring for Purposes of Radiation Protection, Vienna, Austria, 2005 - IAEA, Safety Series No. GS-G-3.1, Application of the Management System for Facilities and Activities, Vienna, Austria, 2006 - IAEA, Safety Series No. GS-G-3.5, The Management System for Nuclear Installations, Vienna, Austria, 2009 - IAEA, TECDOC 1657, Design Lessons Drawn from the Decommissioning of Nuclear Facilities, Vienna, Austria, 2011 - IAEA, Safety Guide No. WS G 2.3, Regulatory Control of Radioactive Discharges to the Environment, Vienna, Austria, 2000
N290.19	<i>Risk-informed decision making for nuclear power plants</i> (2018)	- INSAG-10 addendum INSAG 28 published in 2024 - SSG-4 Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants
REGDOC-2.3.3	<i>Periodic Safety Reviews</i> (2015)	- Specific Safety Guide No. SSG-25 Periodic Safety Review for Nuclear Power Plants - Safety Fundamentals No. SF-1 Fundamental Safety Principles - Safety Standards Series No. NS-G-2.10 superseded by SSG-25
N290.18	<i>Periodic safety review for nuclear power plants</i>	- INSAG-10 Defence in Depth in Nuclear Safety - Safety Reports Series No. 57 superseded by SSG-48 Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants - Specific Safety Guide No. SSG-25 - TECDOC-1740 Use of a Graded Approach in the Application of the Management System Requirements for Facilities and Activities
REGDOC-3.1.1	<i>Reporting Requirements for Nuclear Power Plants</i> , Version 3 (2024)	None
Licence application guides		
REGDOC-1.1.2	<i>Licence Application Guide: Licence to Construct a Nuclear Power Plant</i> (2022)	- NSS-35-G Security During the Lifetime of a Nuclear Facility - Treaty on the Non-Proliferation of Nuclear Weapons (INFCIRC/140) - Agreement between Government of Canada and IAEA for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons IAEA, INFCIRC/164



Doc number	Document title	Referenced IAEA documents
		Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non Proliferation of Nuclear Weapons, IAEA INFCIRC/164/Add 1
REGDOC-1.1.3	<i>Licence Application Guide: Licence to Operate a Nuclear Power Plant</i> , Version 1.1 (2022)	- International Atomic Energy Agency (IAEA), INFCIRC/164, Agreement between Government of Canada and IAEA for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons - IAEA, Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, IAEA INFCIRC/164/Add 1, 2000.
REGDOC-1.1.5	<i>Supplemental Information for Small Modular Reactors</i> (2019)	None
REGDOC-1.2.1	<i>Guidance on Deep Geological Repository Site Characterization</i> (2021)	None referenced, several noted in Additional Information
REGDOC-1.2.2	<i>Licence Application Guide: Class IB Processing Facilities</i> (2024)	- SSR-4 (2017) Safety of Nuclear Fuel Cycle Facilities - SSR-1 (2019) Site Evaluation for Nuclear Installations - SSG-5 (2010) Safety of Conversion Facilities and Uranium Enrichment Facilities - SSG-6 (2010) Safety of Uranium Fuel Fabrication Facilities - SSG-7 (2010) Safety of Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities - SSG-42 (2017) Safety of Nuclear Fuel Reprocessing Facilities - SSG-43 (2017) Safety of Nuclear Fuel Cycle Research and Development Facilities - Agreement between Government of Canada and IAEA for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons IAEA, INFCIRC/164 (1972) - Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, IAEA INFCIRC/164/Add 1 (2000) - Nuclear Security Series No. 35-G (2019) Security During the Lifetime of a Nuclear Facility



Doc number	Document title	Referenced IAEA documents
		• SSR-6 Rev1 (2018) Regulations for the Safe Transport of Radioactive Material
REGDOC-1.2.3	<i>Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository (2024)</i>	• No. 17-T (Rev. 1) (2021) Computer Security Techniques for Nuclear Facilities • More references in the Additional Information section
Management system		
REGDOC-2.1.1	<i>Management System (2019)</i>	• GSR Part 2 (2016) Leadership and Management for Safety: General Safety Requirements • TECDOC-1169 (2000), Managing suspect and counterfeit items in the nuclear industry
REGDOC-2.1.2	<i>Safety Culture (2018)</i>	• SF-1 (2006) Fundamental Safety Principles • GSR Part 1 (2010) Government, Legal and Regulatory Framework for Safety • GSR Part 2 (2016) Leadership and Management for Safety • GS-G-3.5 (2009) The Management System for Nuclear Installations • NS-G-2.4 (2001) The Operating Organization for Nuclear Power Plants • INSAG-24 (2010) The Interface Between Safety and Security at Nuclear Power Plants • INSAG-15 (2002) Key Practical Issues in Strengthening Safety Culture • Safety Series Report No. 11 (1998) Developing Safety Culture in Nuclear Activities - Practical Suggestions to Assist Progress • Information Circular 274 Rev. 1 Mod. 1 (2016) Amendment to the Convention on the Physical Protection of Nuclear Material • Series No. 7 (2008) Nuclear Security Culture • TECDOC No. 1801 (2016) Management of the Interface between Nuclear Safety and Security for Research Reactors • Security Series No. 20 (2013) Objective and Essential Elements of a State's Nuclear Security Regime • Security Series No. 13 (2011) Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities • Security Series No. 14 (2011) Nuclear Security Recommendations on Radioactive Material and Associated Facilities • TECDOC No. 1329 (2002) Safety Culture in Nuclear Installations: Guidance for Use in the Enhancement of Safety Culture



Doc number	Document title	Referenced IAEA documents
		• Safety Report Series No. 83 (2016) • More references in the Additional Information
N286-12	<i>Management system requirements for nuclear facilities (2012)</i>	None
N286.7	<i>Quality assurance of analytical, scientific and design computer programs for nuclear power plants (2016)</i>	• TECDOC 1740 Use of a Graded Approach in the Application of the Management System Requirements for Facilities and Activities
N286.10	<i>Configuration management for reactor facilities (2016)</i>	• INSAG-19 (2003) Maintaining the Design Integrity of Nuclear Installations throughout their Operating Life
N299 series	<i>Series of standards on quality assurance program requirements for the supply of items and services for nuclear power plants</i>	• INSAG-15 • Safety Standard Series No. GS-G-3.5 The Management System for Nuclear Installations • TECDOC-1329 Safety Culture in Nuclear Installations: Guidance for Use in the Enhancement of Safety Culture • TECDOC-1169
N299.1	Category 1 (2019)	
N299.2	Category 2 (2019)	
N299.3	Category 3 (2019)	
N299.4	Category 4 (2019)	
Human performance management		
REGDOC-2.2.1	<i>Human Performance (2023)</i>	• SF-1 (2006) Fundamental Safety Principles • GSR Part 2 (2016) Leadership and Management for Safety • GSR Part 3 (2014) Radiation Protection and Safety of Radiation • GS-G-3.5 (2009) • TECDOC-1846 (2018) Regulatory Oversight of Human and Organizational Factors for Safety of Nuclear Installations
REGDOC-2.2.2	<i>Personnel Training, Version 2 (2016)</i>	• TECDOC- 1057 (1999) Experience in the use of Systematic Approach in Training (SAT) for Nuclear Power Plant Personnel
REGDOC-2.2.3	<i>Personnel Certification: Radiation Safety Officers (2014)</i>	None
REGDOC-2.2.3	<i>Personnel Certification, Volume III: Certification of Reactor Facility Workers, Version 2 (2023)</i>	None



Doc number	Document title	Referenced IAEA documents
REGDOC-2.2.4	<i>Fitness for Duty: Managing Worker Fatigue</i> (2017)	None
REGDOC-2.2.4	<i>Fitness for Duty, Volume II: Managing Alcohol and Drug Use</i> , Version 3 (2021)	• NS-R-2 (2000) Safety of Nuclear Power Plants: Operation, Requirements • GS-G-1.3 (2002) Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body • GS-G-1.2 (2002) Review and Assessment of Nuclear Facilities by the Regulatory Body • NS-G-2.4 (2001) The Operating Organization for Nuclear Power Plants • NS-G-2.8 (2002) Recruitment, Qualification and Training of Personnel for Nuclear Power Plants • GSR Part 1 (2016) Rev. 1, Governmental, Legal and Regulatory Framework for Safety
REGDOC-2.2.4	<i>Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical and Psychological Fitness</i> (2018)	None referenced, one noted in Additional Information
REGDOC-2.2.5	<i>Minimum Staff Complement</i> (2019)	None
Operating performance		
REGDOC-2.3.1	<i>Conduct of Licensed Activities: Construction and Commissioning</i> (2016)	• SSG-28 (2014) Commissioning for Nuclear Power Plants: Safety Guide • NS-G-2.3 (2001) Modifications to Nuclear Power Plants: Safety Guide • More references in Additional information section
REGDOC-2.3.2	<i>Accident Management</i> , Version 2 (2015)	• SF-1 (2006) IAEA Safety Standards for Protection of People and the Environment - Fundamental Safety Principles • NS-G-2.15 (2009) Severe Accident Management Programmes for Nuclear Power Plants - Safety Guide • SSR-2/2 (2011) Implementation of Accident Management Programmes in Nuclear Power Plants • Safety Report Series No. 32, STI/PUB/1167 (2004) Implementation of Accident Management Programs in Nuclear Power Plants • SVS-09 (2003) Guidelines for the Review of Accident Management Programs in Nuclear Power Plants • INSAG-10 (1997) Defence in Depth in Nuclear Safety



Doc number	Document title	Referenced IAEA documents
		- INSAG-12, 75-INSAG-3 Rev.1 (1999) Basic Safety Principles for Nuclear Power Plants - TECDOC-1440 (2005) Overview of Training Methodology for Accident Management at Nuclear Power Plants
N290.15	<i>Requirements for the safe operating envelope of nuclear power plants</i> (2019)	None
Safety analysis		
REGDOC-2.4.1	<i>Deterministic Safety Analysis</i> (2014)	- Safety Reports Series No. 55 Safety Analysis for Research Reactors - Safety Standards Series No. NS-R-4 superseded by SSR-3 Safety of Research Reactors - Safety Standards Series No. SSG-2 Deterministic Safety Analysis for Nuclear Power Plants - Safety Standards Series No. GSR Part 4 Safety Assessment for Facilities and Activities
REGDOC-2.4.2	<i>Probabilistic Safety Assessment (PSA) for Nuclear Power Plants</i> (2022)	- Safety Standard SSG-3 superseded by SSG-3 (Rev. 1) - Safety Standard SSG-4 Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants - Safety Fundamentals No. SF-1
REGDOC-2.4.3	<i>Nuclear Criticality Safety, Version 1.1</i> (2020)	- Safety Standards, SSR-4 - Safety Standards, SSG-6, superseded by IAEA Safety Standards Series No. SSG-6 (Rev. 1), Safety of Uranium Fuel Fabrication Facilities - Safety Standards Series No. GS-R-2, superseded by GSR Part 7 Preparedness and Response for a Nuclear or Radiological Emergency - Safety Standards Series No. SSR-6 Rev. 1
N286.7	<i>Quality assurance of analytical, scientific and design computer programs</i> (2016)	TECDOC-1740
N290.16	<i>Requirements for beyond design basis accidents</i> (2016)	- INSAG-10 - Nuclear Energy Series No. NW-T-2.7 Experiences and Lessons Learned Worldwide in the Cleanup and Decommissioning of Nuclear Facilities in the Aftermath of Accidents



Doc number	Document title	Referenced IAEA documents
		Safety Series No. 98 On-site Habitability in the Event of an Accident at a Nuclear Facility: Guidance for Assessment and Improvement
N290.17	<i>Probabilistic safety assessment for nuclear power plants (2017)</i>	• Safety Standard SSG-3 superseded by SSG-3 (Rev. 1) • Safety Standard SSG-4 • TECDOC-1804 Attributes of Full Scope Level 1 Probabilistic Safety Assessment (PSA) for Applications in Nuclear Power Plants • TECDOC-1983 Risk Aggregation for Nuclear Installations • Safety Reports Series No. 9 Categorization of Radioactive Sources
N290.18	<i>Periodic safety review for nuclear reactor facilities (2017)</i>	• Safety Reports Series No. 57 superseded by SSG-48 • Safety Standards Series No. SSG-25 • TECDOC-1740 • INSAG-10
REGDOC-2.4.4	<i>Safety Analysis for Class IB Nuclear Facilities (2022)</i>	• GS-G-3.5 (2009) The Management System for Nuclear Installations • SSR-4 (2017) • SSG-5 (2010) Safety of Conversion Facilities and Uranium Enrichment Facilities • SSG-6 (2010) • TECDOC No. 1267 (2002), Procedures for Conducting Probabilistic Safety Assessment for Non-Reactor Nuclear Facilities • GSR Part 7 (2015) Preparedness and Response for a Nuclear or Radiological Emergency • SSG-9 (2010) Seismic Hazards in Site Evaluation for Nuclear Installations • NS-R-3 (Rev. 1) (2016), Site Evaluation for Nuclear Installations • NS-G-3.1 (2002) External Human Induced Events in Site Evaluation for Nuclear Power Plants • More documents in the Additional Information Section
REGDOC-2.4.5	<i>Nuclear Fuel Safety and Qualification (2024)</i>	• SSG-52 (2019) Design of the Reactor Core for Nuclear Power Plants • TECDOC No. 1926 (2020) Technical Review Of Acceptance Criteria For Pressurized Heavy Water Reactor Fuel
Physical design		
REGDOC-2.5.1	<i>General Design Considerations: Human Factors (2019)</i>	None



Doc number	Document title	Referenced IAEA documents
REGDOC-2.5.2	<i>Design of Reactor Facilities (2023)</i>	• NS-G-2.154 (2019) Severe Accident Management Programs for Nuclear Power Plants • INSAG-10 (2010) • NS-G-2.2 (2000) Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants • GS-G-3.5 (2009) The Management System for Nuclear Installations Safety Guide • INSAG-19 (2003) • GS-R-3 (2006) The Management System for Facilities and Activities • NS-G-2.11 (2006) A System for the Feedback of Experience from Events in Nuclear Installations • GSR Part 4 (2009) • NS-G-3.1 (2002) External Human Induced Events in Site Evaluation for Nuclear Power Plants • Safety Series No. 50-P-1 (1990) Application of the Single Failure Criterion • Safety Reports Series No. 3 (1998) Equipment Qualification in Operational Nuclear Power Plants: Upgrading, Preserving and Reviewing • NS-G-1.3 (2002) Instrumentation and Control Systems Important to Safety in Nuclear Power Plants • NS-G-1.1 (2000) Software for Computer Based Systems Important to Safety in Nuclear Power Plants • NS-G-2.1 (2000) Fire Safety in Operation of Nuclear Power Plants • Safety Report Series No. 8 (1998) Preparation of Fire Hazard Analysis for Nuclear Power Plants • NS-G-1.7 (2004) Protection Against Internal Fires and Explosions in the Design of Nuclear Power Plants • NS-G-2.5 (2002) Core Management and Fuel Handling for Nuclear Power Plants • NS-G-1.12 (2005) Design of the Reactor Core for Nuclear Power Plants • NS-G-1.9 (2004) Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants • NS-G-2.6 (2002) Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants • NS-G-1.10 (2004) Design of Reactor Containment Systems for Nuclear Power Plants



Doc number	Document title	Referenced IAEA documents
		• NS-G-2.9 (2003) Commissioning for Nuclear Power Plants • SSR 2/2 (2011) Safety of Nuclear Power Plants: Commissioning and Operation • GS-R-2 (2002) Preparedness and Response for a Nuclear or Radiological Emergency • TECDOC-967, Rev.1, Guidance and considerations for the implementation of INFCIRC/225/Rev.5, The Physical Protection of Nuclear Material and Nuclear Facilities. • TECDOC-1276, Handbook on the Physical Protection of Nuclear Materials and Facilities • INFCIRC-225, Rev.5 (2011), Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities • Nuclear Security Series No. 17 (2011) Computer Security at Nuclear Facilities • TECDOC-1657 (2011): Design Lessons Drawn from the Decommissioning of Nuclear Facilities • WS-G-2.1 (1999) Decommissioning of Nuclear Power Plants and Research Reactors • RS-G-1.1 (1999) Occupational Radiation Protection • NS-G-1.13 (2005) Radiation Protection Aspects of Design for Nuclear Power Plants • NS-G-1.8 (2004) Design of Emergency Power Systems of Nuclear Power Plants • GS-G-3.3 (2008) The Management System for the Processing, Handling and Storage of Radioactive Waste Safety Guide • NS-G-1.4 (2003) Design of Fuel Handling and Storage Systems in Nuclear Power Plants Safety Guide • NS-G-3.3 (2002) Evaluation of Seismic Hazards for Nuclear Power Plants • NS-G-1.5 (2003) External Events Excluding Earthquakes in the Design of Nuclear Power Plants • NS-G-3.5 (2003) Flood Hazard for Nuclear Power Plants on Coastal and River Sites • NS-G-3.4 (2003) Meteorological Events in Site Evaluation for Nuclear Power Plants • SSG-18 (2011) Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations



Doc number	Document title	Referenced IAEA documents
		• NS-G-1.11 (2004) Protection Against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants • NS-G-1.6 (2003) Seismic Design and Qualification for Nuclear Power Plants • SSG-9 (2010) Seismic Hazards in Site Evaluation for Nuclear Installations • SSG-2 (2009) Deterministic Safety Analysis for Nuclear Power Plants • NS-G-1.2 (2001) Safety Assessment and Verification for Nuclear Power Plants • SSG-3 (2010) Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants • SSG-4 (2010) Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants • Safety Series No. 50-P-10 (1995) Human Reliability Analysis in Probabilistic Safety Assessment for Nuclear Power Plants • Safety Reports Series No. 25 (2002), Review of Probabilistic Safety Assessments by Regulatory Bodies • Safety Series No. 50-P-7 (1995), Treatment of External Hazards in Probabilistic Safety Assessment for Nuclear Power Plants • Safety Report Series No.10 (1998) Treatment of Internal Fires in Probabilistic Safety Assessment for Nuclear Power Plants • More documents in the Additional Information Section
RD-367	<i>Design of Small Reactor Facilities</i> (2011)	As REGDOC-2.5.2 above
N290.13	<i>Environmental qualification of equipment for nuclear power plants</i> (2018)	Safety Glossary
N285.0/N285.6 series	<i>General requirements for pressure-retaining systems and components in CANDU nuclear power plants/Material Standards for reactor components for CANDU nuclear power plants</i> (2012)	None



Doc number	Document title	Referenced IAEA documents
N287.1	<i>General requirements for concrete containment structures for nuclear power plants (2014)</i>	None
N287.2	<i>Material requirements for concrete containment structures for nuclear power plants (2017)</i>	None
N287.3	<i>Design requirements for concrete containment structures for nuclear power plants (2014)</i>	• Safety Reports Series No. 82 (Rev.1) Ageing Management for Nuclear Power Plants: International Generic Ageing Lessons Learned (IGALL) • Safety Reports Series No. 87 Safety Aspects of Nuclear Power Plants in Human Induced External Events: Assessment of Structures • Safety Reports Series No. 88 Safety Aspects of Nuclear Power Plants in Human Induced External Events: Margin Assessment • Specific Safety Guide No. SSG-48
N287.4	<i>Construction, fabrication, and installation requirements for concrete containment structures for nuclear power plants (2019)</i>	None
N287.5	<i>Examination and testing requirements for concrete containment structures for nuclear power plants (2020)</i>	None
N287.6	<i>Pre-operational proof and leakage rate testing requirements for concrete containment structures for nuclear power plants (2022)</i>	None
N291	<i>Requirements for nuclear safety-related structures (2019)</i>	• Safety Reports Series No. 57 superseded by SSG-48
N289.1	<i>General requirements for seismic design and qualification of nuclear power plants (2018)</i>	• Safety Standards Series No. NS-G-1.6 superseded by SSG-67 Seismic Design for Nuclear Installations • Safety Standards Series No. NS-G-2.13 superseded by IAEA Safety Standards Series No. SSG-89 Evaluation of Seismic Safety for Nuclear Installations • Safety Report Series No. 28 Seismic Evaluation of Existing Nuclear Power Plants • Specific Safety Guide No. SSG-25



Doc number	Document title	Referenced IAEA documents
		• Safety Report Series No. 66 Earthquake Preparedness and Response for Nuclear Power Plants • TECDOC-1333 Earthquake experience and seismic qualification by indirect methods in nuclear installations
N289.2	<i>Ground motion determination for seismic qualification of nuclear power plants (2021)</i>	• Safety Standards Series No. NS-G-1.5 superseded by SSG-68 Design of Nuclear Installations Against External Events Excluding Earthquakes • Safety Standards Series No. NS-G-3.6 Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants • Safety Standards Series No. SSG-9 • Safety Standards Series No. SSG-21 • TECDOC-1796 Seismic Hazard Assessment in Site Evaluation for Nuclear Installations: Ground Motion Prediction Equations and Site Response • TECDOC-CD-1833 Best Practices in Physics Based Fault Rupture Models for Seismic Hazard Assessment of Nuclear Installation
N289.3	<i>Design procedures for seismic qualification of nuclear power plants (2020)</i>	• Safety Standards Series No. NS-G-1.6 superseded by SSG-67 • Safety Standards Series No. SSG-9 • Safety Standards Series No. NS-G-3.6 •
N289.4	<i>Testing procedures for seismic qualification of nuclear power plant structures, systems and components (2022)</i>	• Safety Guide No. NS-G-2.13 superseded by IAEA Safety Standards Series No. SSG-89
N289.5	<i>Seismic instrumentation requirements for nuclear power plants and nuclear facilities (2012)</i>	• Safety Reports Series No. SR-66 Format and Content of the Package Design Safety Report for the Transport of Radioactive Material • Safety Standards Series No. NS-G-1.6 superseded by SSG-67
N290.0/N290.2 Package	<i>General requirements for safety systems of nuclear power plants (2017)</i> <i>Requirements for emergency core cooling systems of nuclear power plants (2017)</i>	• NS-G-1.11 superseded by IAEA Safety Standards Series No. SSG-64 Protection against Internal Hazards in the Design of Nuclear Power Plants



Doc number	Document title	Referenced IAEA documents
N290.0/N290.1 Package	<i>General requirements for safety systems of nuclear power plants (2011)</i> <i>Requirements for the shutdown systems of nuclear power plants (2013)</i>	None
N290.0/N290.3 Package	<i>General requirements for safety systems of nuclear power plants (2011)</i> <i>Requirements for the containment system of nuclear power plants (2016)</i>	None
N290.4	<i>Requirements for reactor control systems of nuclear power plants (2011)</i>	None
N290.5	<i>Requirements for electrical power and instrument air systems of CANDU nuclear power plants (2016)</i>	None
N290.6	<i>Requirements for monitoring and display of nuclear power plant safety functions in the event of an accident (2016)</i>	• NP-T-3.16 Accident Monitoring Systems for Nuclear Power Plants • Safety Reports Series No. 46 Assessment of Defence in Depth for Nuclear Power Plants
N290.11	<i>Requirements for reactor heat removal capability during outage of nuclear power plants (2021)</i>	None
N290.14	<i>Qualification of digital hardware and software for use in instrumentation and control applications for nuclear power plants (2015)</i>	None
N290.12	<i>Human factors in design for nuclear power plants (2014)</i>	None



Doc number	Document title	Referenced IAEA documents
REGDOC-2.5.7	<i>Design, Testing and Performance of Exposure Devices (2020)</i>	• SSR-6 (2018) Regulations for the Safe Transport of Radioactive Material • SSG-26 (2014) Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material
Fitness for service		
REGDOC-2.6.1	<i>Reliability Programs for Nuclear Power Plants (2017)</i>	• TECDOC-524 (1989) Status, Experience and Future Prospects for the Development of Probabilistic Safety Criteria
REGDOC-2.6.2	<i>Maintenance Programs for Nuclear Power Plants (2017)</i>	None referenced, several noted in Additional Information
REGDOC-2.6.3	<i>Aging Management (2014)</i>	• Safety Standards Series, Safety Guide, No. NS-G-2.12 superseded by SSG-48 • Safety Report Series No. 57 superseded by SSG-48 • Safety Standards Series, Specific Safety Guide, SSG-25 • Safety Report Series No. 82 superseded by Safety Reports Series No. 82 (Rev. 1)
N285.4	<i>Periodic inspection of CANDU nuclear power plant components (2019)</i>	• None
N285.5	<i>Periodic inspection of CANDU nuclear power plant containment components (2018)</i>	• None
N285.7	<i>Periodic inspection of CANDU nuclear power plant balance of plant systems and components (2015)</i>	• TECDOC-1511 superseded by TECDOC-1804
N285.8	<i>Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors (2021)</i>	• None
N287.7	<i>In-service examination and testing requirements for concrete containment structures for nuclear power plants (2017)</i>	• None
N287.8	<i>Aging management for concrete containment structures for nuclear power plants (2015)</i>	• Safety Report Series No. 57 superseded by SSG-48 • NS-G-2.12 superseded by SSG-48



Doc number	Document title	Referenced IAEA documents
		• TECDOC-1025 Ageing Management of Concrete Structures in Nuclear Power Plants • Safety Standards Series No. NS-G-2.6 • TECDOC-1503 Nuclear power plant life management processes: Guidelines and practices for heavy water reactors • TECDOC-1736 Approaches to Ageing Management for Nuclear Power Plants • Technical Reports Series No. 338 Methodology for the Management of Ageing of Nuclear Power Plant Components Important to Safety • Safety Reports Series No. 15 • Safety Series No. 50-P-3 • Safety Reports Series No. 82
N290.8	<i>Technical specification requirements for nuclear power plant components (2015)</i>	• None
N290.9	<i>Reliability and maintenance programs for nuclear power plants (2019)</i>	• Specific Safety Guide No. SSG-10
N290.20	<i>Aging management requirements for nuclear power plants</i>	• TECDOC-1740 • Safety Report Series No. 57 superseded by SSG-48 • Safety Report Series No. 82 superseded by Safety Reports Series No. 82 (Rev. 1) • Safety Standards Series No. SSG-25 • Safety Standards Series No. SSG-48 • Safety Standards Series No. SSR-2/2 (Rev.1) • Safety Reports Series No. 80 • Safety Standards Series No. GS-G-3.5 • Specific Safety Requirements No. SSR- 2/1
Radiation protection		
REGDOC-2.7.1	<i>Radiation Protection Version 1.1 (2025)</i>	• Safety Reports Series No. 21 (2002), Optimization of Radiation Protection in the Control of Occupational Exposure
REGDOC-2.7.2	<i>Dosimetry, Volume I: Ascertaining Occupational Dose (2021)</i>	• TECDOC-1731 (2013), Implications for Occupational Radiation Protection of the New Dose Limit for the Lens of the Eye



Doc number	Document title	Referenced IAEA documents
		• TECDOC-1162 (2000) Generic Procedures for Assessment and Response During a Radiological Emergency • Safety Series No. 114 (1996) Direct Methods for Measuring Radionuclides in the Human Body, • Safety Reports Series No. 37 (2004) Methods for Assessing Occupational Radiation Doses Due to Intakes of Radionuclides
REGDOC-2.7.2	<i>Dosimetry, Volume II: Technical and Management System Requirements for Dosimetry Services (2020)</i>	None
Conventional health and safety		
REGDOC-2.8.1	<i>Conventional Health and Safety (2019)</i>	None
Z1000	<i>Occupational health and safety management (2014)</i>	
Environmental protection		
REGDOC-2.9.1	<i>Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.2 (2020)</i>	None
N288.1	<i>Guidelines for modelling radionuclide environmental transport, fate, and exposure associated with the normal operation of nuclear facilities (2020)</i>	• Safety Report Series No. 19 • Safety Series No. 50-5G-59 • TECDOC-857 • TECDOC-964 • Technical Reports Series No. 364 • Technical Reports Series No. 422 • Technical Report Series No. 472 • TECDOC-1991 • Technical Reports Series No. 479
N288.2	<i>Guidelines for calculating the radiological consequences to the public of a release of airborne</i>	• Safety Guide No. NS-G-3.2 superseded by SSG-71 • Safety Guide No. 50-P-12 • Safety Guide No. GS-G-2.1 • Safety Guide No. GS-R-2



Doc number	Document title	Referenced IAEA documents
	<i>radioactive material for nuclear reactor accidents</i> (2019)	• GSR Part 7 • TECDOC-955 • TECDOC-1200
N288.3.4	<i>Performance testing of nuclear air-cleaning systems at nuclear facilities</i> (2013)	• None
N288.4	<i>Environmental monitoring programs at nuclear facilities and uranium mines and mills</i> (2019)	• AQ 48 • Safety Series No. RS-G-1.2 superseded by GSG-7 • TECDOC-1360 • TECDOC-1415
N288.5	<i>Effluent and emissions monitoring programs at nuclear facilities</i> (2022)	• None
N288.6	<i>Environmental risk assessments at nuclear facilities and uranium mines and mills</i> (2022)	• Safety Reports Series No. 21 • Technical Reports Series No. 332 • Technical Reports Series No. 472 • Technical Report Series No. 479
N288.7	<i>Groundwater protection programs at Class I nuclear facilities and uranium mines and mills</i> (2015)	• Specific Safety Guide No. SSG-60
N288.8	<i>Establishing and implementing action levels for releases to the environment from nuclear facilities</i> (2017)	• None
N288.9	<i>Guideline for design of fish impingement and entrainment programs at nuclear facilities</i> (2018)	• None
REGDOC-2.9.2	<i>Environmental Protection: Controlling Releases to the Environment</i> (2024)	• GSR Part 3 (2014) Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards • TECDOC 1000 (1998) Clearance of Materials Resulting from the Use of Radionuclides in Medicine, Industry and Research



Doc number	Document title	Referenced IAEA documents
		• Safety Series No. 19 (2001) Generic Models for Use in Assessing the Impact of Discharges of Radioactive Substances to the Environment • GSG-9 (2018) Regulatory control of discharges to the environment: General Safety Guide • TECDOC 1714 (2013) Management of Discharge of Low Level Liquid Radioactive Waste Generated in Medical, Educational, Research and Industrial Facilities • More documents in the Additional Information Section
Emergency management and fire protection		
REGDOC-2.10.1	<i>Nuclear Emergency Preparedness and Response, Version 2 (2016)</i>	• Safety Standards Series GS-R-2 superseded by GSR Part 7 • Safety Standards Series GS-G-2.1
N293-12	<i>Fire protection for nuclear power plants (2012)</i>	• INSAG Series No. 10 • INSAG Series No. 12 • Safety Reports Series No. 10 • Safety Reports Series No. 46 • Safety Standards Series No. NS-G-1.7 superseded by IAEA Safety Standards Series No. SSG-64 • Safety Standards Series No. NS-G-2 superseded by IAEA Safety Standards Series No. 77 • Safety Reports Series No. 8
N1600	<i>General requirements for nuclear emergency management programs (2021)</i>	• EPR-Exercise (2005) • EPR Public Communication (2012) • EPR Public Communication Plan (2015) • EPR Method (2003) • EPR-NPP Public Protective Actions (2013) • IAEA-SVS-12 (Rev 1) (2016) superseded by IAEA-SVS-12 (Rev. 2) • Safety Glossary (2018) superseded by the 2022 (Interim) Edition of the IAEA Nuclear Safety and Security Glossary • Safety Guide GS-G-2.1 (2007) • Safety Standards No. GSG-11 (2018) • General Safety Guide GSG-13 (2018) • Safety Standards Series No. GSR Part 7 (2015) • Specific Safety Guide No. SSG-2



Doc number	Document title	Referenced IAEA documents
Waste Management		
REGDOC-2.11.1	<i>Waste Management, Volume II: Management of Uranium Mine Waste Rock and Mill Tailings (2018)</i>	• NF-T-1.2 (2010) Best Practice in Environmental Management of Uranium Mining • WS-G-1.2 (2002), Management of Radioactive Waste from the Mining and Milling of Ores
REGDOC-2.11.1	<i>Waste Management Volume III: Assessing the Long-Term Safety of Radioactive Waste Management (2021)</i>	• SSR-5 (2011) Disposal of Radioactive Waste
Security		
REGDOC-2.12.2	<i>Site Access Security Clearance (2013)</i>	• Nuclear Security Series No. 8 (2008), Implementing Guide, Preventive and Protective Measures against Insider Threats
REGDOC-2.12.3	<i>Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material, Version 2.1 (2020)</i>	• Code of Conduct on the Safety and Security of Radioactive Sources (2004) • RS-G1.9 (2005) Categorization of Radioactive Sources • SSR-6 (2012) Regulations for the Safe Transport of Radioactive Material • Nuclear Security Series No. 7 (2008) Nuclear Security Culture • Nuclear Security Series No. 14 (2011) Nuclear Security Recommendations on Radioactive Material and Associated Facilities • More documents in the Additional Information Section
Safeguards and non-proliferation		
REGDOC-2.13.1	<i>Safeguards and Nuclear Material Accountancy (2018)</i>	• STR-368 International Target Values 2010 for Measurement Uncertainties in Safeguarding • Agreement between Government of Canada and IAEA for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons IAEA, INFCIRC/164 (1972) • Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non Proliferation of Nuclear Weapons, IAEA INFCIRC/164/Add 1 (2000)
REGDOC-2.13.2	<i>Import and Export, Version 2 (2018)</i>	• RS-G-1.9 (2005) Categorization of Radioactive Sources, • Code of Conduct on the Safety and Security of Radioactive Sources (2004) • Guidance on the Import and Export of Radioactive Sources (2012)
Packaging and Transport		



Doc number	Document title	Referenced IAEA documents
REGDOC-2.14.1	<i>Information Incorporated by Reference in Canada's Packaging and Transport of Nuclear Substances Regulations (2021)</i>	• SSR-6 (2018) Regulations for the Safe Transport of Radioactive Material • TS-G-1.4 (2008) The Management System for the Safe Transport of Radioactive Material • SSG-26 (2018) Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material • General Safety Requirement Part 3 (2014) Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards
REGDOC-2.14.1	<i>Packaging and Transport, Volume II: Radiation Protection Program Design for the Transport of Nuclear Substances (2018)</i>	• SSR-6 (2012) Regulations for the Safe Transport of Radioactive Material • Safety Standards Series No. TS-G-1.3 (2017) Radiation Protection Programmes for the Transport of Radioactive Material • Specific Safety Guide No. SSG-26 (2014) Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition) • More documents in the Additional Information Section
Public and Indigenous Engagement		
REGDOC-3.2.1	<i>Public Information and Disclosure (2018)</i>	None
REGDOC-3.2.2	<i>Indigenous Engagement, Version 1.2 (2022)</i>	None
CNSC Processes and Practices		
REGDOC-3.5.1	<i>Information Dissemination: Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills, Version 2.1 (2022)</i>	None
REGDOC-3.5.2	<i>Compliance and Enforcement: Administrative Monetary Penalties, Version 2 (2015)</i>	None
REGDOC-3.5.2	<i>Compliance and Enforcement, Volume II: Orders under the Nuclear Safety and Control Act (2019)</i>	None
REGDOC-3.5.3	<i>Regulatory Fundamentals, Version 2.1 (2022)</i>	• International Atomic Energy Agency (IAEA), IAEA Information Circular 164 Agreement Between the Government of Canada and the IAEA for the Application



Doc number	Document title	Referenced IAEA documents
		of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, Vienna, 1972. • IAEA, IAEA Information Circular 164 Add.1 Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, Vienna, 2000. • More documents in the Additional Information Section
REGDOC-3.5.4	<i>Pre-licensing Review of a Vendor's Reactor Design</i> (2018)	None

Status of REGDOCs in current NPPs Licence Condition Handbooks

The CNSC licensing process takes a phased approach to implementing new or revised CNSC regulatory documents (as well as CSA Group standards) via the addition of references to the document in licence conditions handbooks (LCHs). The status at the end of the reporting period of the REGDOCs (not applicable (NA), compliance verification criteria (CVC), implementation ongoing (IO) or guidance) in the LCH of the NPPs is indicated in table 18. In some cases where a newer version of the REGDOC has been published, an NPP may have only implemented an older version and has not yet started or completed the implementation of the newer version. In some cases, a cell in the table may be blank because the LCH has not yet been revised to include a reference to that REGDOC. The implementation of CSA Group standards across the NPPs is similarly “incremental.”

In addition to the variable of the timing of the implementation of new or revised documents, their applicability as CVC or guidance for new reactor facilities, including SMRs, will depend on the design and operation being proposed.

Legend:

- DNGS Darlington Nuclear Generating Station
- PNGS Pickering Nuclear Generating Station
- BNGS Bruce Nuclear Generating Station
- PLNGS Point Lepreau Nuclear Generating Station
- DNNP Darlington New Nuclear Project



Table 18: Status of REGDOCs in LCHs

Doc #	Document title	DNGS	PNGS	BNGS	PLNGS	DNNP
General						
REGDOC-1.1.1	<i>Site Evaluation and Site Preparation for New Reactor Facilities, Version 1.1 (2022)</i>	NA	NA	NA	NA	NA
	<i>Site Evaluation and Site Preparation for New Reactor Facilities, Version 1.2 (2022)</i>	NA	NA	NA	NA	CVC
REGDOC-2.3.3	<i>Periodic Safety Reviews (2015)</i>	CVC	CVC	CVC	CVC	NA
REGDOC-3.1.1	<i>Reporting Requirements for Nuclear Power Plants, Version 3 (2024)</i>	NA	CVC	NA	NA	NA
	<i>Reporting Requirements for Nuclear Power Plants, Version 2 (2016)</i>	CVC	NA	CVC	CVC	CVC
Licence application guides						
REGDOC-1.1.2	<i>Licence Application Guide: Licence to Construct a Nuclear Power Plant (2022)</i>	NA	NA	NA	NA	CVC
REGDOC-1.1.3	<i>Licence Application Guide: Licence to Operate a Nuclear Power Plant, Version 1.2 (2022)</i>	Guidance	NA	Guidance	Guidance	NA
	<i>Licence Application Guide: Licence to Operate a Nuclear Power Plant, Version 1.1 (2017)</i>	NA	Guidance	NA	NA	NA
REGDOC-1.1.5	<i>Supplemental Information for Small Modular Reactors (2019)</i>	NA	NA	NA	NA	NA
REGDOC-1.2.1	<i>Guidance on Deep Geological Repository Site Characterization (2021)</i>	NA	NA	NA	NA	NA
REGDOC-1.2.2	<i>Licence Application Guide: Class 1B Processing Facilities</i>	NA	NA	NA	NA	NA
REGDOC-1.2.3	<i>Licence Application Guide: Licence to Prepare Site for a Deep Geological Repository (2024)</i>	NA	NA	NA	NA	NA
Management system						
REGDOC-2.1.1	<i>Management System (2019)</i>	CVC	Guidance	Guidance	CVC	Guidance



Doc #	Document title	DNGS	PNGS	BNGS	PLNGS	DNNP
REGDOC-2.1.2	<i>Safety Culture</i> (2018)	CVC	CVC	CVC	CVC	CVC
Human performance management						
REGDOC-2.2.1	<i>Human Performance</i> (2023)	IO	IO	IO	IO	NA
	<i>Human Factors</i> (2019)	NA	Guidance	Guidance	CVC	CVC
REGDOC-2.2.2	<i>Personnel Training</i> , Version 2 (2016)	CVC	Guidance	CVC	CVC	CVC
	<i>Personnel Training</i> , Version 1 (2014)		CVC			
REGDOC-2.2.3	<i>Personnel Certification, Volume III: Certification of Reactor Facility Workers, Version 2</i> (2023)	CVC	CVC	CVC	CVC	Guidance
REGDOC-2.2.4	<i>Fitness for Duty: Volume I: Managing Worker Fatigue</i> (2017)	CVC	CVC	CVC	CVC	Guidance
REGDOC-2.2.4	<i>Fitness for Duty, Volume II: Managing Alcohol and Drug Use</i> , Version 3 (2021)	CVC	CVC	CVC	CVC	Guidance
REGDOC-2.2.4	<i>Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical and Psychological Fitness</i> (2018)	CVC	CVC	CVC	CVC	Guidance
REGDOC-2.2.5	<i>Minimum Staff Complement</i> (2019)	Guidance	Guidance	Guidance	Guidance	Guidance
Operating performance						
REGDOC-2.3.1	<i>Conduct of Licensed Activities: Construction and Commissioning</i> (2016)	Guidance		Guidance		CVC
REGDOC-2.3.2	<i>Accident Management</i> , Version 2 (2015)	CVC	CVC	CVC	CVC	CVC
Safety analysis						
REGDOC-2.4.1	<i>Deterministic Safety Analysis</i> (2014)	CVC	CVC	CVC	CVC	CVC
REGDOC-2.4.2	<i>Probabilistic Safety Assessment (PSA) for Nuclear Power Plants</i> (2022)	IO	IO	IO	IO	CVC
	<i>Probabilistic Safety Assessment (PSA) for Nuclear Power Plants</i> (2014)	CVC	CVC	CVC	CVC	



Doc #	Document title	DNGS	PNGS	BNGS	PLNGS	DNNP
REGDOC-2.4.3	<i>Nuclear Criticality Safety, Version 1.1 (2020)</i>	NA	Guidance	CVC	Guidance	CVC
REGDOC-2.4.4	<i>Safety Analysis for Class IB Nuclear Facilities (2022)</i>				CVC	
REGDOC-2.4.5	<i>Nuclear Fuel Safety and Qualification (2024)</i>	CVC	IO	Guidance	IO	
Physical design						
REGDOC-2.5.1	<i>General Design Considerations: Human Factors (2019)</i>	Guidance	Guidance	Guidance	Guidance	CVC
REGDOC-2.5.2	<i>Design of Reactor Facilities (2023)</i>					
	<i>Design of Reactor Facilities (2014)</i>	Guidance	Guidance	Guidance	Guidance	CVC
REGDOC-2.5.7	<i>Design, Testing and Performance of Exposure Devices (2020)</i>	NA	NA	NA	NA	
Fitness for service						
REGDOC-2.6.1	<i>Reliability Programs for Nuclear Power Plants (2017)</i>	CVC	CVC	CVC	CVC	CVC
REGDOC-2.6.2	<i>Maintenance Programs for Nuclear Power Plants (2017)</i>	CVC	CVC	CVC	CVC	NA
REGDOC-2.6.3	<i>Aging Management (2014)</i>	CVC	CVC	CVC	CVC	CVC
Radiation protection						
REGDOC-2.7.1	<i>Radiation Protection Version 1.1 (2025)</i>					
	<i>Radiation Protection Version 1 (2021)</i>	Guidance	Guidance	Guidance	Guidance	Guidance
REGDOC-2.7.2	<i>Dosimetry, Volume I: Ascertaining Occupational Dose (2021)</i>		Guidance	Guidance	Guidance	Guidance
REGDOC-2.7.2	<i>Dosimetry, Volume II: Technical and Management System Requirements for Dosimetry Services (2020)</i>	NA	NA	NA	NA	
Conventional health and safety						
REGDOC-2.8.1	<i>Conventional Health and Safety (2019)</i>	Guidance	Guidance	Guidance	Guidance	Guidance
Environmental protection						
REGDOC-2.9.1	<i>Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.2 (2020)</i>		CVC	CVC	CVC	CVC



Doc #	Document title	DNGS	PNGS	BNGS	PLNGS	DNNP
	<i>Environmental Protection: Environmental Principles, Assessments and Protection Measures, Version 1.1 (2017)</i>	CVC				
REGDOC-2.9.2	<i>Environmental Protection: Controlling Releases to the Environment (2024)</i>	IO	IO	IO	IO	Guidance
Emergency management and fire protection						
REGDOC-2.10.1	<i>Nuclear Emergency Preparedness and Response, Version 2 (2016)</i>	CVC	CVC	CVC	CVC	CVC
Waste Management						
REGDOC-2.11.1	<i>Waste Management, Volume I: Management of Radioactive Waste</i>	CVC	CVC	CVC	CVC	CVC
REGDOC-2.11.1	<i>Waste Management, Volume II: Management of Uranium Mine Waste Rock and Mill Tailings (2018)</i>	NA	NA	NA	NA	NA
REGDOC-2.11.1	<i>Waste Management Volume III: Assessing the Long-Term Safety of Radioactive Waste Management (2021)</i>	NA	NA	NA	NA	
REGDOC-2.11.2	<i>Decommissioning, Version 1 (2021)</i>		CVC		CVC	CVC
Security						
REGDOC-2.12.2	<i>Site Access Security Clearance (2013)</i>	CVC	CVC	CVC	CVC	CVC
REGDOC-2.12.3	<i>Security of Nuclear Substances: Sealed Sources , Version 1 (2013)</i>	NA	NA	CVC	NA	NA
	<i>Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material, Version 2.1 (2020)</i>	CVC	CVC	Guidance	CVC	
Safeguards and non-proliferation						
REGDOC-2.13.1	<i>Safeguards and Nuclear Material Accountancy (2018)</i>	CVC	CVC	CVC	CVC	CVC
	<i>Import and Export, Version 2 (2018)</i>			Guidance	Guidance	CVC



Doc #	Document title	DNGS	PNGS	BNGS	PLNGS	DNNP
REGDOC-2.13.2	<i>Import and Export, Version 1 (2016)</i>		Guidance			
Packaging and Transport						
REGDOC-2.14.1	<i>Information Incorporated by Reference in Canada's Packaging and Transport of Nuclear Substances Regulations (2021)</i>		Guidance	Guidance	Guidance	
REGDOC-2.14.1	<i>Packaging and Transport, Volume II: Radiation Protection Program Design for the Transport of Nuclear Substances (2018)</i>					
Public and Indigenous Engagement						
REGDOC-3.2.1	<i>Public Information and Disclosure (2018)</i>	CVC	CVC	CVC	CVC	CVC
REGDOC-3.2.2	<i>Indigenous Engagement, Version 1.2 (2022)</i>	CVC	CVC	CVC	CVC	CVC
CNSC Processes and Practices						
REGDOC-3.5.1	<i>Information Dissemination: Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills, Version 2.1 (2022)</i>					
REGDOC-3.5.2	<i>Compliance and Enforcement: Administrative Monetary Penalties, Version 2 (2015)</i>					
REGDOC-3.5.2	<i>Compliance and Enforcement, Volume II: Orders under the Nuclear Safety and Control Act (2019)</i>					
REGDOC-3.5.3	<i>Regulatory Fundamentals, Version 2.1 (2022)</i>					CVC
REGDOC-3.5.4	<i>Pre-licensing Review of a Vendor's Reactor Design (2018)</i>	NA	NA	NA	NA	

Annex 7.2 (iii)(b)

Details related to verification of compliance

Table 19 indicates some of the systems and areas that are covered by Type II and field inspections at operating NPPs.

Table 19: Systems and areas covered by inspections

Processes and functions	Facilities and equipment
Fuel handling	Control room
Startup	Reactor building
Shutdown safety	Turbine hall
Heat sinks	Battery room
Outage management	Control equipment room
Fuel and physics	Containment
Pressure boundary	Emergency coolant injection
Effluent control and monitoring	Shutdown system 1
Environmental monitoring	Shutdown system 2
	Stand-by safety systems
	Safety-related systems
	Electrical systems
	Emergency mitigation equipment

Annex 8.1 (b)

CNSC organizational details

The CNSC includes five branches that report to the President: Regulatory Operations, Technical Support, Regulatory Affairs, Corporate Services, and Legal and Commission Affairs. Regulatory Operations Branch is described in subsection 8.1(b), whereas the other four branches are described below.

Besides the five branches, the Internal Audit, Evaluation and Ethics Division (IAEED) also reports to the CNSC President. Its evaluation function is described in subsection 8.1(e), whereas its values and ethics function is described here.

Internal Audit, Evaluation and Ethics Division (IAEED) – Values and Ethics

The Values and Ethics function within the IAEED administers five internal ethics-related programs that directly or indirectly support regulatory independence:

- The Values and Ethics Program provides counselling and training to CNSC employees to support ethical decision making in the work environment.
- The Internal Disclosure Program is designed to help employees safely and constructively disclose wrongdoing and protects them from reprisal when making allegations in good faith or testifying in disclosure cases under the *Public Servants Disclosure Protection Act*.
- The Conflict of Interest and Post-employment Program offers employees tools to prevent and avoid situations that could create the appearance of a conflict of interest or result in a potential or actual conflict of interest.
- The Political Activities Guidelines set the principles that allow employees to engage in election campaigns while upholding their duty to conduct their CNSC responsibilities in a politically impartial manner.
- The fraud risk management oversight program ensures that the CNSC has effective controls in place to prevent, detect and respond to fraud risks.

The Values and Ethics function also manages complaints made by external entities to ensure that a neutral body within the CNSC oversees the investigation and resolution processes.

Technical Support Branch

The Technical Support Branch consists of a large number of employees with particular knowledge and skills who provide technical support to the activities of the Regulatory Operations Branch (including the Directorate of Power Reactor Regulation) and the Regulatory Affairs Branch. The branch accomplishes this by providing specialist advice for regulatory programs, reviewing NPP licensee submissions, participating in compliance verification activities and helping to develop regulatory framework documents. Collaborations frequently include contributions involving several disciplines from across the Technical Support Branch and the Regulatory Operations Branch, requiring an integrated approach to resolving issues. The staff of the Technical Support Branch also share scientific and technical information and experience with stakeholders in Canada and other countries and undertake special projects within their expertise and mandate.

The Technical Support Branch comprises four directorates:

- Directorate of Assessment and Analysis
- Directorate of Safety Management
- Directorate of Environmental and Radiation Protection and Assessment
- Directorate of Security and Safeguards

The Directorate of Assessment and Analysis has expertise in the areas of chemistry, nuclear fuel, reactor physics, engineering (electrical, materials, mechanical, metallurgical, nuclear, civil/structural, and systems), design, aging management, maintenance, and equipment qualification, as well as fire protection, robustness, vulnerability design engineering and safety analysis, including deterministic safety analysis, probabilistic safety assessment and hazards analysis. The Directorate of Assessment and Analysis consists of six divisions:

- Engineering Design Assessment Division
- Operational Engineering Assessment Division
- Probabilistic Safety Assessment and Reliability Division
- Systems Engineering Division
- Reactor Behaviour Division
- Reactor Physics and Thermalhydraulics Division

The Directorate of Safety Management has expertise in the areas of human and organizational safety management, human factors, safety culture, management systems, examination, certification and training. It consists of four divisions:

- Management Systems Division
- Personnel Certification Division
- Human and Organizational Performance Division
- Training Program Evaluation Division

The Directorate of Environmental and Radiation Protection and Assessment has expertise in the areas of environmental assessment/impact assessment, environmental risk assessment, environmental monitoring and environmental management systems, as well as radiation protection, dosimetry and health sciences. It consists of five divisions:

- Environmental Risk Assessment Division
- Environmental Assessment Division
- Laboratory Services Division
- Radiation Protection Division
- Health Sciences and Environmental Compliance Division

The Directorate of Security and Safeguards has expertise in the area of emergency management and response. It is responsible for the CNSC's Nuclear Emergency Management Program, including its implementation and the planning of activities with other federal/provincial agencies and international organizations (see article 16). It also has expertise in: nuclear security; import and export of nuclear substances, equipment and devices; safeguards; and non-proliferation. It consists of four divisions:

- Nuclear Security Division
- Emergency Management Programs Division
- Non-proliferation and Export Control Division
- International Safeguards Division

Regulatory Affairs Branch

The Regulatory Affairs Branch plays a central role in managing the regulatory framework in addition to communications and stakeholder relations. It encompasses the Regulatory Policy Directorate, the Strategic Planning Directorate and the Strategic Communications Directorate. The Regulatory Policy Directorate is charged with managing the regulatory framework, which includes reviews of the adequacy of regulatory instruments, management of their revision, and producing new regulatory instruments (including new REGDOCs). The Strategic Planning Directorate is responsible for planning and reporting at the organizational level (e.g., reporting to Parliament), and for evaluating the CNSC's effectiveness and efficiency in relation to its regulatory mandate. It also manages international affairs and Indigenous relations. The Strategic Communications Directorate is responsible for both internal and external communications and hence contributes to measures related to openness and transparency.

Corporate Services Branch

The Corporate Services Branch provides organizational-wide services, activities and resources that support the needs of programs and other corporate obligations of the organization. These include management and oversight, human resources management, financial management, information and technology management, acquisition services, and other administrative services.

Legal and Commission Affairs Branch

The Legal and Commission Affairs Branch includes Legal Services and the Commission Registry. Legal Services acts as counsel to the Commission in its statutory roles and provides legal representation in litigation and prosecution cases. It also provides advice and legal opinions to CNSC staff. The Commission Registry consists of the Commission Registrar and supporting staff. It plans the Commission's hearings and meetings; provides technical and administrative support to the President and other members of the Commission; communicates on matters related to Commission business and acts as the official registrar for Commission documentation.

Annex 9 (c)

Public information programs of NPP licensees and applicants

The availability and clarity of information pertaining to nuclear activities is essential to establishing an atmosphere of openness, transparency and trust between the applicant/licensee and the public.

The primary goal of a public information and disclosure 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 the NPP are effectively communicated in plain language to the public, stakeholders, target audiences and Indigenous Nations and communities.

Public information and disclosure programs are supported by disclosure protocols that outline the type of information on the facility and its activities that will be shared with the public (e.g., major changes to operations, periodic environmental performance reports) and timelines for sharing that information.

Each licensee works to keep all its target audiences informed of current and future operations, emergency preparedness measures, and its commitment to safety, security and the environment. The licensee does this through the production and distribution of community newsletters, open house meetings, website updates, event reporting, news releases, community partnership and sponsorship, public and Indigenous engagement, social and traditional media, government relations, external stakeholder engagement, and employee and retiree communication tools.

During the reporting period, NB Power, Bruce Power and OPG requested licence renewals or amendments for their power reactor operating licence. Because of the importance of these requests, specific licence renewal or amendment information packages, including operational and scientific information, were communicated with the public and target audiences.

Prior to licence renewals, each licensee consults the public, its stakeholders, its target audiences and Indigenous Nations and communities through various methods previously determined as meaningful to its audiences. Topics of discussion include licence requirements (such as those related to the environment, safety and security), periodic safety reviews, waste management, [Fisheries Act](#) authorization information, Indigenous engagement and environmental risk assessments. In parallel, CNSC staff complete a full review of each public information program and hosted independent engagement sessions to provide audience-specific public information to communities associated with each licence renewal. In turn, members of the public and target audiences have the opportunity to meet directly with the CNSC.

The public information and disclosure programs of NPP licensees are required to have the following elements:

- objectives
- target audience identification

- public and media opinion-tracking
- public information strategy and products
- public disclosure protocol
- public disclosure notification to the CNSC
- program evaluation and improvement process
- documentation and records
- contact information

The public information strategies and products within the licensees' programs typically consist of:

- community newsletters mailed directly to households and businesses
- advertising in local newspapers
- regular updates provided to local municipal, provincial and federal governments
- an interactive visitors' centre
- annual open houses on operational performance
- an Indigenous relations program
- communication with employees
- an informative website and social media channels
- regular information sessions on topics identified as areas of public interest
- public polling and focus groups to gather information on public opinion
- media releases

For illustration, some examples of the public outreach undertaken by Bruce Power, NB Power and OPG during the reporting period are described below.

During the reporting period, Bruce Power:

- consulted with Indigenous Nations and communities whose treaty or Indigenous rights may be directly affected by the NPP's operation
- continued an Indigenous scholarship program to assist students as they further their studies at post-secondary institutes
- offered free summer bus tours to the public
 - weekday (only) tours resumed in 2022, after the COVID pandemic, resulting in approximately 3700 tours for 2022 and 2023
 - in 2024, daily tours resumed, resulting in over 5700 tours
- posted its monthly newsletter on its website
- continued to invest in support programs in the local community (e.g., health and wellness, youth development)
- conducted regular provincial and regional public opinion polling to scientifically measure support in a number of key areas
- conducted a series of television advertising campaigns in the Province of Ontario to promote the production of cobalt-60 and lutetium-177 by Bruce Power for use in sterilizing medical equipment and in cancer treatment
- provided updates on a number of site initiatives including the major component replacement (MCR) outage for Unit 6, Bruce Power Net Zero and power increases due to turbine side efficiency improvements
- provided public updates on the pressure tube inspections that had discovered elevated hydrogen content (described in ninth Canadian report)

During the reporting period at both Pickering and Darlington, OPG:

- distributed a community newsletter, 'Neighbours', three times per year to more than 250,000 households and businesses in Durham Region (the newsletter is also available online)
- provided regular updates to local municipal levels of government, community organizations and local businesses
- provided regular updates to existing community committees (Durham Nuclear Health Committee, Community Advisory Council) and other stakeholders
- held regular meetings with local Indigenous Nations and communities regarding nuclear operations, environmental reporting and projects (i.e., Darlington refurbishment and DNNP) as well as OPG's Indigenous Opportunities Network
- shared information on what to do in the event of a nuclear emergency
- provided support to community initiatives through its corporate Power for Change project
- provided information to the public through its website and social media platforms (OPG receives tens of thousands of visitors annually to its website, and maintains an active presence on social media)

During the reporting period, NB Power:

- hosted virtual and in-person public information sessions to keep the public apprised of activities, including the licence renewal process and the full-scale integrated emergency exercise (Synergy Challenge)
- hosted stakeholder meetings throughout the province to provide updates on activities at Point Lepreau
- held community meetings with Indigenous Nations and communities, municipalities, local fishery and community representatives, environmentalists and the general public to discuss NB Power activities including its [Fisheries Act](#) authorization, licence renewal and NPP operations
- supported the local naturalist clubs by allowing access and services to the point at Point Lepreau to support observation of migrating birds and monarch butterfly tagging programs and activities
- hosted Indigenous Nations and communities and members of the public at Point Lepreau to participate in and learn about environmental protection initiatives
- participated in monthly meetings with New Brunswick Indigenous representatives to discuss and share NB Power activities as well as learn from their community members' interests and activities
- provided information to the public through its website and social media
- distributed its quarterly newsletter within a 20 km radius of the NPP and posted the newsletter to the NB Power website
- conducted regular provincial public opinion polling to measure support and understand key interests
- produced, distributed to the local communities and posted on the NB Power website a calendar featuring pictures taken within the local community and containing information on general and nuclear emergency preparedness and background information on radiation
- supported community initiatives through the NB Power corporate citizenship program
- participated in educational programs with local school children, youth and college/university students
- participated in trade and technical education initiatives to promote science and technology

- provided speakers to various service clubs and organizations

In addition to the typical public information programs for existing NPPs, Bruce Power, NB Power and OPG also conduct on-going and comprehensive outreach programs focused on the pre-distribution of potassium iodide (KI) pills in the vicinity of their NPPs. More details can be found in subsection 16.1(d).

Annex 10 (a)

Safety policies at the nuclear power plants

Each existing licensee has adopted a different style of demonstrating its priority to safety, with some choosing to state high-level safety principles as part of a distinct nuclear safety policy for their organization.

Ontario Power Generation

The OPG nuclear safety and security policy states that:

Nuclear Safety and Security shall be the overriding priority in all activities performed in support of OPG nuclear facilities. Nuclear Safety shall have clear priority over schedule, cost and production. This policy identifies the Chief Nuclear Officer as being accountable to the Chief Executive Officer and the Board of Directors to establish a management system that fosters nuclear safety as the highest priority.

Bruce Power

Ensuring a healthy nuclear safety culture is an objective for the Bruce Power management system and a means to high standards of excellence. Bruce Power states its commitment to safety within its nuclear safety policy as follows:

Bruce Power is committed to fostering a healthy nuclear safety and security culture whereby all employees strive to embrace our safety-first value - guarding our four safety pillars (reactor, industrial, radiological, and environmental) - to ensure we protect each other, our plant, our community and the environment. Reactor safety is the overriding priority. We promote cooperation and sharing of good practices related to nuclear security culture. Having a healthy nuclear safety and security culture contributes to achieving excellence and business results of safe, reliable, securing tomorrow.

NB Power

The *Nuclear Management Manual*, the highest-level document governing the operations of Point Lepreau, has the following as the first points of the management commitments:

- NB Power is committed to the safe, reliable and efficient operation of Point Lepreau Generating Station.
- meeting the requirements and expectations of NB Power policies related to Nuclear Safety, Conventional Safety, and the Environment

Key core values of the organization are stated as follows:

We take care of our nuclear core. We understand the unique nature of the nuclear core and are committed to making nuclear safety our overriding priority.

We are committed to the safety of every employee and member of the public through:

- Planning safety onto our work • Following the rules • Being a leader in safety
- Reporting so we can get better • Having courage • Saying no to unsafe work



In addition, the *Nuclear Management Manual* is introduced by the following statement:
Our Management System is a combination of the culture and interrelated activities that are used to direct and carry out work. It includes the management and support of personnel to enable them to implement the documented processes established within the Management System so that the performance objectives are achieved safely, consistently and efficiently.

Annex 11.2 (a)

Details related to training and number of workers

Improvements to licensees training programs

The following summarizes some ways that NPP licensees have improved their training programs during the reporting period.

Workplace Learning: Bruce Power

In the past, Bruce Power was primarily focused on the 'traditional' classroom approach to training (e.g., lectures, and PowerPoint presentations). Feedback from students and leaders was that this style was not responsive enough to meet the needs of the workers.

This feedback is aligned with INPO 23-001, *Guidelines for Advancing Teaching and Learning in the Nuclear Power Industry*, which highlights continuous learning as a core element of a culture that supports sustaining high levels of plant performance and continuous improvement. Continuous learning supplements and moves beyond conventional training methods to non-conventional methods such as self-paced learning, customizable content based on individual needs and collaborative learning.

Accordingly, Bruce Power has adapted by becoming an industry leader in workplace learning by increasing hands-on learning and leveraging technology to support continuous improvement and staff that are highly proficient in the moment through just-in-time training, microlearning videos, learning packages in a computer-based training platform, adaptive learning and professional development in LinkedIn Learning.

Safety System Qualifications: Bruce Power

In order to support increasing the number of staff with the control maintenance safety system (shutdown system, or SDS) qualification, an initiative was undertaken to improve the qualification process. The full qualification, which includes both on-the-job and classroom training in SDS1 and SDS2, as well as emergency coolant injection and negative pressure containment, has historically taken approximately five years. With this qualification, control maintainers can troubleshoot and perform corrective maintenance on all aspects of the special safety systems and the reactor regulating system. It is a minimum staff complement (MSC) role, meaning a qualified person always has to be present to support operations and maintenance on the safety systems.

To support this plan, a team conducted significant in-field mentorship with qualified staff, while soliciting the trainees for feedback. The team also collaborated with NB Power and OPG to benchmark qualification improvements and ensure they were providing the best and most up-to-date training to workers.

Career Development: Bruce Power

Bruce Power is employing an online education marketplace that can be used for professional development and upskilling, providing staff with the opportunity to update and enhance

employee skills and knowledge for current and future roles. Employee requests for courses are aligned to the professional development needs of both the employee and the business. Future-focused development or career opportunity employee requests are encouraged. Costs incurred by the tuition programs through the system are funded by Bruce Power.

Tritium removal facility and fuel handling simulator: Ontario Power Generation

During the reporting period significant upgrades were made to the Tritium Removal Facility and a second fuel handling simulator was added at Darlington, to enhance the operator training program. The simulators provide a realistic training environment where operators can be trained to standards similar to those of certified operations staff. The simulators are also being used to enhance operator proficiency through “just-in-time” training prior to infrequently performed evolutions.

Human Performance Simulator: Ontario Power Generation

OPG has embedded the use of a Boeing 737 Flight Simulator into the human performance training program for all staff. The new training program focuses on the psychology of human performance, introduces the key tools and allows trainees to practice the use of these tools in an environment most are unfamiliar with. This new program has proven to be an engaging experience and has been used to improve human performance across the fleet.

Leadership learning redesign: Ontario Power Generation

In 2023, OPG conducted a learning needs analysis to address the changing needs of employees. The analysis revealed a clear desire for experiential learning over traditional training. As a result, “My Leadership Academy” was developed and shifted from a content-heavy, module-based model to a cohort-based program that combines experiential learning with on-the-job practice catered to the diverse requirements of aspiring, new, and experienced leaders.

Building leaders faster: Ontario Power Generation

In 2024, OPG launched an enterprise-wide series of easy-to-consume learning sessions to support leadership development. The series was complemented by micro-learning specific to business-units. These sessions provided a collaborative environment where leaders could engage in open discussions on critical leadership topics, including navigating difficult conversations and leading change. Through guided discussions and feedback from human resources experts and business leader-peers, leaders gained valuable insights, established better connections with their peers and built leadership skills.

Video Learning on Demand: Ontario Power Generation

OPG continued to develop and maintain a suite of short duration learning videos that are easily accessible by all staff. Video learning content can be used in the training environment on demand by the employee and embedded into the electronic safe work planning and pre-job brief application used at the stations to facilitate just-in-time learning.

Leadership training: NB Power

NB Power has placed a significant focus on the development and delivery of in-classroom leadership training with all station leaders. The focus of the training is cultivating a deliberate and strategic focus on the behaviours and actions of leaders and teams that inspire an environment of high standards (aligned with INPO 16-008 *Leadership and Team Effectiveness Attributes Implementation*). A key program success has been having dedicated senior management mentors be part of the training with a specific focus on developing front-line leaders.

Building Competency: NB Power

NB Power has also placed a significant focus on advancing teaching and learning concepts to strengthen the continuous learning aspect of its culture by promoting the behaviours and building competence needed to establish a learning organization (aligned with INPO 23-001). The teaching and learning concepts continue to strengthen all aspects of the organization with a specific focus on maintenance, operations and engineering

NB Power continues to develop and utilize dynamic learning activities to address the application and use of human performance tools and techniques associated with tasks that are infrequently performed such as maintenance on certain components, radiation protection activities and operational evolutions within the main control room. In dynamic learning, an activity or task being taught includes, as much as possible, the actual conditions encountered and tools required. Real-world situations are simulated and the activity is enhanced with role playing by other participants. These learning activities are supported and utilized by all levels of the organization from the Site Vice President to the maintainers in the field and contract staff. The benefit of utilizing dynamic learning activities has been demonstrated in reducing radiological dose and risk to workers, reducing equipment out-of-service timelines and removing errors associated with proficiency and human performance during task and activity evolutions during both on-line and outage states.

Requirements and guidance for qualification and numbers of workers

A hierarchy of laws, regulations, licence conditions and regulatory documents specify the requirements for the number of workers to be present at an NPP as well as the qualifications and training of personnel who perform critical, safety-related activities.

The NSCA and its regulations provide the legislative basis for the number of workers and the qualification, training, examination and certification of personnel. Specifically, the *General Nuclear Safety and Control Regulations* state that the licensee shall:

- (a) ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the Act, the regulations made under the Act and the licence
- (b) train the workers to carry on the licensed activity in accordance with the Act, the regulations made under the Act and the licence

The [*Class I Nuclear Facilities Regulations*](#) require each applicant for a licence to construct, operate or decommission a Class I nuclear facility to provide details about the qualifications, training and experience of any worker involved in the facility's operation or maintenance.

The licensing basis for NPPs includes the following requirements related to numbers of workers, qualifications and training:

- A MSC must be in attendance at all times to ensure safe operation of the NPP. This includes a sufficient number of qualified personnel to ensure adequate emergency response capability. The MSC is specified in licensee documents that are submitted as part of the application for a licence.
- A sufficient number of the following designated positions must be in attendance at all times at an NPP. These will vary depending upon the design of the NPP:
 - authorized nuclear operator/control room operator (all NPPs are required to have an authorized nuclear operator in direct attendance at each unit's main control room panels at all times)
 - Unit 0 control room operator (Bruce A, Bruce B, Darlington)
 - control room shift supervisor and shift manager for multi-unit NPPs
 - shift supervisor for single-unit NPPs (Point Lepreau)
- A certified responsible/senior health physicist must be appointed.
- Certified personnel must meet the relevant certification requirements applicable to their positions, as specified in CNSC regulatory document [REGDOC-2.2.3, Personnel Certification, Volume III: Certification of Reactor Facility Workers, Version 2.](#)

Annex 11.2 (b)

Workforce planning processes

All licensees have processes to ensure adequate resources and facilities are always available for responding to planned activities and contingencies. The following is an example of Bruce Power's processes to plan and optimize its workforce. The workforce planning process is reviewed annually as part of Bruce Power's business planning cycle. The process includes a talent segmentation exercise that analyzes the requirements for various positions and the available staff. It identifies the specific criticality levels of all jobs across the company, as well as the normal complement (e.g., requirements) for those positions. This information is then applied as business assumptions for future staffing-level planning activities.

Several business assumptions are also applied against actual headcount and job-level targets to mitigate risks to critical positions. An attrition model forecasts future retirements and staff movements across the site, based on historical retirement and staff movement trends, retirement surveys, available skills within and outside the organization, and a risk assessment/environmental scan of internal and external factors. In addition, the lead time (e.g., recruitment and training) is identified for all critical positions (including certified staff) and serves as a basis for "pre-hiring" before an incumbent actually leaves his or her position. This ensures mission-critical knowledge can be captured and transferred to a new hire.

Bruce Power's workforce planning process allows for continuous adjustments to the workforce plan, as it is considered a living document that must meet business requirements. Senior managers also review the status of Bruce Power's planned staffing efforts and other critical reports semi-monthly.

This experience, knowledge and continual review are applied to execute a gap analysis between current staffing levels and the optimal future state. During annual business planning sessions, executives and senior managers reconcile work program requirements and Bruce Power's long-term workforce model to develop appropriate staffing levels across the site for each year of the planning horizon. Consequently, Bruce Power has a system in place to ensure that current programs are managed, while implementing improvement strategies to reach its future workforce model and staffing levels.

Annex 12 (a)

Responsibilities and accountabilities for human performance at NPPs

Each licensee incorporates, in its management system, an organizational and management philosophy that uses a hierarchical method to account for human performance:

- the primary responsibility for human performance rests with each individual.
- first-line managers are accountable for monitoring and correcting human performance issues.
- management provides the necessary expectations, facilities and tools to aid human performance.
- non-line organizations provide independent oversight of human performance.

The priority given to safety by each licensee and the focus on safety culture (as discussed in article 10) are critical to this hierarchical approach. Clear lines of authority and communication are established, so that individuals throughout the organization are aware of their responsibilities toward nuclear safety. At the individual level, the emphasis is on personal dedication and accountability for each individual engaged in an activity that affects the safety of the NPP. An individual's recognition and understanding of this responsibility, as well as a questioning and self-checking attitude, are essential for minimizing human errors.

Human performance tools for workers are used to anticipate, prevent and detect errors before they cause harm to people, the plant, property or the environment. Although these tools can be used by any employee in a wide range of situations, they are particularly useful to front-line workers and their managers, who touch plant equipment and are capable of altering its status. Human performance tools help workers maintain positive control of a work situation, ensuring the job is done correctly the first time.

Errors by knowledge workers, especially engineers, potentially have the greatest adverse impact on NPP safety. "In-process" errors are often more subtle than front-line active errors committed by operators and maintainers of plant equipment, in that they tend to create latent errors that, if undetected, become embedded in the physical configuration of the plant equipment or documentation. Additionally, latent errors may go unnoticed for very long periods. Human performance tools for knowledge workers assist them in anticipating, preventing and catching most errors related to their work. Knowledge-worker tools provide a defensive barrier against latent errors that can affect plant safety or production later.

Management's roles and responsibilities to aid in human performance include:

- clearly communicating performance expectations through policies and procedures
- establishing an effective organization with well-defined and understood responsibilities, accountabilities and authorities
- ensuring an operational safety focus
- hiring sufficient numbers of properly-qualified workers
- developing sound procedures to clearly define safety-related tasks
- creating a workplace environment where people are encouraged to provide honest feedback and report errors without fear of reprisal

- continuously enhancing the procedures by incorporating lessons learned
- providing the necessary training and education to emphasize the reasons behind established safety practices and procedures, together with the consequences of safety shortfalls in personal performance
- providing sufficient and proper facilities, tools and equipment, and support staff
- conducting self-assessments to promote continuous improvement
- ensuring that human factors issues are systematically considered in any new design or modification to an existing facility
- providing additional levels of oversight, independent of the line organization, to evaluate human performance
- ensuring the use of OPEX feedback

Each level of management is also vested with a specific level of authority as defined in management system documents. Managers should have a clear understanding of what they can approve versus what they must refer to a higher authority. Errors are minimized by requiring anyone who approves a document or activity to verify consistency and compliance with:

- the individual's limits of authority
- the applicable external requirements (e.g., laws, regulations and the licence) and internal boundaries (e.g., operating policies and principles (OP&Ps), safety reports and quality assurance manuals)
- operating and maintenance practices
- design assumptions and intent

First-line managers are accountable for monitoring and correcting human performance issues. The primary method is direct observation of pre-job planning and preparation, work execution and post-job wrap-up activities. The flow of information and the communication of problems both up and down the line, including identification of human errors, are key to human error detection and correction.

A formal observation and coaching program assists managers and supervisors in directing their observation activities to those areas where the most significant impact will be achieved. The program also provides guidance on effective non-confrontational approaches to interacting with employees when managers and supervisors deliver coaching feedback on performance that met or did not meet the requirements.

Annex 12 (e)

Human factors engineering in NPP design and modification

In the Canadian nuclear power industry, human factors engineering (HFE) is applied in new designs from the conceptual design phase to the final detailed design, installation and commissioning phases. In operating NPPs, HFE considers operational, maintenance and aging management factors – and is integrated in the development of procedures as well as change control processes when any modifications are made.

In CANDU NPPs, a rigorous HFE approach is used to design main control rooms, secondary control areas, emergency support facilities, instrumentation and controls, safety systems and local field interfaces (e.g., in the areas of human system interface components, equipment layouts, control room habitability, control room display design, panel design and annunciation design, as well as for the design of structures, systems and components (SSCs) for testing, inspection, maintenance, fuel handling, transport and storage, waste management, chemistry, radiation, security, emergency response and management). HFE is applied in a graded manner, using human-factor-related criteria based on risk and complexity.

A systematic process is defined, documented and implemented to integrate human factors into the design process. HFE activities are identified and documented for each design and incorporated into the design plan and/or human factors plan. The plans are based on the regulatory requirements, international standards and best practices, as well as experience derived from the application of HFE to previous CANDU design projects throughout the evolution of CANDU technology. The plans are then implemented to ensure that the resulting design is compatible with human capabilities and limitations and that the systems and equipment can be safely and effectively operated and maintained for all postulated system states and operating conditions. HFE summary reports are produced to document the results of the process. All licensees and AtkinsRéalis perform periodic self-assessments of their HFE programs to confirm they are fully implemented and effective.

HFE is incorporated into nuclear design projects, including new-build and refurbishment projects and nuclear engineering services, in accordance with regulatory requirements and industry standards. HFE in design applies to the entire system design and extends beyond nuclear systems (e.g., balance of plant and fuel handling).

The NPP licensees have implemented CSA Group standard N290.12, *Human factors in design for nuclear power plants*, which identifies 11 elements to be addressed by HFE:

- HFE program management
- OPEX review
- functional requirements analysis and function allocation
- task analysis
- staffing and qualification
- treatment of important human actions
- human-system interface design
- procedure development
- training program development

- human factors verification and validation
- design implementation (integration)

In addition to providing input about the design itself, human factors are also addressed as part of the constructability, operability, maintainability and safety review as well as in the development of procedures, instructions and training. Also, human factors considerations and human performance tools are used throughout a nuclear facility to address installation and commissioning of the design as well as the operability, maintainability and safety of NPPs during operation and shutdown.

Annex 14 (ii) (b)

Aging management programs at each nuclear power plant

CNSC regulatory document [REGDOC-2.6.3, *Aging Management*](#), establishes the regulatory requirements and provides guidance for integrated and component-specific aging management programs at NPPs.

Along with the aging management programs required by REGDOC-2.6.3, Canadian licensees have developed a series of periodic inspection programs and plans that expand the minimum inspection and testing program requirements to address operational and safety issues. The most significant of these programs and plans are described below.

Feeder pipe lifecycle management plan

This plan establishes an inspection and maintenance strategy to mitigate risks related to feeder aging and degradation mechanisms. Specific program inspection and maintenance activities are described to mitigate degradation caused by bend thinning, bend cracking, localized flaws adjacent to welds and weld cracking. A visual inspection program is included to detect any localized feeder fretting due to contact with components and structures in close proximity. This plan also documents the strategy for determining whether feeder replacement is needed.

Fuel channel lifecycle management plan

This plan includes strategies for ensuring that the effects of fuel channel aging are monitored (with inspections conducted per CSA Group standard N285.4, *Periodic inspection of CANDU nuclear power plant components*) and managed effectively. It also discusses degradation mechanisms – including pressure tube dimensional changes due to service conditions (axial and diametral expansion, wall thinning and tube sag), deuterium uptake, fracture toughness changes, pressure tube to calandria tube contact and the potential for blister growth, as well as re-fueling-related, service-induced damage to inside surfaces. Degradation mechanisms for fuel channel annulus spacers are also discussed along with plans to ensure their fitness for service. Research results are used to guide the inspection plans.

Flow-accelerated corrosion program

This program identifies susceptible systems and monitors and manages degradation related to flow-accelerated corrosion and other degradation mechanisms (such as erosion), mainly in secondary-side (non-nuclear) and certain primary-side (nuclear) piping systems. The program is based on the Electric Power Research Institute (EPRI) program. It uses the Chexal-Horowitz engineering corrosion (CHECWORKS) software as a guide in identifying and selecting inspection locations and processing measured data to determine thinning rates and acceptability for continued service. For piping that cannot be modelled using CHECWORKS due to geometrical constraints or thinning mechanisms (such as small-bore piping or thinning due to an erosive mechanism), manual calculations are used to evaluate the thinning rate and acceptability for continued service.

Steam generator lifecycle management plan

This plan establishes the inspection and maintenance strategy used to control risks related to steam generator aging and degradation mechanisms, and includes measures to detect, record, trend and mitigate those mechanisms. Program elements include tube wall inspections and inspections of other internal components (e.g., moisture separators, tie rods, feedwater boxes, and nozzles), water chemistry management, and primary- and secondary-side deposit management and removal (via water lancing, internal tube blasting, blow-down practices during operation and occasional chemical cleaning).

Containment

Requirements for the design, construction, commissioning and in-service inspection of concrete containment structures are provided in CSA Group standard N287.7, *In-service examination and testing requirements for concrete containment structures for CANDU nuclear power plants*. Licensees perform periodic in-service inspection and testing of the containment at specified intervals, to ensure that structural integrity and leak-tightness are maintained. Licensees are required to submit the periodic inspection and testing results, as well as their evaluations, to the CNSC for review. If inspection results indicate an adverse trend, the CNSC may require the licensee to increase the frequency of the inspection and/or take compensatory measures.

Additional inspection requirements for containment components are specified in CSA Group standard N285.5, *Periodic inspection of CANDU nuclear power plant containment components*.

Component replacement

The Canadian nuclear industry continues to take initiatives to prevent and manage problems with acquiring replacements for equipment that is no longer available from the original manufacturer. Often this results in the design, installation and commissioning of replacement components or systems within a rigorous engineering change control process that dispositions the potential impacts of any form, fit or function changes. Another strategy is to purchase a lifetime quantity of spare parts where feasible and economically justified. COG has an emergency spares assistance process that obtains spare parts from other utilities to meet the needs of CANDU NPPs. As well, a number of replacement components (including gaseous fission product detectors, 48-volt indicating fuses, heavy-water leak-detection systems, potentiometers, shut-off rod motors and digital control computers) were acquired through COG on behalf of several CANDU NPPs. The Canadian industry has also developed some capability, within an appropriate quality assurance program, to reverse-engineer and manufacture replacement parts that are no longer available.

Example of integrated plant life management plan

Bruce Power and OPG have evolved their approach to managing the aging and health of key structures, systems or components in alignment with evolving regulatory requirements, best practice, and OPEX. Their asset management approach is an example of the implementation of an integrated NPP aging management program to support key assets in reaching their target lifetimes for reliable operations. The asset management approach utilizes existing processes by integrating engineering practices for monitoring system and component health, periodic

inspection, equipment reliability and aging management, thus continuously gathering data in a “plan-do-check-act” cycle. A number of initiatives and strategies are underway to achieve or exceed target lifetimes. The program’s scope and process have been developed with consideration for nuclear industry regulatory requirement documents, along with best practice and guidance documents. These documents include:

- CNSC regulatory document [REGDOC-2.3.3, Periodic Safety Reviews](#)
- CNSC regulatory document [REGDOC-2.6.3, Aging Management](#)
- CNSC regulatory document [REGDOC-2.6.1, Reliability Programs for Nuclear Power Plants](#)
- IAEA safety guide [NS-G-2.12, Ageing Management for Nuclear Power Plants](#)

NB Power has enhanced its approach to aging management through its long-term assessment management program and aging management program to ensure long-term safe reliable operation of SSCs. The programs assess the long-term needs of key equipment against CNSC regulatory documents, CSA Group standards, and international guidance.

Annex 15 (a)

Details of radiation protection requirements and worker dose results

The [Radiation Protection Regulations](#) (RPR) form the primary regulatory basis for radiation protection, including the requirement for licensees to implement radiation protection programs. The regulations incorporate many of the International Commission on Radiological Protection (ICRP) recommendations (ICRP 103, 2007) and the IAEA's [Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards](#) (BSS) No. GSR Part 3 (2014).

The RPR address the following:

- implementation and requirements of licensee radiation protection programs
- requirements for ascertaining and recording doses
- definition of action level and the actions to be taken when an action level has been reached
- requirement for informing workers of the risks associated with radiation to which the worker may be exposed and of effective and equivalent dose limits
- requirement for when to use licensed dosimetry services to ascertain dose
- effective and equivalent dose limits for nuclear energy workers (NEWs), pregnant NEWs and persons who are not NEWs
- dose limits that apply during the control of emergencies
- actions to be taken when a dose limit is exceeded and the process for authorizing return to work
- requirements for licensed dosimetry services
- requirements for labelling containers and devices
- requirements for posting radiation warning signs

The CNSC has developed a number of regulatory documents to assist licensees in matters related to radiation protection and environmental protection.

At the end of the reporting period, the CNSC published the following new radiation protection regulatory document that superseded the previous version:

- [REGDOC-2.7.1, Radiation Protection, Version 1.1](#)

REGDOC-2.7.1 describes measures licensees can take to keep all doses to persons ALARA, social and economic factors being taken into account. Elements that the CNSC considers to be essential in the approach to ALARA are:

- demonstrated management commitment to the ALARA principle
- implementation of the ALARA principle through a licensee's management of work practices (including provision of dedicated resources, training, documentation and other measures)
- programs that control exposures to workers and the public
- planning for unusual situations
- development of performance goals and regular operational reviews

Section 8 of the RPR requires licensees to use a CNSC-licensed dosimetry service to measure and monitor radiation doses of NEWs who have a reasonable probability of receiving either an effective dose greater than 5 mSv or an equivalent dose to the skin, or the hands and feet,

greater than 50 mSv in a one-year dosimetry period. CNSC regulatory document [REGDOC-2.7.2, Dosimetry, Volume II: Technical and Management System Requirements for Dosimetry Services](#) specifies the requirements for licensed dosimetry service providers. Along with the technical requirements and the requirements for annual independent testing by accredited national calibration laboratories, the dosimetry service licensees must implement quality assurance programs. Section 19 of the RPR requires every licensee who operates a dosimetry service to file with the [National Dose Registry](#) (NDR) the dose results of each NEW for whom it has measured and monitored a dose of radiation.

Summary of doses to NPP workers during the reporting period

The RPR require licensees to ensure that the effective dose received by workers at NPPs does not exceed 50 mSv in a one-year dosimetry period or 100 mSv in a five-year dosimetry period. Table 20 shows the collective dose from routine operations and outages, as well as the total collective dose and maximum individual effective dose received by a worker at Canadian NPPs for the years 2022 to 2024. As indicated, no worker exceeded the annual dose limit of 50 mSv.

Table 20: Occupational dose summary for Canadian NPPs, 2022 to 2024

NPP	Year	Number of reactors	Collective dose from routine operations (person-mSv)	Collective dose from outages, (including forced outages), and refurbishment (person-mSv)	Total collective dose (person-mSv)	Maximum individual effective dose (mSv)
Bruce A and B*	2022	8	986	12,771	13,757	21.29
	2023	8	884	15,336	16,220	20.58
	2024	8	1029	15,895	16,924	19.41
Darlington*	2022	4	259	10,694	10,953	19.43
	2023	4	312	9,766	10,078	20.20
	2024	4	208	13,583	13,791	20.63
Pickering	2022	6	885	3,148	4,033	13.37
	2023	6	939	3,018	3,957	13.55
	2024	6	799	1,884	2,683	10.59
Point Lepreau	2022	1	176	1,207	1,383	14.76
	2023	1	258	167	425	8.90
	2024	1	107	1,216	1,323	11.41

* Refurbishment activities conducted during this reporting period

The RPR require licensees to ensure that the effective dose for the five-year dosimetry period (defined as the period of five calendar years beginning on January 1, 2001 and every period of five calendar years after that period) does not exceed 100mSv. Table 21 shows the maximum individual effective dose accumulated to date for the current five-year dosimetry period of 2021

to 2025. As shown in the table, no worker had exceeded the five-year dose limit of 100mSv, as of the fourth year of dose data collection.

Table 21: Maximum individual effective dose to workers at each Canadian NPP, for five-year dosimetry period of 2021 to 2025

Station	Maximum individual effective dose (mSv)*
Bruce A and B	59.89
Darlington	69.40
Pickering	50.46
Point Lepreau	38.71

*The current 5-year dosimetry period (01 January 2021 – 31 December 2025) is incomplete at the time of writing. The data provided is for the 4-year period: 01 January 2021 – 31 December 2024.

Table 22 summarizes the collective dose data for NPPs.

Table 22: Total collective dose at all Canadian nuclear power plants, 2022 to 2024

Year	Number of reactors	Collective dose (person-Sv)
2022	19	30.0
2023	19	30.7
2024	19	34.7

Annex 16.1 (b)

Onsite emergency plans at Canadian nuclear power plants

Bruce Power Nuclear Emergency Plan

In the context of the Bruce Power Nuclear Emergency Response Plan, a nuclear emergency is any emergency that poses a radiation hazard to people or property offsite. The Bruce Power Nuclear Emergency Plan is a corporate-level plan that serves as the common basis of site-specific nuclear emergency preparedness and response arrangements. It describes concepts, structures, roles and processes needed to implement and maintain Bruce Power's radiological emergency response capability. It also represents a basis for controlling changes and modifications to the Bruce Power emergency preparedness capability. In 2024, Bruce Power revised its plan to take into account the changes to its management system and make some general improvements to the document.

As well as its response to design-basis events, the plan takes into account requirements for supporting a sustained response to a beyond-design-basis, multi-unit event resulting in an extended loss of offsite power for up to 72 hours without assistance. Bruce Power's emergency response capability is consistent with the onsite planning basis and process of determining the MSC. This process involves a review and justification of the staffing requirements required for dealing with the spectrum of events that could require both operational and emergency response.

The Bruce Power plan defines a station emergency as a sudden, unexpected occurrence of unusual radiological conditions with the potential for accidental exposure to staff or the public exceeding regulatory limits. A station emergency can also be declared for a non-radiological event requiring protection of onsite personnel and activation of Bruce Power's emergency response organization.

The emergency plan is consistent with the corresponding Bruce Power safety analysis and reports provided to the CNSC to meet the requirements set out in CNSC regulatory document [REGDOC-2.10.1 Nuclear Emergency Preparedness and Response, Version 2](#).

Security (or hostile action) response is addressed through separate provisions. However, the provisions regarding potential releases of radioactive materials also apply to security incidents (e.g., the need for offsite notification, situation updates or confirmation of any radioactive releases). Emergency response related to transportation of nuclear substances is addressed by a separate plan, which was also updated in early 2025.

To implement its emergency plan, Bruce Power has developed specific nuclear emergency preparedness and response arrangements. In the event of an onsite nuclear emergency at the Bruce Power site, staff would immediately classify the nuclear emergency in accordance with criteria specified in the station emergency procedure. Should this emergency have offsite implications, staff would further categorize it according to criteria contained in Ontario's [Provincial Nuclear Emergency Response Plan](#) (PNERP, which is described in annex 16.1(d)). To simplify this step, many events have been categorized according to the Province of Ontario's notification designations.

Emergency drills and exercises are an integral part of Bruce Power's overall program assessment process. These exercises are conducted periodically at Bruce A and B in cooperation with other organizations and jurisdictions that have a role in nuclear emergency preparedness and response. Every three years, Bruce Power participates in a provincial nuclear emergency exercise, which includes internal and external stakeholder participation, to test Bruce Power's response to the PNERP.

Bruce Power maintains emergency public response capabilities within various communications departments, including employee communications, investor and media relations, government relations and community relations. The primary targets of Bruce Power's nuclear emergency public information program are people who live or work near Bruce A and B as well as certain Bruce Power employees and contacts who would need to be informed of an emergency. In the event of a nuclear emergency involving Bruce A and B, Bruce Power's emergency response procedures and agreements require the corporation to coordinate its public information efforts and activities with those of other participating jurisdictions or organizations, such as provincial agencies operating within the framework of the PNERP.

Bruce Power's communications response in a given emergency will depend upon the circumstances. For events that are not severe enough to warrant activation of the PNERP but may be of interest to neighbours and other stakeholders, Bruce Power would issue news releases or verbal briefings to the local media, with copies provided to provincial and municipal officials. If the situation warrants, Bruce Power may activate its local media centre for briefing or interview purposes.

More severe events may require activation of the PNERP and the Province of Ontario's Joint Emergency Information Centre operated by the Office of the Fire Marshall and Emergency Management. Pending activation and operation of the centre, Bruce Power's emergency response organization would, on an interim basis, communicate relevant information to the public and the media. With the Joint Emergency Information Centre in operation, the provincial government would assume control of information regarding the offsite response. The Municipality of Kincardine (where Bruce A and B are located) would establish a local emergency information centre at its offices. Bruce Power would assist the municipality with preparing information for the local public by ensuring its accuracy. Emergency-related information prepared at local and provincial emergency information centres would be jointly scrutinized for accuracy by all three parties prior to its release.

Ontario Power Generation Consolidated Nuclear Emergency Plan

The OPG Consolidated Nuclear Emergency Plan is a corporate-level plan that serves as the common basis of site-specific nuclear emergency preparedness and response arrangements at Darlington and Pickering. It describes concepts, structures, roles and processes to implement and maintain an effective OPG response to radiological emergencies that could endanger onsite staff, the public or the environment. It provides a framework for interaction with external authorities and defines OPG commitments under the PNERP.

Similar to Bruce Power, the OPG Consolidated Nuclear Emergency Plan defines a station emergency as a sudden unexpected occurrence of unusual radiological conditions with the

potential for accidental exposure to staff or the public exceeding regulatory limits. The OPG plan focuses on the on-site activities required to safely manage the event, and potential release of radioactive materials from fixed-facilities, including the OPG interfaces with the PNERP. The formal scope of the plan excludes security incidents (hostile action) at OPG NPPs, as these incidents are dealt with in detail in other OPG documents. However, the plan's provisions regarding potential releases of radioactive materials also apply to security incidents. These include the requirements for offsite notifications, situation updates and confirmation of any radioactive releases.

The emergency plan is consistent with the corresponding OPG nuclear safety analyses and reports provided to the CNSC.

To implement its nuclear emergency plan, OPG has developed site-specific nuclear emergency preparedness and response arrangements for its NPPs. In the event of an onsite nuclear emergency at an OPG NPP, OPG staff would immediately classify the nuclear emergency in accordance with criteria specified in emergency procedures. Should the emergency have offsite implications, OPG staff would further categorize it according to criteria contained in the PNERP. PNERP categorization criteria are referenced in procedures to ensure alignment. Offsite notifications would be made following categorization within required time limits.

Emergency drills and exercises are an integral part of OPG's overall process of program assessment. Exercises are conducted regularly at all OPG NPPs, in cooperation with other organizations and jurisdictions that have a role in nuclear emergency preparedness and response. Five drills or exercises are conducted at each OPG NPP annually to test the effectiveness of the emergency plans and procedures, facilities, equipment and training effectiveness, as well as members of OPG's emergency response organizations. Included in these drills are multi-unit severe accidents to validate OPG's severe accident management guidelines and the deployment of emergency mitigating equipment.

OPG maintains emergency public information capabilities within its nuclear public affairs department. The primary audiences for OPG's nuclear emergency public information program are those who live or work near OPG NPPs. In the event of a nuclear emergency involving an OPG NPP, OPG emergency response procedures and agreements require it to coordinate its public information efforts and activities with those of other participating jurisdictions or organizations, such as provincial agencies operating within the framework of the PNERP.

The OPG public affairs response in a given emergency would depend upon the related circumstances. For events that are not severe enough to warrant activation of the PNERP but that may be of interest to neighbours and other stakeholders, OPG would issue news releases or verbal briefings to the local media, with copies provided to provincial and municipal officials. Should the situation warrant, OPG may activate its onsite or near-site Emergency Information Centre for briefing or interview purposes.

More severe events may require activation of the PNERP and provincial and municipal emergency information centres. OPG may also communicate relevant information within its jurisdiction to the public and media.

Point Lepreau Nuclear Emergency Response Plan

The NB Power Nuclear Emergency Response Plan is an all-hazards, onsite emergency plan for Point Lepreau. This plan serves as the basis for emergency preparedness, prevention and mitigation, response and recovery at the NPP. The plan outlines hazards, command structure, roles and responsibilities, and processes required to implement and maintain NB Power's emergency response capability.

The Nuclear Emergency Response Plan is built on the basis of protecting the NPP, public, personnel and environment during any event which may occur within this framework, including radiological, fire, medical, hazmat, severe weather, natural and security events, and severe accidents.

Although security events are captured within the plan, security response to hostile actions is dealt with through separate provisions. However, the provisions regarding potential release of radioactive materials also apply to security incidents.

To support the Nuclear Emergency Response Plan, Point Lepreau has a full suite of response procedures that are integrated into the management system. These procedures and response guidelines allow the emergency response organization to effectively respond to and manage any event that may occur. The plan is consistent with the corresponding NB Power safety analysis and reports provided to the CNSC as well as the requirements in CNSC regulatory document [REGDOC-2.10.1, Nuclear Emergency Preparedness and Response, Version 2](#).

Emergency drills and exercises are an integral part of Point Lepreau's emergency management program. Exercises are conducted regularly with the NPP's emergency response organization, with full-scale integrated exercises being conducted every three years in cooperation with other organizations and jurisdictions that have a role in nuclear emergency preparedness and response.

The New Brunswick Emergency Measures Organization (NBEMO), an agency of the provincial government, is responsible for actions to protect the public. As such, NBEMO manages the [Point Lepreau Offsite Emergency Plan](#) (see annex 16.1(d)), including the development and testing of its capabilities. NB Power has a direct partnership with NBEMO and supports the management of the offsite plan in all aspects. This includes potassium iodide (KI) distribution, demographic surveys, annual calendars and emergency planning information for the public. Additionally, NB Power staff support off-site surveys and the mass decontamination plan, which details requisite monitoring and decontamination in the event that a nuclear emergency requires evacuation of local residents.

Annex 16.1 (d)

Provincial offsite emergency plans

Province of Ontario

The provincial [Emergency Management and Civil Protection Act](#) governs emergency preparedness and response in Ontario. This legislation requires the provincial government to formulate a plan for emergencies arising in connection with nuclear facilities. It also permits the province to designate municipalities that must plan for nuclear emergencies. Emergency Management Ontario administers the Province of Ontario's [Provincial Nuclear Emergency Response Plan](#) (PNERP) on behalf of the province and coordinates nuclear emergency preparedness and response in Ontario. The PNERP is approved by the Ontario Cabinet and has been in place since 1986. As the lead provincial document for offsite nuclear emergency preparedness and response, the PNERP details the support and coordination of the activities of provincial ministries, nuclear facilities, the Government of Canada (including the CNSC) and designated municipalities in order to meet the plan's objectives.

The PNERP provides the offsite basis for nuclear emergency planning, preparedness and response, with the primary aim of ensuring public safety in the event of a nuclear emergency. These include those at the three NPPs in Ontario, other types of nuclear facilities (including research reactors), and NPPs in neighbouring jurisdictions, as well as for other types of radiological events.

The plan covers various components, including:

- aim and guiding principles
- hierarchy of emergency plans and procedures
- description of the hazard
- planning basis
- preparedness
- protective action response strategy
- concept of operations
- emergency organization
- operational policies
- emergency information
- public education
- detailed responsibilities of the various participants
- provincial and municipal committee oversight

The plan also includes considerations for the recovery phase and notes that recovery phase actions may be described in a separate plan.

Full-scale exercises focusing on nuclear or radiological emergencies are conducted regularly with the participation of the licensees and different levels of government.

The planning basis for the PNERP was most recently reviewed following the Fukushima accident. Following a consultation process that included both stakeholders as well as the public, the PNERP master plan was updated and approved in late 2017. The site-specific and detailed implementing plans for Pickering, Darlington and Bruce NPPs were subsequently updated and approved in 2018/19 and the implementing plan for FERMI-2¹⁵

¹⁵ Fermi-2 is located in the USA on Lake Erie, less than 20 km from the Province of Ontario border.

was updated in 2021. The PNERP is currently under review as part of the 5-year review cycle (this is relevant to Challenge 9RM C-2).

Province of New Brunswick

The provincial nuclear preparedness program is governed by a partnership between NB Power and the New Brunswick Department of Justice and Public Safety, New Brunswick Emergency Measures Organization (NBEMO). The primary agencies for emergency management and public security in New Brunswick are the:

- NBEMO, which is the provincial lead agency for emergency management and business continuity, including radiological-nuclear contingencies
- New Brunswick Office of the Provincial Security Advisor, which is the provincial lead agency for security and critical infrastructure protection

NBEMO has the lead responsibility to develop provincial emergency action plans and to direct, control and coordinate emergency responses under the [New Brunswick Emergency Measures Act](#).

The [New Brunswick All-Hazards Emergency Management Plan](#), interchangeably referred to as the Emergency Measures Plan or the All-Hazards Plan, provides comprehensive guidance for managing emergencies. Its scope ranges from singular provincial departmental responses to fully synchronized efforts involving all provincial departments and partner agencies, with the support of the federal government when necessary.

NBEMO's Regional Emergency Management Coordinators coordinate the use of provincial resources to deal with emergency situations in rural areas and urban municipalities.

Enhancements to emergency preparedness and response in New Brunswick, during the previous and current reporting periods, included the following:

- replaced the inventory of KI pills (expiry date April 2032) in the emergency planning zones in 2021
- increased members on the Everbridge Notification System (automated telephone and email notification system) to include New Brunswick Health.
- improved communications systems linking the Offsite Emergency Operations Centre (owned and maintained by NB Power) and the Provincial Emergency Operations Centre
- participated in the IAEA Emergency Preparedness Review (EPREV)
- implementation of a web-based emergency management software (WebEOC)

Distribution of a demographic public safety survey within the emergency planning zones is planned for the summer of 2025. NBEMO maintains a multi-year emergency exercise program that allows regular exercises and training to take place, fully supported by NB Power through its partnerships. This includes exercises at the Offsite Emergency Operations Centre (which would be operated and supported during an event by representatives from both organizations) in accordance with the [Point Lepreau Nuclear Offsite Emergency Plan](#).

The plan includes the specific responses that would be carried out by various agencies to deal with the emergency. It contains information on actions to enable recovery, including identifying areas that are potentially contaminated, activating the New Brunswick Radiological Ingestion Pathway Monitoring Plan, disseminating information to the public, and providing health and human services. NBEMO reviews the plan on a two-year cycle.

Annex 16.1 (e)

Details of federal emergency provisions

Detailed provisions of the Federal Nuclear Emergency Plan

Health Canada administers the [*Federal Nuclear Emergency Plan*](#) (FNEP).

Within the FNEP, a nuclear emergency is defined as an event that has led or could lead to the uncontrolled release of radioactive material or exposures to uncontrolled sources of radiation, which pose or could pose a threat to public health and safety, property and the environment.

The FNEP contains:

- an outline of the Government of Canada's aim, authority, emergency organization and concept of operations for dealing with the response phase of a nuclear emergency
- a description of the framework of federal emergency preparedness policies, the planning principles on which the FNEP is based and the links with other specific documents of relevance to the FNEP
- a description of the specific roles and responsibilities of participating organizations that are involved in the planning, preparedness or response phases of a nuclear emergency
- provincial annexes that describe interfaces among federal and provincial emergency management organizations, as well as the arrangements for a coordinated response and the provision of federal support to provinces affected by a nuclear emergency

Five nuclear emergency event categories are defined in the FNEP, according to the potential scope of impacts on Canada and Canadians:

- Category A: an emergency at an NPP in Canada
- Category B: an emergency at an NPP in the United States or Mexico
- Category C: an emergency involving a nuclear-powered vessel in Canada
- Category D: other serious radiological emergencies or potential threats in Canada that require a multi-departmental or multi-jurisdictional response
- Category E: a nuclear emergency outside of North America

The scope of the FNEP excludes the following situations:

- emergencies that pose only a limited radiological threat over a localized area and are not anticipated to exceed the capabilities of regulatory, local or provincial/territorial authorities to respond:
- management and coordination of the Government of Canada's actions during the recovery phase

As an emergency evolves, the coordinated response will be scaled according to the scope of the emergency and associated triggers. During routine operations, FNEP notification and alerting capabilities are provided by a 24/7 FNEP duty officer, who monitors situations of interest, conducts internal reporting, and responds to drills, exercises and requests for information. These activities are managed by Health Canada's Radiation Protection Bureau with input from specific partners when required and include normal preparedness activities.

Under the FNEP, a multi-departmental technical assessment group (TAG) would be convened to provide federal-level technical assessment of the threat and risk associated with the offsite radiological hazard, as well as associated protective action recommendations, as required, for mitigating the radiological consequences to health, safety, property and the environment. The TAG supports the broader federal response and coordinates the scientific

and technical response to a nuclear emergency at the federal level and in collaboration with similar groups at the provincial level.

Transition to recovery

Once a nuclear emergency situation is stabilized and immediate actions to protect public health and safety are completed, emergency management of the radiological hazard shifts from the response phase to the recovery phase. FNEP senior officials (from Health Canada and the CNSC), in consultation with the TAG Chair, the Federal Assistant Deputy Minister of the Emergency Management and Regional Operations Branch (Public Safety Canada) and the Federal Coordinating Officer would recommend the return of the FNEP to a routine reporting level as well as the termination of some or all components of the FNEP not required for the transition to recovery. The Federal Assistant Deputy Minister Emergency Management Committee, in consultation with the Privy Council Office, would approve the transition to recovery and termination of the emergency.

Responsibility for recovery falls primarily within provincial/territorial jurisdiction. If federally assisted recovery actions were required, the responsibility for coordinating recovery operations would be assigned to a specific Minister of the Government of Canada by the Privy Council Office and the Prime Minister.

Guidance for recovery is available in Health Canada's [Guidance on Planning for Recovery Following a Nuclear or Radiological Emergency](#). The document aligns with the most recent guidance from the IAEA on the termination of a nuclear emergency and addresses recommendations that were identified following the initial IAEA Emergency Preparedness Review (EPREV) of Canada. The document also focusses on the non-radiological impacts of nuclear emergencies on the public and provides best practices for minimizing the psychosocial impacts that are applicable to most emergency recovery scenarios. The inclusion of psychosocial consequences is new to the field of emergency management in general, and to nuclear emergency management in particular.

Provisions of the CNSC in emergency preparedness and response

The CNSC maintains an Emergency Operations Centre (EOC) at its headquarters in Ottawa to respond to nuclear or radiological emergencies. This facility is used during emergency exercises to confirm nuclear and radiological emergency preparedness. The CNSC EOC also has an emergency generator in case there is a loss of electricity to the building. The CNSC has an alternate site for emergency staff to assemble should its main headquarters be inaccessible.

The CNSC Strategic Emergency Management Plan defines the overall strategic objectives for the CNSC in a nuclear or radiological emergency and the CNSC Nuclear Emergency Response Plan (NERP) details the CNSC's response to nuclear and radiological emergencies that fall within the CNSC's mandate. The Strategic Emergency Management Plan is issued under the authority of the President of the CNSC, in accordance with the objectives of the NSCA and its regulations and the [Emergency Management Act](#). The plan is designed to provide a compatible interface with the emergency plans and procedures of CNSC licensees, provincial governments, the Government of Canada and international organizations.

The NERP supports the requirements established in the CNSC's Strategic Emergency Management Plan, demonstrates how the CNSC fulfills its legislative requirements regarding

the response to nuclear emergencies and describes how a CNSC emergency response would transition to recovery. The NERP also describes the strategies and guidelines the CNSC would follow to cope with a nuclear emergency. It describes:

- the role and responsibilities of the CNSC in nuclear emergencies
- the organizational structure of the CNSC during an emergency
- the response activities and the demobilization and transition to recovery role
- the EOC technical infrastructure

It also describes the actions performed by EOC staff to provide CNSC executives with accurate and up-to-date information on the status of the emergency and to inform the Commission, the Minister of Natural Resources Canada (NRCan), the Parliament of Canada, the Prime Minister, other government officials, fulfills Canada's international obligations ([Convention on Early Notification and Response Assistance Network](#)) and also ensures the public are informed as to what actions are being taken, both onsite and offsite.

As part of the NERP, the CNSC has established various technical and administrative arrangements including bilateral cooperation agreements with other national and international jurisdictions, as well as a CNSC Duty Officer program. Normally, the CNSC is notified of an emergency through the 24/7 emergency telephone line of the duty officer. Additionally, anyone can seek emergency information, advice or assistance 24 hours a day for actual or potential incidents involving nuclear materials or radiation through the duty officer.

The CNSC also has regulations that require NPP licensees to have automated transfer of plant data from those facilities available to the CNSC. This "real-time data" link enhances the CNSC's ability to perform assessment and prognosis of the accident and calculate the source term for dose assessment and plume modelling.

Annex 16.1 (f)

Description of major emergency exercises, training and other initiatives

Interoperability Exercise at Pickering

Building on the lessons learned at Darlington in the previous reporting period, OPG conducted a similar full-scale exercise at Pickering Nuclear Generating Station in September 2023. This three-day event involved hundreds of participants, including representatives from all levels of government and non-governmental organizations.

The primary objectives for the interoperability exercise at Pickering were to:

- test the preparedness of OPG, government, and non-government agencies to respond to a nuclear emergency at Pickering
- assess the interoperability and coordination among participating organizations during a complex emergency scenario
- evaluate the effectiveness of public notification and protective action decision-making processes
- examine the ability to share timely and consistent information with the public and media
- strengthen technical data sharing and decision-making among response partners
- protect emergency workers and manage event recovery procedures
- incorporate feedback from community advisory councils and improve engagement with Indigenous Nations and communities

The interoperability exercise achieved all of its primary objectives. This was confirmed through an independent evaluation led by a third-party expert team. The exercise demonstrated effective preparedness, coordination, and communication among OPG, government partners, and community stakeholders. After-action reviews were conducted, and while opportunities for further improvement were identified, the main goals of the exercise were successfully met.

Exercise Synergy Challenge 2024

On 29 and 30 October 2024, NB Power, in partnership with regional, provincial, and federal authorities, hosted a two-day full-scale nuclear emergency response exercise at Point Lepreau titled Synergy Challenge 2024. This exercise provided an opportunity to demonstrate and validate response capabilities with a wide variety of responders working together to manage consequences resulting from an event at Point Lepreau. The overall objective was to validate the preparedness of NB Power, Point Lepreau, government, and non-governmental organizations and agencies to respond to a design-basis accident.

Exercise objectives were developed using a tiered approach. The tier-one objectives, listed below, represented the strategic objectives of the exercise, which had the consensus of all participating organizations. Synergy 2024 successfully tested these objectives, thus validating the interoperability and coordination of the response efforts of participating organizations.

1. validate the preparedness of Point Lepreau Nuclear Generating Station, NB Power, government and non-government organizations and agencies to respond to a simulated radiological emergency

2. test the interoperability of participating organizations and coordination of response efforts
3. validate current on-and off-site nuclear emergency plans
4. demonstrate the ability of the organization to provide consistent and accurate communications
5. produce a joint evaluation report on the interoperability, coordination, and integration of participating organizations during a simulated nuclear emergency at Point Lepreau

Exercise Synergy Challenge 2024 also met its tier-two and tier-three objectives. NB Power submitted the exercise assessment of all tier-two and tier-three objectives to the CNSC in December 2024, completed a collective 'after-action report' with the response agencies, and developed an associated corrective action plan.

Exercise Cobalt Magnet 2025

Canada collaborated on the planning and execution of Exercise Cobalt Magnet 2025, a six-day, full-scale nuclear emergency response exercise led by the United States that focused on cross-border collaboration. The exercise simulated the consequences of a spent fuel pool accident on the shores of Lake Erie in Michigan. Given that the Canadian border lies within the 10-mile (16 km) automatic action zone, it was critical to ensure a coordinated response between the two countries.

Federal planning for this international exercise was co-led by the U.S. Department of Energy's National Nuclear Safety Administration and Health Canada/Public Health Agency of Canada. State and provincial planning efforts were co-led by the State of Michigan and the Province of Ontario.

More than 3,000 participants from 107 government departments at the federal, state, provincial, and municipal levels took part in the exercise. A key objective of the international planning effort was to ensure effective coordination and information exchange between Canadian and U.S. government organizations. This focus on collaboration will also be a major aspect of the after-action reporting.

Seventeen Canadian federal government partners played an integral role in coordinating the consequence management response, both directly with their U.S. counterparts and through the lead technical bodies, including the FNEP's TAG and the U.S. Federal Monitoring and Assessment Center.

Several key successes in interoperability emerged from the exercise, such as:

- direct communication between the President and CEO of the Canadian Nuclear Safety Commission (CNSC) and the Chair of the U.S. Nuclear Regulatory Commission
- exchange of liaison officers between Health Canada and the U.S. Department of Energy, coordinated through Global Affairs Canada and the U.S. Department of State
- technical information sharing over shared software platforms between Health Canada and U.S. Department of Energy
- coordination of a combined U.S.-Canada monitoring map displaying radiological risk and monitored activity levels on both sides of the border
- joint reporting by the U.S. and Canadian governments to the IAEA

IAEA Convention Exercise series

Between April 2022 and March 2025, Health Canada participated in 6 exercises of the IAEA Convention Exercise (ConvEx) series. These exercises provided opportunities to test the

competent authority's response to radiological and nuclear emergencies using the IAEA's Unified System for Information Exchange. The exercises involved communication between the National Warning Point and the competent authority as well as an opportunity to generate radiological data using the IAEA International Radiation Monitoring Information System (IRMIS).

METER training

The Medical Emergency Treatment for Exposures to Radiation (METER) course is delivered to train medical professionals who respond to the medical aspects of a radiological or nuclear emergency. This course is offered periodically by Health Canada at various locations across Canada. During the reporting period, five sessions were conducted, providing training to 152 trainees.

A project is currently underway to increase the number of trained emergency physicians capable of supporting future course delivery. This initiative aims to strengthen training capacity to better meet demand.

Radiological assurance monitoring training

On request from the provinces and territories, Health Canada and FNEP partners can provide support for field operations during a radiological or a nuclear emergency. The FNEP Field Response Team can perform field radiation assurance monitoring and surveillance in populated zones during an emergency and support radiological security surveillance for planned major public events.

Health Canada organizes regular offsite training for the FNEP Field Response Team to maintain readiness and expand operational capacity, comply with health and safety practices, and "train the trainer." During the reporting period, two training sessions were organized in May 2022 and April 2023. The FNEP Field Response Team also participated in the Cobalt Magnet 2025 exercise. The exercise was used to validate the FNEP Field Response Team concept of operations for notification, mobilisation, deployment, and assurance monitoring.

Annex 18

Supporting details related to CNSC design requirements and design assessments

Design requirements in REGDOC-2.5.2

CNSC regulatory document [REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants](#), sets out technology-neutral expectations (to the extent possible) for the design of new, water-cooled NPPs. REGDOC-2.5.2 includes direction on:

- establishing safety goals and objectives for the design
- utilizing safety principles in the design
- applying safety management principles
- designing structures, systems and components (SSCs)
- interfacing engineering aspects, NPP features and facility layout
- integrating safety assessments into the design process

In general terms, the dose acceptance criteria in REGDOC-2.5.2 follow from the postulate that the risks due to a new technology should not be significant contributors to existing societal risks. The dose acceptance criteria must also be sufficient to ensure that very few accidents will require protective measures. The safety goal for large-release frequency is expressed in terms of the release of cesium-137 that would require long-term relocation of the local population to mitigate potential health effects. The safety goal for small-release frequency is expressed in terms of the release of iodine-131 that would require temporary evacuation to mitigate health effects. To achieve a balance between prevention and mitigation, a third goal is defined to limit the frequency of severe core damage. This ensures the designer does not place too much reliance on reactor containment. The actual safety goals are shown in subsection 14(i)(d).

REGDOC-2.5.2 stipulates that SSCs important to safety are of proven design and are designed according to appropriate modern standards. Where a new SSC design, feature or engineering practice is introduced, adequate safety is proven using a combination of supporting R&D programs and an examination of relevant experience from similar applications. A qualification program is established to verify that the new design meets all applicable safety expectations. New designs are tested before entering service and are then monitored in service to verify that their expected behaviour is achieved. REGDOC-2.5.2 stipulates that the NPP design draws on OPEX in the nuclear industry as well as on relevant research programs.

REGDOC-2.5.2 also contains requirements related to reliability, operability and human factors (as they relate to design).

The requirement in REGDOC-2.5.2 to design for reliability includes consideration of common-cause failures and allowances for equipment outages. There are design requirements related to single-failure criteria for safety groups and fail-safe designs for SSCs important to safety. There are also special considerations for shared instrumentation among safety systems and shared SSCs between reactors.

REGDOC-2.5.2 sets a requirement for various safety actions to be automated so that operator action is not necessary within a justified period of time from the onset of anticipated operational occurrences or design-basis accidents. Appropriate and clear distinctions

between the functions assigned to operating personnel and to automatic systems is facilitated by the systematic consideration of human factors and the human-machine interface. The need for operator intervention on a short timescale is minimized.

REGDOC-2.5.2 requires a human factors engineering (HFE) program that facilitates the interface between operating personnel and the NPP by utilizing proven, systematic analysis techniques to address human factors. The program must promote attention to plant layout and procedures, maintenance, inspection and training, as well as the application of ergonomic principles to the design of working areas and environments. The NPP's design must facilitate diagnosis, operator intervention and management of the NPP's condition during and after anticipated operational occurrences, design-basis accidents and beyond-design-basis accidents (BDBAs). This facilitation is achieved by adequate monitoring instrumentation and plant layout and suitable controls for the manual operation of equipment.

The HFE program should:

- reduce the likelihood of human error as much as is reasonably achievable
- provide means for identifying the occurrence of human error and methods by which to recover from such error
- mitigate the consequences of error

Human factors verification and validation plans are established for all appropriate stages of the design process to confirm that the design adequately accommodates all necessary operator actions.

REGDOC-2.5.2 also stipulates that the human-machine interfaces in the main control room, the secondary control room, the emergency support centre and the plant provide operators with necessary and appropriate information in a usable format that is compatible with the necessary decision and action times. Design requirements are established for both the main control room and emergency support centre to provide a suitable environment for workers under all possible conditions, taking ergonomic factors into account.

Pre-licensing vendor design review

The CNSC process for pre-licensing vendor design review has three phases.

Phase 1

The CNSC reviews submissions to confirm that the vendor understands Canadian regulatory requirements and expectations.

Phase 2

The CNSC review submissions further and provides conclusions as to whether the proposed design meets REGDOC-2.5.2 and related documents. The scope of the review usually involves 19 focus areas:

- general plant description, defence-in-depth, safety goals and objectives, and dose acceptance criteria
- classification of SSC
- reactor core nuclear design
- means of reactor shutdown
- fuel design and qualification
- control system and facilities
 - main control systems
 - instrumentation and control

- control facilities
- emergency power systems
- emergency core coolant and emergency heat removal systems
- containment/confinement and safety-important civil structures
- prevention and mitigation of BDBAs and severe accidents
- safety analysis (deterministic safety analysis, probabilistic safety assessment (PSA) and analysis of internal and external hazards
- pressure boundary design
- fire protection
- radiation protection
- vendor R&D program
- human factors
- out-of-core criticality
- robustness, safeguards and security
- management system (design process and quality assurance in design and safety analysis)
- incorporation of decommissioning in design considerations

Phase 3

Based on feedback received from the CNSC, the vendor may discuss, in more depth, resolution paths for any design issues identified in phase 2. The scope of submissions is fixed by the vendor.

The review does not include non-technical considerations such as:

- design costs
- completion of design
- scheduling factors relative to the review of a licence application
- capacity factors
- design changes that could be required as a result of future findings

Table 23 lists the pre-licensing vendor design reviews that were in progress at the CNSC during the reporting period. The status column indicates the status of the review at the end of the reporting period.

Table 23: Status of Vendor Design Reviews

Vendor	Design	MW electrical (approx)	Review phase	Status
Terrestrial Energy Inc.	Integral Molten Salt Reactor	200	1	Complete
Ultra Safe Nuclear Corporation	MMR-5 and MMR-10 (high-temperature gas)	5–10	1	Complete
LeadCold Nuclear Inc.	SEALER (molten lead)	3	1	Closed

Vendor	Design	MW electrical (approx)	Review phase	Status
ARC Clean Technology	ARC-100 (liquid sodium)	100	1	Complete
NuScale Power, LLC	NuScale Integral (pressurized water)	60	2*	Closed
GE-Hitachi Nuclear Energy	BWRX-300 (boiling water)	300	2*	Complete
X Energy, LLC	Xe-100 (high-temperature gas)	80	2*	Complete
Westinghouse Electric Company	eVinci (heat pipes / solid core)	5 MWe	2*	In progress

*Phase 1 objectives will be addressed within the Phase 2 scope of work