



CMD 26-H7-APP-Ref1

Date: 2025-06-27

**Reference from
Ontario Power Generation**

In the matter of

Ontario Power Generation

Application to refurbish Pickering Nuclear
Generating Station and to renew licences
for the Pickering Nuclear Generating
Station and Waste Management Facility

**Commission Public Hearing
Part 1**

June 2026

**Référence de
Ontario Power Generation**

À l'égard de

Ontario Power Generation

Demande concernant la réfection de la
centrale nucléaire de Pickering et le
renouvellement de ses permis pour la
centrale et l'installation de gestion des
déchets

**Audience publique de la Commission
Partie 1**

Juin 2026

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- [Reference 1](#) OPG Letter, K. Aggarwal to C. Salmon, “Pickering Waste Management Facility - Application for Waste Facility Operating Licence WFOL-W4-350.00/2028 Amendment to Construct and Operate the Pickering Component Storage Structure”, May 31, 2024, e-Doc 7293912, CD# 92896-CORR-00531-01544.
- [Reference 2](#) Attachments 1 to 4 in OPG Letter, P. Seguin to R. Richardson, “Pickering NGS, Units 1 to 4 – Submission of the Detailed Decommissioning Plan and Storage with Surveillance Plan”,
December 9, 2024, e-Doc 7423802, CD# NA44-CORR-00531-37304.
- [Reference 3](#) CNSC Letter, Dr. T. Berube to OPG, “Record of Decision DEC 22-H104 – Application for
Acceptance of Ontario Power Generation’s Revised Consolidated Financial Guarantee”,
December 6, 2022, e-Doc 6930798, CD# N-CORR-00531-23514.

Reference 1

OPG Letter, K. Aggarwal to C. Salmon, “Pickering Waste Management Facility - Application for Waste Facility Operating Licence WFOL-W4-350.00/2028 Amendment to Construct and Operate the Pickering Component Storage Structure”, May 31, 2024, e-Doc 7293912, CD# 92896-CORR-00531-01544.

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May 31, 2024

CD# 92896-CORR-00531-01544 P

Ms. Candace Salmon
Commission Registrar,
Canadian Nuclear Safety Commission
P.O. Box 1046
280 Slater Street
Ottawa, Ontario, K1P 5S9

Dear Ms. Salmon:

Pickering Waste Management Facility - Application for Waste Facility Operating Licence WFOL-W4-350.00/2028 Amendment to Construct and Operate the Pickering Component Storage Structure

The purpose of this letter is to request the Canadian Nuclear Safety Commission, referred to as “the Commission”, for an amendment to the Pickering Waste Management Facility (PWMF), Waste Facility Operating Licence (WFOL) WFOL-W4-350.00/2028, to construct and operate the Pickering Component Storage Structure (PCSS) for storage of Low and Intermediate Level Waste (L&ILW) that will be generated by Pickering Nuclear Generating Station (NGS).

This additional interim storage capacity, intended for radioactive component waste/material, will be required to support the refurbishment of Pickering NGS Units 5 through 8 and decommissioning activities. OPG has previously provided a letter of intent communicating the operational need to construct and operate the PCSS (Reference 1) and received CNSC staff’s recommendations on requirements and expectations for the OPG licence amendment application for this activity (Reference 2).

This submission includes the following documentation:

- Attachment 1 provides the compliance matrix for the *Nuclear Safety and Control Act*, and the associated regulations required for the amendment of the PWMF WFOL to construct and operate the PCSS.
- Attachment 2 provides the licence impact assessment of the proposed new licensed activity on PWMF’s licensing basis for each of the 15 Safety and Control Areas of PWMF’s WFOL. It also provides the description and key attributes of the PCSS, and provides the proposed wording for the amendment to PWMF WFOL-W4-350.00/2028.
- Enclosure 1 provides 92896-REP-01320-00019 R000, “*Pickering Component Storage Structure Safety Assessment*” in support of the licensing impact assessment.
- Enclosure 2 provides 92896-REP-00701-00019 R001, “*Predictive Environmental Risk Assessment for Pickering Component Storage Structure*” which was previously submitted as Enclosure 1 of Reference 1.

The design considerations for the PCSS complies with all applicable regulatory requirements. The safety analysis, 92896-REP-01320-00019 R000, "*Pickering Component Storage Structure Safety Assessment*", which is referred to as the "safety case", can be summarized as follows:

- **Design:** OPG has and will continue to follow its Engineering Change Control process, as described in N-PROG-MP-0001, "*Engineering Change Control*", for ensuring the design complies with applicable regulatory requirements as defined in the LCH, LCH-W4-350.00/2028, and that configuration management will be maintained.
- **Continued Safe Operation:** The safety case, 92896-REP-01320-00019 R000, "*Pickering Component Storage Structure Safety Assessment*", provided as Enclosure 1 of this submission, demonstrates that the operation of the PCSS and storage of L&ILW components will have a negligible effect on the safe operation, public and worker safety.
- **Environmental Protection:** The predictive environmental risk assessment completed for PCSS, 92896-REP-00701-00019 R001, "*Predictive Environmental Risk Assessment for Pickering Component Storage Structure*", provided as Enclosure 2 of this submission, concludes that the construction and operation of the PCSS will have negligible impact on the environment.
- **Licensing Basis:** The construction and operation of the PCSS will have minimal impact on PWMF's licensing basis, governance, programs, and processes. Attachment 1 of this submission provides the compliance matrix for the Nuclear Safety Control Act and associated regulations required for the amendment of the PWMF WFOL.

OPG continues to regularly engage with Indigenous Nations and communities to provide and share information regarding activities at the Pickering NGS and PWMF, including the PCSS. OPG will continue to proactively engage the identified Indigenous Nations and communities through various activities, such as staff briefings, community information sessions, written communication and workshops. The specific objective is to ensure that Indigenous Nations and communities around the Pickering NGS and PWMF are provided with a forum to discuss key topics of Indigenous interest which includes the licence amendment application, for the PCSS.

The following documentation will be provided for CNSC staff review prior to the target commencement date of construction activities:

- The design requirements, environmental management plan, and construction verification plan for the PCSS in accordance with PWMF WFOL-W4-350.00/2028, Licence Condition 15.1, *Construction Plans*. This submission is tracked under Regulatory Action Management Request (REGM) # 28267121.
- An update to the safety analysis report, 92896-REP-01320-00019 R000, "*Pickering Component Storage Structure Safety Assessment*" for the final design of the PCSS. This submission is tracked under REGM # 28267123.

Based on the most current project information, the target availability of the PCSS to begin storing L&ILW on an interim basis was re-evaluated as April 2027 which is sooner than the in-service date of August 2027, previously communicated in Reference 1. As the project progresses, OPG will inform CNSC staff of any updates to the in-service date through the submission of the required regulatory documents.

The following subsequent technical documentation will be provided to CNSC staff prior to the target operation date of the PCSS:

- The PCSS final commissioning report for CNSC staff acceptance in accordance with PWMF WFOL-W4-350.00/2028, Licence Condition 15.2, *Commissioning Report*. This submission is tracked under REGM # 28267122.
- The updates to the Operating Policies and Principles for the PWMF. This submission is tracked under REGM # 28267257.

In summary, OPG remains committed to the safe operation of the PWMF and re-affirms that the construction and operation of the PCSS will be implemented in accordance with the PWMF licensing basis. L&ILW will be stored safely in the PCSS as presented in the associated safety case without compromise to continued safe facility operation, public and worker safety, and environmental protection.

OPG is requesting the Canadian Nuclear Safety Commission to amend the PWMF, WFOL-W4-350.00/2028, to construct and operate the PCSS for interim storage of L&ILW from Pickering NGS by February 2025.

Should you have any questions, please contact Ms. Liliana Moraru, Senior Manager, Regulatory Affairs - Strategic Projects, at (905) 260-4089 or liliana.moraru@opg.com.

Sincerely,



Kapil Aggarwal, M. Eng., P. Eng
Vice President
Nuclear Sustainability Services
Ontario Power Generation Inc.

Encl.

cc:	K. Campbell	- CNSC (Ottawa)
	T. Kalindjian	- CNSC (Ottawa)
	R. Buhr	- CNSC (Ottawa)
	R. van Hoof	- CNSC (Ottawa)
	M. McLaughlin	- CNSC (Ottawa)

- References:
1. OPG Letter, K. Aggarwal to N. Petseva, "Pickering Waste Management Facility – Letter of Intent to Construct the Pickering Component Storage Structure", February 1, 2024, e-Doc# 7214316, CD# 92896-CORR-00531-01485.
 2. CNSC letter, K. Campbell to K. Aggarwal, "CNSC Staff Response to OPG Submission - Letter of Intent to Construct the Pickering Component Storage Structure at the Pickering Waste Management Facility", March 20, 2024, e-Doc 7240022, CD# 92896-CORR-00531-01545.

ATTACHMENT 1

OPG letter, K. Aggarwal to C. Salmon, "Pickering Waste Management Facility - Application for Waste Facility Operating Licence WFOL-W4-350.00/2028 Amendment to Construct and Operate the Pickering Component Storage Structure"

CD# 92896-CORR-00531-01544 P

Licence Compliance Matrix – Nuclear Safety Control Act and Associated Regulations

Prepared By:	P. Hendrix
Checked By:	B. Noye

ATTACHMENT 1**Licence Compliance Matrix – Nuclear Safety Control Act and Associated Regulations**

This Attachment, along with the accompanying letter and Attachment 2 of this submission, provides the information required by the Nuclear Safety and Control Act and the applicable Nuclear Regulations made pursuant to the Act, and constitutes an application by OPG to amend the current Pickering Waste Management Facility (PWMF) Waste Facility Operating Licence WFOL-W4-350.00/2028 to construct and operate the Pickering Component Storage Structure (PCSS) for interim storage of low and intermediate level waste from Pickering NGS.

The tables below are divided by applicable Regulation and demonstrate how OPG has addressed each applicable regulatory requirement of the subject Regulation.

Nuclear Safety and Control Act		
Section	Requirement	OPG Response
Licences		
24(2)	<i>Application</i> <i>The Commission may issue, renew, suspend in whole or in part, amend, revoke, or replace a licence, or authorize its transfer on receipt of an application:</i> <i>(a) in the prescribed form;</i>	This submission (letter and attachments) provides the information required by the Nuclear Safety and Control Act (referred to as the Act) and the applicable Regulations made pursuant to the Act and provides supplemental information in support of OPG's application for licence amendment. This requirement has been met.
	<i>(b) containing the prescribed information and undertakings and accompanied by the prescribed documents; and</i>	See response above under clause 24 (2) (a).
	<i>(c) accompanied by the prescribed fee.</i>	OPG is in good standing with respect to the provision of CNSC licensing fees and will provide any additional fees associated with this WFOL amendment request, if requested.
24(4)	<i>Conditions for issuance, etc.</i> <i>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:</i>	OPG understands that qualification will be determined through consideration by the Commission of this application and the associated supporting material, as well as deliberation through the Commission decision-making process.
	<i>(a) is qualified to carry on the activity that the licence will authorize the licensee to carry on; and</i>	OPG is qualified to safely undertake the additional activities associated with the storage of Low and Intermediate Level Waste (L&ILW) at the PWMF.

Nuclear Safety and Control Act		
Section	Requirement	OPG Response
	<i>(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.</i>	Attachment 2 of this submission documents the assessments and provisions in support of the licence amendment request. Specifically: - documents worker health and safety provisions. - documents assessments and impact on environmental protection. - documents the security considerations.
25	Renewal, etc. <i>The Commission may, on its own motion, renew, suspend in whole or in part, amend, revoke or replace a licence under the prescribed conditions.</i>	OPG understands this requirement and will continue to comply.
26	Prohibitions <i>Subject to the regulations, no person shall, except in accordance with a licence:</i> <i>(a) possess, transfer, import, export, use or abandon a nuclear substance, prescribed equipment or prescribed information;</i> <i>(b) mine, produce, refine, convert, enrich, process, reprocess, package, transport, manage, store or dispose of a nuclear substance;</i> <i>(c) produce or service prescribed equipment;</i> <i>(d) operate a dosimetry service for the purposes of this Act;</i> <i>(e) prepare a site for, construct, operate, modify, decommission or abandon a nuclear facility; or</i> <i>(f) construct, operate, decommission or abandon a nuclear-powered vehicle or bring a nuclear-powered vehicle into Canada.</i>	OPG staff understand these requirements and will continue to comply.

General Nuclear Safety and Control Regulations		
Section	Requirement	OPG Response
Licences – General Application Requirements		
3(1)	<i>An application for a licence shall contain the following information:</i> <i>(a) the applicant's name and business address;</i>	Applicant's name and business address: Ontario Power Generation, Inc 1908 Colonel Sam Dr. Oshawa, Ontario, L1H 8W8 Official Language: English Contact person, signing authority and licence holder: Kapil Aggarwal Vice President Nuclear Sustainability Services, Ontario Power Generation Telephone: 416-402-6484
	<i>(b) the activity to be licensed and its purpose;</i>	OPG requests an amendment to the PWMF WFOL, WFOL-W4-350.00/2028, to construct and operate the PCSS for storage of L&ILW from Pickering NGS.
	<i>(c) the name, maximum quantity and form of any nuclear substance to be encompassed by the licence;</i>	L&ILW from refurbishment of Pickering NGS Units 5 through 8 and decommissioning activities. Per unit, the quantity of waste will be but is not limited to: • 12 Steam Generators • 380 Fuel Channels (comprising of end fittings, pressure tubes, calandria tubes, annulus spacers and calandria tube inserts). Details of the quantity and form of the waste can be found in Enclosure 1 of this submission.
	<i>(d) a description of any nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence;</i>	A description of the PWMF is provided in Attachment 2 of this submission.
	<i>(e) the proposed measures to ensure compliance with the Radiation</i>	OPG understands this requirement and will remain in compliance with the current licence

General Nuclear Safety and Control Regulations		
Section	Requirement	OPG Response
	<i>Protection Regulations, the Nuclear Security Regulations and the Packaging and Transport of Nuclear Substances Regulations, 2015;</i>	conditions documented in WFOL-W4-350.00/2028 and with the Radiation Protection Regulations, the Nuclear Security Regulations, and the Packaging and Transport of Nuclear Substances Regulations as described in Attachment 2 of this submission.
	<i>(f) any proposed action level for the purpose of section 6 of the Radiation Protection Regulations;</i>	The requested WFOL amendment will not require changes to the radiation protection action levels.
	<i>(g) the proposed measures to control access to the site of the activity to be licensed and the nuclear substance, prescribed equipment or prescribed information;</i>	The requested WFOL amendment will not require changes to the measures to control PWMF site access, the nuclear substance, prescribed equipment or prescribed information.
	<i>(h) the proposed measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information;</i>	The requested WFOL amendment will not require changes to the measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information.
	<i>(i) a description and the results of any test, analysis or calculation performed to substantiate the information included in the application;</i>	The requested WFOL amendment to authorize the storage of L&ILW in the PCSS at the PWMF is supported by a robust safety case that is summarized in Attachment 2 of this submission.
	<i>(j) the name, quantity, form, origin and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste;</i>	See response above under clause 3 (1) (c). This waste will be managed in accordance with OPG's current programs and processes.
	<i>(k) the applicant's organizational management structure insofar as it may bear on the applicant's compliance with the Act and the regulations made under the Act, including the internal allocation of functions, responsibilities and authority;</i>	The organizational management structure will not change as a result of the requested licence amendment.
	<i>(l) a description of any proposed financial guarantee relating to the activity to be licensed; and</i>	OPG understands the regulatory requirement to maintain a financial guarantee for its facilities per REGDOC-3.3.1. The financial impact related to the PCSS will be included in the 2027

General Nuclear Safety and Control Regulations		
Section	Requirement	OPG Response
		CNSC Financial Guarantee submission associated with the updated PWMF PDP.
	<i>(m) any other information required by the Act or the regulations made under the Act for the activity to be licensed and the nuclear substance, nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence.</i>	OPG understands this requirement and will continue to comply.
(1.1)	<i>The Commission or a designated officer authorized under paragraph 37(2)(c) of the Act, may require any other information that is necessary to enable the Commission or the designated officer to determine whether the applicant</i> <i>(a) is qualified to carry on the activity to be licensed;</i> <i>(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.</i>	OPG understands this requirement and will continue to comply.
Application for Amendment, Revocation or Replacement of Licence		
6	<i>An application for the amendment, revocation or replacement of a licence shall contain the following information:</i> <i>(a) a description of the amendment, revocation or replacement and of the measures that will be taken and the methods and procedures that will be used to implement it;</i> <i>(b) a statement identifying the changes in the information contained in the most recent application for the licence;</i>	(a) Attachment 2 of this submission documents the description of the amendment (Appendix A) and of the measures that will be taken and the methods and procedures that will be used to implement it. (b) Attachment 2 of this submission documents the changes that will be required to any licensing basis documents. The L&ILW will be stored within a specified array in the PWMF PCSS, a shielded building.

General Nuclear Safety and Control Regulations		
Section	Requirement	OPG Response
	<i>(c) a description of the nuclear substances, land, areas, buildings, structures, components, equipment and systems that will be affected by the amendment, revocation or replacement and of the manner in which they will be affected; and</i> <i>(d) the proposed starting date and the expected completion date of any modification encompassed by the application.</i>	(c) This licence amendment request is to operate the Pickering Waste Management Facility (hereinafter “the facility”), to include the PCSS in addition to the Pickering Used Fuel Dry Storage Facility located at the Pickering Nuclear Generating Station, City of Pickering, Regional Municipality of Durham, Province of Ontario. (d) The first steam generators (SGs) would arrive between 2027 and 2028. The remaining wastes will follow pending the refurbishment activities on each unit with completion expected in 2034.
Incorporation of Material in Application		
7	<i>An application for a licence or for the renewal, suspension in whole or in part, amendment, revocation or replacement of a licence may incorporate by reference any information that is included in a valid, expired or revoked licence.</i>	OPG understands and has provided applicable references to information contained in the existing licence and Licence Conditions Handbook.
Obligations		
12(1)	Obligations of Licensees <i>Every licensee shall</i>	OPG understands the requirements and will continue to comply. Specifically:
	<i>(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;</i>	OPG will ensure a sufficient number of qualified workers will be available to safely carry out the activities requested under this licence amendment.
	<i>(b) train the workers to carry on the licensed activity in accordance with the Act, the regulations made under the Act and the licence;</i>	OPG staff will be trained on operation and maintenance activities associated with the requested licence amendment.
	<i>(c) 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;</i>	Refer to section 2.9, LC 9.1 in Attachment 2 of this submission for details on environmental protection.
	<i>(d) provide the devices required by the Act, the regulations made under the Act and the licence and maintain them within the manufacturer’s specifications;</i>	OPG understands this requirement and will continue to comply.

General Nuclear Safety and Control Regulations		
Section	Requirement	OPG Response
	<i>(e) require that every person at the site of the licensed activity use equipment, devices, clothing and procedures in accordance with the Act, the regulations made under the Act and the licence;</i>	OPG understands this requirement and will continue to comply.
	<i>(f) 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;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.9, LC 9.1 in Attachment 2 for further details on control of releases.
	<i>(g) implement measures for alerting the licensee to the illegal use or removal of a nuclear substance, prescribed equipment or prescribed information, or the illegal use of a nuclear facility;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.12, LC 12.1 in Attachment 2 of this submission for further details on security.
	<i>(h) implement measures for alerting the licensee to acts of sabotage or attempted sabotage anywhere at the site of the licensed activity;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.12, LC 12.1 in Attachment 2 of this submission for further details on security.
	<i>(i) take all necessary measures to facilitate Canada's compliance with any applicable safeguards agreement;</i>	OPG understands this requirement and will continue to comply.
	<i>(j) instruct the workers on the physical security program at the site of the licensed activity and on their obligations under that program;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.12, LC 12.1 in Attachment 2 of this submission for further details on security.
	<i>(k) keep a copy of the Act and the regulations made under the Act that apply to the licensed activity readily available for consultation by the workers.</i>	OPG understands this requirement and will continue to comply.
12(2)	<i>Every licensee who receives a request from the Commission or a person who is authorized by the Commission for the purpose of this subsection, to conduct a test, analysis, inventory or inspection in respect of the licensed activity or to review or to modify a design, to modify equipment,</i>	OPG understands this requirement and will continue to comply. Testing and commissioning procedures and reports associated with the storage of L&ILW will

General Nuclear Safety and Control Regulations		
Section	Requirement	OPG Response
	<i>to modify procedures or to install a new system or new equipment shall file, within the time specified in the request, a report with the Commission that contains the following information:</i> <i>(a) confirmation that the request will or will not be carried out or will be carried out in part;</i> <i>(b) any action that the licensee has taken to carry out the request or any part of it;</i> <i>(c) any reasons why the request or any part of it will not be carried out;</i> <i>(d) any proposed alternative means to achieve the objectives of the request; and</i> <i>(e) any proposed alternative period within which the licensee proposes to carry out the request.</i>	be made available to facilitate the regulatory role of CNSC staff.
Transfers		
13	<i>No licensee shall transfer a nuclear substance, prescribed equipment or prescribed information to a person who does not hold the licence, if any, that is required to possess the nuclear substance, prescribed equipment or prescribed information by the Act and the regulations made under the Act.</i>	OPG understands this requirement and will continue to comply.

General Nuclear Safety and Control Regulations		
Section	Requirement	OPG Response
Notice of Licence		
14	<i>(1) Every licensee other than a licensee who is conducting field operations shall post, at the location specified in the licence or, if no location is specified in the licence, in a conspicuous place at the site of the licensed activity,</i> <i>(a) a copy of the licence, with or without the licence number, and a notice indicating the place where any record referred to in the licence may be consulted; or</i> <i>(b) a notice containing</i> <i>(i) the name of the licensee,</i> <i>(ii) a description of the licensed activity,</i> <i>(iii) a description of the nuclear substance, nuclear facility or prescribed equipment encompassed by the licence, and</i> <i>(iv) a statement of the location of the licence and any record referred to in it.</i> <i>(2) Every licensee who is conducting field operations shall keep a copy of the licence at the place where the field operations are being conducted.</i> <i>(3) Subsections (1) and (2) do not apply to a licensee in respect of</i> <i>(a) a licence to import or export a nuclear substance, prescribed equipment or prescribed information;</i> <i>(b) a licence to transport a nuclear substance; or</i> <i>(c) a licence to abandon a nuclear substance, a nuclear facility, prescribed equipment or prescribed information.</i>	OPG understands this requirement and will continue to comply with this requirement.

General Nuclear Safety and Control Regulations		
Section	Requirement	OPG Response
Publication of Health and Safety Information		
16	<i>(1) Every licensee shall make available to all workers the health and safety information with respect to their workplace that has been collected by the licensee in accordance with the Act, the regulations made under the Act and the licence.</i> <i>(2) Subsection (1) does not apply in respect of personal dose records and prescribed information.</i>	OPG understands this requirement and will continue to comply. OPG's Health and Safety Policy is posted on the OPG intranet website.
Obligations of Workers		
17	<i>Every worker shall:</i> <i>(a) use equipment, devices, facilities and clothing for protecting the environment or the health and safety of persons, or for determining doses of radiation, dose rates or concentrations of radioactive nuclear substances, in a responsible and reasonable manner and in accordance with the Act, the regulations made under the Act and the licence;</i> <i>(b) comply with the measures established by the licensee to protect the environment and the health and safety of persons, maintain security, control the levels and doses of radiation, and control releases of radioactive nuclear substances and hazardous substances into the environment;</i> <i>(c) promptly inform the licensee or the worker's supervisor of any situation in which the worker believes there may be</i> <i>(i) a significant increase in the risk to the environment or the health and safety of persons,</i> <i>(ii) a threat to the maintenance of the security of nuclear facilities and of</i>	OPG understands this requirement and will continue to comply.

General Nuclear Safety and Control Regulations		
Section	Requirement	OPG Response
	<i>nuclear substances or an incident with respect to such security,</i> <i>(iii) a failure to comply with the Act, the regulations made under the Act or the licence,</i> <i>(iv) an act of sabotage, theft, loss or illegal use or possession of a nuclear substance, prescribed equipment or prescribed information, or</i> <i>(v) a release into the environment of a quantity of a radioactive nuclear substance or hazardous substance that has not been authorized by the licensee;</i> <i>(d) observe and obey all notices and warning signs posted by the licensee in accordance with the Radiation Protection Regulations; and</i> <i>(e) take all reasonable precautions to ensure the worker's own safety, the safety of the other persons at the site of the licensed activity, the protection of the environment, the protection of the public and the maintenance of the security of nuclear facilities and of nuclear substances.</i>	

Class 1 Nuclear Facility Regulations		
Section	Requirement	OPG Response
Licence Applications – General Requirements		
3	<i>An application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain the following information in addition to the information required by section 3 of the General Nuclear Safety and Control Regulations:</i>	The changes to the site are described in Section 1 of Attachment 2. A map showing the site layout is shown in Figure 1 of Attachment 2.
	<i>(a) a description of the site of the activity to be licensed, including the location of any exclusion zone and any structures within that zone;</i>	
	<i>(b) plans showing the location, perimeter, areas, structures and systems of the nuclear facility;</i>	The requested WFOL amendment will not require changes to site ownership.
	<i>(c) evidence that the applicant is the owner of the site or has authority from the owner of the site to carry on the activity to be licensed;</i>	
	<i>(d) the proposed management system for the activity to be licensed, including measures to promote and support safety culture;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.1, LC 1.1 in Attachment 2 of this submission for further details on management system.
	<i>(d.1) the proposed human performance program for the activity to be licensed, including measures to ensure workers' fitness for duty.</i>	OPG understands this requirement and will continue to comply. Refer to section 2.2, LC 2.1 in Attachment 2 of this submission for further details on human performance and fitness for duty.
	<i>(e) the name, form, characteristics and quantity of any hazardous substances that may be on the site while the activity to be licensed is carried on;</i>	Similar to the Retube Waste Storage Building at the Darlington Waste Management Facility, it is expected there will be minimal hazardous material.
	<i>(f) the proposed worker health and safety policies and procedures;</i>	OPG understands this requirement and will continue to comply. Refer to sections 2.7 and 2.8 (LC 7.1 and LC 8.1) in Attachment 2 of this submission for further details on radiation protection and conventional health and safety respectively.

Class 1 Nuclear Facility Regulations		
Section	Requirement	OPG Response
	<i>(g) the proposed environmental protection policies and procedures;</i>	OPG understands this requirement and will continue to comply.
	<i>(h) the proposed effluent and environmental monitoring programs;</i>	Refer to section 2.9, LC 9.1 in Attachment 2 of this submission for further details on environmental protection including environmental monitoring.
	<i>(i) if the application is in respect of a nuclear facility referred to in paragraph 2(b) of the Nuclear Security Regulations, the information required by section 3 of those Regulations;</i>	Not Applicable
	<i>(j) 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; and</i>	OPG understands this requirement and will continue to comply. Refer to Section 3 in Attachment 2 of this submission for further details on public information and Indigenous Nations engagement.
	<i>(k) the proposed plan for the decommissioning of the nuclear facility or of the site.</i>	OPG understands this requirement and will continue to comply. Refer to section 2.11, LC 11.2 in Attachment 2 of this submission for further details on decommissioning plans.
Licence to Operate		
6	<i>An application for a licence to operate a Class 1 nuclear facility shall contain the following information in addition to the information required by section 3:</i>	OPG understands this requirement and will continue to comply.
	<i>(a) a description of the structures at the nuclear facility, including their design and their design operating conditions;</i>	
	<i>(b) a description of the systems and equipment at the nuclear facility, including their design and their design operating conditions;</i>	
	<i>(c) a final safety analysis report demonstrating the adequacy of the design of the nuclear facility;</i>	OPG understands this requirement and will continue to comply.

Class 1 Nuclear Facility Regulations		
Section	Requirement	OPG Response
		Refer to section 2.4, LC 4.1 in Attachment 2 of this submission for further details on safety analysis.
	<i>(d) the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.3, LC 3.1 in Attachment 2 of this submission for further details on operating performance.
	<i>(e) the proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.14, LC 14.1 in Attachment 2 of this submission for further details on packaging and transport.
	<i>(f) the proposed measures to facilitate Canada's compliance with any applicable safeguards agreement;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.13, LC 13.1 in Attachment 2 of this submission for further details on safeguards.
	<i>(g) the proposed commissioning program for the systems and equipment that will be used at the nuclear facility;</i>	OPG understands this requirement and will continue to comply.
	<i>(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 effects;</i>	OPG understands this requirement and will continue to comply. Refer to sections 2.7, 2.8, and 2.9 (LC 7.1, LC 8.1 and LC 9.1 respectively) in Attachment 2 of this submission for further details on radiation protection, conventional health and safety respectively and environmental protection.

Class 1 Nuclear Facility Regulations		
Section	Requirement	OPG Response
	(i) <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;</i> (j) <i>the proposed measures to control releases of nuclear substances and hazardous substances into the environment;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.9, LC 9.1 in Attachment 2 of this submission for further details on environmental protection.
	(k) <i>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</i> (i) <i>assist off-site authorities in planning and preparing to limit the effects of an accidental release,</i> (ii) <i>notify off-site authorities of an accidental release or the imminence of an accidental release,</i> (iii) <i>report information to off-site authorities during and after an accidental release,</i> (iv) <i>assist off-site authorities in dealing with the effects of an accidental release, and</i> (v) <i>test the implementation of the measures to prevent or mitigate the effects of an accidental release;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.10, LC 10.1 in Attachment 2 of this submission for further details on emergency preparedness.

Class 1 Nuclear Facility Regulations		
Section	Requirement	OPG Response
	<i>(l) the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility, including measures to alert the licensee to such acts;</i>	OPG understands this requirement and will continue to comply. Refer to section 2.12, LC 12.1 in Attachment 2 of this submission for further details on security program.
	<i>(m) the proposed responsibilities of and qualification requirements and training program for workers, including the procedures for the requalification of workers; and</i> <i>(n) the results that have been achieved in implementing the program for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility.</i>	OPG understands this requirement and will continue to comply. Refer to section 2.2, LC 2.2 in Attachment 2 of this submission for further details on training program.

Radiation Protection Regulations		
Section	Requirement	OPG Response
4	<i>Every licensee must implement a radiation protection program and must, as part of that program,</i> <i>(a) keep the effective dose and equivalent dose received by and committed to persons as low as reasonably achievable, taking into account social and economic factors, through the implementation of</i> <i>(i) management control over work practices,</i> <i>(ii) personnel qualification and training,</i> <i>(iii) control of occupational and public exposure to radiation, and</i> <i>(iv) planning for unusual situations; and</i> <i>(b) ascertain the quantity and concentration of any nuclear substance released as a result of the licensed activity</i> <i>(i) by direct measurement as a result of monitoring, or</i> <i>(ii) if the time and resources required for direct measurement as a result of monitoring outweigh the usefulness of ascertaining the quantity and concentration using that method, by estimating them.</i>	OPG has a well-established radiation protection program that complies with all elements of the Radiation Protection Regulations. Further details are provided in Section 2.7, LC 7.1 on OPG's radiation protection considerations for the storage of L&ILW.

Nuclear Security Regulations
OPG will continue to adhere to all facets of the Nuclear Security Regulations and keep in place all current security processes in the handling and storage of L&ILW from Pickering NGS.

ATTACHMENT 2

OPG letter, K. Aggarwal to C. Salmon, "Pickering Waste Management Facility - Application for Waste Facility Operating Licence WFOL-W4-350.00/2028 Amendment to Construct and Operate the Pickering Component Storage Structure"

CD# 92896-CORR-00531-01544 P

Licence Impact Assessment in Support of Construction and Operation of the Pickering Component Storage Structure at Pickering Waste Management Facility

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Licence Impact Assessment in Support of Construction and Operation of the Pickering Component Storage Structure at Pickering Waste Management Facility



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LAND ACKNOWLEDGEMENT

The lands and waters on which the Pickering Nuclear Generating Station (PNGS) is situated are the treaty and traditional territory of the Michi Saagiig and Chippewa Nations, collectively known as the Williams Treaties First Nations.

PNGS is within the territory of the Gunshot Treaty and the Williams Treaties of 1923. These Treaty Rights were reaffirmed in 2018 in a settlement with Canada and the Province of Ontario.

To acknowledge the treaty and traditional territory, is to recognize the rights of the First Nations. It is to recognize the history of the land, predating the establishment of the earliest European colonies. It is also to acknowledge the significance for the Indigenous peoples who lived and continue to live upon it, to acknowledge the people whose practices and spiritualities are tied to the land and water and continue to develop in relation to the territory and its other inhabitants today.



1.0 INTRODUCTION

1.1 Background

The purpose of this document is to provide technical information in support of Ontario Power Generation's (OPG) request for amendment to the Pickering Waste Management (PWMF) Waste Facility Operating Licence (WFOL), WFOL-W4-350.00/2028, to allow for the construction and operation of a new Pickering Component Storage Structure (PCSS) that will support the refurbishment of Pickering NGS Units 5 through 8 and decommissioning activities.

OPG currently operates the PWMF which is composed of two sites:

- PWMF Phase I site: This is located within the Pickering Nuclear Generating Station (PNGS) protected area, south-east of Pickering NGS Unit 8, adjacent to the east side of the station security fence.
- PWMF Phase II site: This is located approximately 500 m north-east of the site in the East Complex.

The proposed PCSS location will be adjacent to the northern boundary of Phase II (See Figure 1). Ownership and operation of the PCSS will reside with the PWMF.

It was determined that in order to support the refurbishment of Pickering NGS Units 5 through 8 and decommissioning activities, construction and operation of the PCSS will provide storage of the Low and Intermediate Level Waste (L&ILW).

The refurbishment project will include activities such as Steam Generators (SG), Pressure Tube, Feeders, and Calandria Tube replacements, that will produce Low Level Waste (LLW) and Intermediate Level Waste (ILW) that will need to be accommodated in PCSS. Similar to Darlington refurbishment project, Retube Waste Containers (RWC) will be used to store the ILW. Based on the expected waste streams that will be produced, the PCSS is expected to have an area of approximately 3,700 m² (40,000 square feet).

The information provided in this Attachment is divided into the following sections:

- Section 1:** Provides the background, summary and operational considerations for the request of the licence amendment to construct and operate the PCSS.
- Section 2:** Summarizes regulatory compliance for the construction and operation of the PCSS and impact on OPG's governance, programs and processes for each of PWMF's WFOL's fourteen Safety and Control Areas (SCA).
- Section 3:** Summarizes public, Indigenous Nations and Métis engagement related to this application for a licence amendment.
- Appendix A:** Provides the proposed wording for the amendment to the PWMF WFOL-W4-350.00/2028.

1.2 Summary of Proposed Activity Requiring Licence Amendment

OPG intends to construct the PCSS with main phases of the project including design, site preparation, construction, operation, and maintenance. *Site preparation* includes all activities associated with preparing the project area for construction of the PCSS. Activities may include clearing the site, excavation, grading, and installation of utilities and infrastructures. *Construction* includes all activities associated with constructing the PCSS immediately following site preparation. *Operation and maintenance* includes all activities associated with normal operation of the PCSS and includes accepting, storing waste, performing regular inspections and general maintenance activities.

Pending the licence amendment, OPG targets to have the PCSS operational by April 2027 in order to support additional interim storage capacity for radioactive component waste from the refurbishment activities and the decommissioning activities.

Long term management and permanent disposal facilities are planned per Canada's Integrated Strategy for Radioactive Waste (ISRW), which was developed by the Nuclear Waste Management Organization (NWMO) at the request from Natural Resources Canada. The recommendations for the strategy were endorsed by the Minister of Energy and Natural Resources in October 2023. Per the ISRW, low-level waste (LLW) will be permanently disposed of in near surface disposal facility, and it will be the responsibility of OPG as the waste generator and owner to develop such a facility. At OPG, we take our role as a steward of nuclear by-products and waste. In 2024, OPG intends to initiate province-wide outreach to find solutions for permanent disposal of our LLW. The outreach will begin with a learning phase, in which OPG reaches out to Indigenous Nations and Communities across Ontario, followed by municipalities, to begin two-way dialogue on the role of nuclear energy and disposal of LLW. For intermediate level waste (ILW), the ISRW determined that a Deep Geologic Repository (DGR) is appropriate for permanent disposal, and the NWMO will implement a consent-based siting process for this. The planning process for this work is now underway.

Figure 1 below is a layout of the proposed PCSS and PWMF.

Figure 1: PCSS and NSS-PWMF Layout



1.3 Safety Case

Safety of the workers, public, and environment is OPG's over-riding priority, proven over many years of both Power Reactor operation and radioactive waste management and storage. OPG is responsible for the continued safe operation of the PWMF and confirms that the construction and operation of the PCSS will be implemented based on a robust safety case and in accordance with OPG's Engineering Change Control process. This is supported by 92896-REP-01320-00019, "*Pickering Component Storage Structure Safety Assessment*", provided as Enclosure 1 of this submission, which demonstrates the continued safe facility operation, public and worker safety, and environmental protection.

The safety case for the construction and operation of the PCSS can be defined based on the following elements:

1. **Design:** OPG has and will continue to follow its Engineering Change Control (ECC) process, as described in N-PROG-MP-0001, "*Engineering Change Control*", for ensuring the design complies with applicable regulatory requirements as defined in the PWMF Licence Condition Handbook (LCH), LCH-W4-350.00/2028, and that configuration management will be maintained.
2. **Continued Safe Operation:** The safety case, 92896-REP-01320-00019, "*Pickering Component Storage Structure Safety Assessment*", provided as Enclosure 1 of this submission, demonstrates that the operation of the PCSS and storage of L&ILW components will have a negligible effect on the safe operation, public and worker safety.
3. **Environmental Protection:** The predictive environmental risk assessment completed for PCSS, 92896-REP-07701-00019 R001, "*Predictive Environmental Risk Assessment for Pickering Component Storage Structure*", provided as Enclosure 2 of this submission, concludes that the construction and operation of the PCSS will have negligible impact on the environment.
4. **Licensing Basis:** The construction and operation of the PCSS will have a negligible impact on PWMF's licensing basis, governance, programs, and processes. Attachment 1 of this submission provides the compliance matrix for the Nuclear Safety Control Act and associated regulations required for the amendment of the PWMF WFOL.

Overall, there are no significant safety or operational issues resulting from construction and operation of the PCSS.

2.0 Safety and Control Areas

This section provides the impact assessment of the proposed new activities on the licensing basis for each of the PWMF WFOL SCAs. OPG is responsible for the continued safe operation of the PWMF and confirms that all modifications made with respect to the construction and operation of the PCSS, will be implemented based on a robust safety case and in accordance with OPG's ECC process. This is supported by safety assessments, which demonstrate continued safe operation of the PWMF, public safety, worker safety and environmental protection.

2.1 Management System

2.1.1 Management System

Licence Condition 1.1 states "*the licensee shall implement and maintain a management system*" and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1). OPG's proven Nuclear Management System provides a framework that establishes the processes and programs required to ensure that OPG achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy nuclear safety culture.

Table 2.1.a: List of Management System Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
Management System Requirements for Nuclear Facilities	CSA N286 (2012)	Continued compliance as applied to all aspects of operation and modifications at PWMF.

Table 2.1.b: Impact of the Construction and Operation of the PCSS on PWMF's Management System Licensing Basis Documents

OPG Management System Licensing Basis Document Title	OPG Document Number	Impact from Construction and Operation of the PCSS
Items and Services Management	OPG-PROG-0009	No Change
Environment Health and Safety Managed Systems	OPG-PROG-0005	No Change
Nuclear Management Systems Organization	N-STD-AS-0020	No Change
Nuclear Safety and Security Culture Assessment	N-PROC-AS-0077	No Change
Nuclear Safety Oversight	N-STD-AS-0023	No Change
Nuclear Safety Policy	N-POL-0001	No Change
Nuclear Management System	N-CHAR-AS-0002	No Change

2.1.2 Quality Assurance, CSA Standard N286-12 Compliance

OPG is compliant with CSA Standard N286-12, “*Management system requirements for nuclear facilities*”. The Nuclear Charter, N-CHAR-AS-0002, “*Nuclear Management System*”, establishes the Nuclear Management System for OPG Nuclear. The Nuclear Management System will not change because of the proposed construction and operation of the PCSS.

2.1.3 Nuclear Safety and Security Culture

OPG routinely monitors the health of its nuclear safety culture through Nuclear Safety Monitoring Panels. These panels were established based on the industry best practices documents in the Nuclear Energy Institute's NEI-09-07, “*Fostering a Strong Nuclear Safety Culture*”. The Nuclear Safety Monitoring Panel examines information from a variety of the processes that have been implemented, such as the corrective action process, the human performance program, audits and self-assessments, external inspections such as CNSC staff's inspections or industry evaluations, employee concerns, and business performance monitoring. This information is evaluated against the traits of a healthy nuclear safety culture to identify strengths and areas for focused attention within the organization. The panel is composed of all the managers senior leadership within OPG. The panel evaluates the information and approves any initiatives or reinforces communications as needed. The construction and operation of the PCSS will not impact the Nuclear Safety and Security Culture requirements.

2.1.4 Management of Contractors

Licence Condition 1.2 requires that “*the licensee shall ensure that every contractor at the facility complies with this licence*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Vendors and contractors are qualified by OPG Supply Chain Quality Services under a process that ensures that the contractors have developed and implemented a management system that meets the applicable requirements outlined in the CSA Standard N286 series of standards.

OPG is ultimately responsible for ensuring that all on-site contractor activities comply with OPG's safety requirements. Day-to-day operations at PWMF are generally maintained by full-time staff of OPG.

2.2 Human Performance Management

2.2.1 Human Performance Program

Licence Condition 2.1 states “*the licensee shall implement and maintain a human performance program*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Human performance relates to reducing the likelihood of human error in work activities. It refers to the outcome of human behaviour, functions, and actions in a specified environment, reflecting the ability of workers and management to meet the system's defined performance under the conditions in which the system will be employed.

Table 2.2.a: List of Human Performance Management Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from Construction and Operation of the PCSS
Fitness for Duty: Managing Worker Fatigue	REGDOC-2.2.4 (2017)	Continued compliance, no impact.
Fitness for Duty, Volume II: Managing Alcohol and Drug Use, Version 3	REGDOC- 2.2.4 (2021)	Continued compliance, no impact.
Safety Culture	REGDOC-2.1.2 (2018)	Continued compliance, no impact.

Table 2.2.b: Impact of Construction and Operation of the PCSS on PWF's Human Performance Management Licensing Basis Documents

OPG Human Performance Licensing Basis Document Title	OPG Document Number	Impact from Construction and Operation of the PCSS
Human Performance	N-PROG-AS-0002	No Change
Hours of Work Limits and Managing Worker Fatigue	N-PROC-OP-0047	No Change

The objective of OPG's Human Performance program, N-PROG-AS-0002, "*Human Performance*" is to minimize human performance events and errors by managing defenses in pursuit of zero events of consequence.

The Human Performance program integrates proactive (prevention) and reactive (detection and correction) human performance initiatives, which includes the following:

- Providing oversight and monitoring of department human performance.
- Identifying emerging human performance issues and determining strategies for related improvement.
- Approving site-wide human performance improvement initiatives and overseeing the implementation progress.
- Use of the human performance toolbox
- Identifying and implementing human performance improvement communication, education, and training opportunities.

2.2.2 Fitness for Duty

As part of OPG's fitness for duty program, OPG has a continuous behaviour observation program in place which trains supervisors and managers to monitor workers for signs of fatigue or other factors which could adversely impact worker performance. OPG has in place hours of work requirements in N-PROC-OP-0047, "*Hours of Work Limits and Managing Worker Fatigue*" which sets limits for the number of hours within a specified time period that station staff can work. The limits, which are in place to guard against fatigue in the workplace, are strict in comparison to other jurisdictions.

The construction and operation of the PCSS will not impact OPG's fitness for duty program or compliance to hours-of-work requirements.

2.2.3 Training Program

Licence Condition 2.2 states "*the licensee shall implement and maintain a training program*" and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1). Similar to the Re-tube Waste Service Building (RWSB), personnel at the PCSS will be fully trained in the storage of L&ILW and on mitigative measures for backout when required. All required staff will be fully trained before the first SG/RWC is received and stored in the PCSS.

Table 2.2.c: List of Training Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from Construction and Operation of the PCSS
Personnel Training	REGDOC-2.2.2 (2016)	Continued compliance, no impact.

Table 2.2.d: Impact of the Construction and Operation of the PCSS on PWMF's Training Program Licensing Basis Documents

OPG Human Performance Licensing Basis Document Title	OPG Document Number	Impact from Construction and Operation of the PCSS
Systematic Approach to Training	N-PROC-TR-0008	No Change
Training	N-PROC-TR-0005	No Change

2.3 Operating Performance

2.3.1 Operating Performance

Licence Condition 3.1 states “*the licensee shall implement and maintain an operating program, which includes a set of operating limits*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Operations and Maintenance of the PCSS will be conducted in accordance with the PWMF Operating Policies and Principles and within the conditions of the operating licence to be issued for the facility by the CNSC. Operations and Maintenance standards will be such that equipment performance and reliability in accordance with design specifications is maintained.

Table 2.3.a Impact of the Construction and Operation of the PCSS on PWMF’s Operating Performance Related Licensing Basis Documents

OPG Document Title	OPG Document Number	Impact from Construction and Operation of PCSS
Application for Renewal of Pickering Waste Management Facility Operating Licence	92896-CORR-00531-01031	No Change
Additional Information to Support the Application for Renewal of Pickering Waste Management Facility Operating Licence	92896-CORR-00531-01075	No Change
Nuclear Waste Management	W-PROG-WM-0001	No Change
Operating Policies and Principles, Pickering Waste Management Facility	92896-OPP-01911.1-00001	Updates to the Operating Policies and Principles will be completed prior to operation of the PCSS.
Pickering Waste Management Facility – Safety Report	92896-SR-01320-10002	Changes will be reflected in the next update of the PWMF Safety Report scheduled for 2028.

The updates to the Operating Policies and Principles for the PWMF will be completed prior to the targeted operation date of the PCSS. This submission is tracked under Regulatory Action Management Request (REGM) # 28267257.

2.3.2 Reporting Requirements

Licence Condition 3.2 states “*the licensee shall implement and maintain a program for reporting to the Commission or a person authorized by the Commission*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.3.b: List of Reporting Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from Construction and Operation of the PCSS
Public Information and Disclosure	REGDOC-3.2.1 (2022)	Continued compliance, no impact.
Reporting Requirements, Volume I: Non-Power Reactor Class I Nuclear Facilities and Uranium Mines and Mills	REGDOC-3.1.2 (2018)	Continued compliance, no impact.

Table 2.3.c: Impact of the Construction and Operation of the PCSS on PWMF's Reporting Requirements Related Licensing Basis Documents

OPG Document Title	OPG Document Number	Impact from Construction and operating of the PCSS
Conduct of Regulatory Affairs	N-PROG-RA-0002	No Change
Performance Improvement	N-PROG-RA-0003	No Change
Preliminary Event Notification	N-PROC-RA-0020	No Change
Operating Policies and Principles, Pickering Waste Management Facility	92896-OPP-01911.1-00001	No Change

2.3.3 Quarterly and Annual Operational Reporting

The annual operational reports will continue as currently conducted and will account for the construction and operation of the PCSS. The quarterly operational reporting to the CNSC is no longer required (Reference 2-2).

2.4 Safety Analysis

2.4.1 Safety Analysis Program

Licence Condition 4.1 states “*the licensee shall implement and maintain a safety analysis program*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

2.4.2 Safety Analysis

The preliminary safety analysis, also referred to as the “safety case” of the PCSS, 92896-REP-01320-00019 R000, “*Pickering Component Storage Structure Safety Assessment*” is provided as Enclosure 1 of this submission. The normal operations safety analysis considered several design options for the PCSS and assessed the corresponding dose rate impact to the public during normal operations. The annual normal operations public dose estimates have increased compared to that of the existing PWMF configuration due to the proximity of the PCSS to the nearest public receptor. The annual dose to an individual member of the public with the most favorable design option of the PCSS is still a small percentage of the 1 mSv limit and meets the 100 µSv annual target for the PWMF.

The normal operations safety analysis demonstrates that compliance with the radiation safety requirements during normal operation of the PCSS can be achieved and several recommendations are given to guide the detailed design of the structure. With respect to malfunction and potential accident scenarios, the estimated bounding doses to members of the public are less than the 1 mSv acceptance criterion. The dose to workers following a postulated bounding accident scenario involving a building collapse of the PCSS is found to be much less than the 50 mSv limit. It is concluded that the dose consequences to workers and members of the public following credible postulated malfunction / accident scenarios will meet all acceptance criteria.

The safety analysis will be updated with the final design requirements of the PCSS and will be provided to CNSC staff prior to the targeted commencement date of construction. This submission is tracked under REGM # 28267123.

Table 2.4.a: List of Safety Analysis Program Related Regulatory Requirements

Licensing Basis Document Title	Document Title	Impact from Operation of the PCSS
General principles for the management of radioactive waste and irradiated fuel	CSA N292.0 (2014)	PCSS preliminary safety analysis was conducted in compliance with applicable requirements.
Interim Dry Storage of Irradiated Fuel	CSA N292.2 (2013)	PCSS preliminary safety analysis was conducted in compliance with applicable requirements.
Management of Low and Intermediate Level Radioactive Waste	CSA N292.3 (2014)	PCSS preliminary safety analysis was conducted in compliance with applicable requirements.
Quality Assurance of Analytical, Scientific and Design Computer programs	CSA N286.7 (2016)	PCSS preliminary safety analysis was conducted in compliance with applicable requirements.

Table 2.4.b: Impact of the Construction and Operation of the PCSS on PWMF’s Safety Analysis Licensing Basis Documents

OPG Safety Analysis Licensing Basis Document Title	OPG Document Number	Impact from operation of the PCSS
Pickering Waste Management Facility – Safety Report	92896-SR-01320-10002	Changes will be reflected in the next update of the PWMF Safety Report scheduled for 2028.

2.5 Physical Design

2.5.1 Design Program

Licence Condition 5.1 states “*the licensee shall implement and maintain a design program*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

The design and any modifications to the PCSS shall comply with applicable codes, standards, and regulations including adequate consideration for human factors. For all designs, the licensee shall modify and otherwise carry out work related to the PCSS in compliance with the applicable versions of the National Building Code of Canada and the National Fire Code of Canada.

Table 2.5.a: List of Design Program Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from Construction and Operation of the PCSS
Fire protection for facilities that process, handle, or store nuclear substances	CSA N393	The PCSS’s design will comply with the requirements in this code
National Building Code of Canada (2020)	NRC	The PCSS’s design will comply with the requirements in this national code.
National Fire Code of Canada (2020)	NRC	The PCSS’s design will comply with the requirements in this national code.

The PCSS design requirements will be provided to CNSC staff prior to the targeted commencement date of construction activities. This submission is tracked under REGM # 28267121.

Table 2.5.b: Impact of the Construction and Operation of the PCSS on PWMF’s Design Program Related Licensing Basis Documents

OPG Physical Design Licensing Basis Document Title	OPG Document Number	Impact from Construction and Operation of the PCSS
Conduct of Engineering	N-STD-MP-0028	No Change
Configuration Management	N-STD-MP-0027	No Change
Design Management	N-PROG-MP-0009	No Change
Engineering Change Control	N-PROG-MP-0001	No Change

2.5.2 Pressure Boundary

Licence Condition 5.2 states “the licensee shall implement and maintain a pressure boundary program and have in place a formal agreement with an Authorized Inspection Agency” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.5.c: List of Pressure Boundary Program Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
Power Piping	ASME B31.1 (2010)	No Impact from the construction and operation of the PCSS and storage of L&ILW on an interim basis.
Boiler, pressure vessel, and pressure piping code	CSA B51 (2009 and Update No. 1)	No Impact from the construction and operation of the PCSS and storage of L&ILW on an interim basis.
General requirements for pressure-retaining systems and components in CANDU nuclear power plants	CSA N285.0 (2008 and Updates No. 1 and 2; and Annex N of N285.0-12 and Update No. 1)	No Impact from the construction and operation of the PCSS and storage of L&ILW on an interim basis.
Standard for the Installation of Private Fire Service Mains and Their Appurtenances	NFPA-24 (2010)	No Impact from the construction and operation of the PCSS and storage of L&ILW on an interim basis.
Standard for the Installation of Stationary Pumps for Fire Protection	NFPA-20 (2010 and Amendment 1 and Amendment 2)	No Impact from the construction and operation of the PCSS and storage of L&ILW on an interim basis.

Table 2.5.d: Impact of the Construction and Operation of the PCSS on PWMF’s Pressure Boundary Related Licensing Basis Documents

OPG Physical Design Licensing Basis Document Title	OPG Document Number	Impact from Construction and Operation of the PCSS
Index to OPG Pressure Boundary Program Elements	N-LIST-00531-10003	No Change
Pressure Boundary Program Manual	N-MAN-01913.11-10000	No Change
Authorized Inspection Agency Service Agreement	N-CORR-00531-20012	No Change

Design Registration	N-PROC-MP-0082	No Change
Pressure Boundary	N-PROG-MP-0004	No Change
System and Item Classification	N-PROC-MP-0040	No Change

2.6 Fitness for Service

Licence Condition 6.1 states “*the licensee shall implement and maintain a fitness for service program*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.6.a: List of Fitness for Service Program Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from Construction and Operation of the PCSS
Aging Management	REGDOC-2.6.3 (2014)	Continued compliance.

Table 2.6.b: Impact of the Construction and Operation of the PCSS on PWMF’s Aging Management Program Related Licensing Basis Documents

OPG Fitness for Service Licensing Basis Document Title	OPG Document Number	Impact from Construction and Operation of the PCSS
Conduct of Engineering	N-STD-MP-0028	No Change
Design Management	N-PROG-MP-0009	No Change
Equipment Reliability	N-PROG-MA-0026	No Change
Integrated Aging Management	N-PROG-MP-0008	No Change
Nuclear Waste Management	W-PROG-WM-0001	No Change

2.7 Radiation Protection

2.7.1 Radiation Protection

Licence Condition 7.1 states “*the licensee shall implement and maintain a radiation program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

As per OPG's N-PROG-RA-0013, "*Radiation Protection*", the overriding objective of the Radiation Protection program at OPG is the control of occupational and public exposure to radiation. For the purposes of controlling radiation doses to workers and the public, this program has five implementing objectives:

- Keeping individual radiation doses below regulatory limits,
- Avoiding unplanned radiation exposures,
- Keeping individual risk from lifetime radiation exposure to an acceptable level
- Keeping collective radiation doses ALARA, social and economic factors taken into account
- Keeping public exposure to radiation well within regulatory limits.

2.7.2 Dose Rate Impact on the Public and Environment

An assessment has been conducted on the impact of calculated dose rates on OPG personnel, the public and the environment.

The construction and use of the PCSS to support storage of radioactive materials (L&ILW) will not result in exceedances of the derived dose rate limit at the boundary of the PWMF licensed area. This will be facilitated by adequate shielding of the PCSS itself as well as operational controls.

The existing Thermoluminescent Dosimeters around PWMF Phase I and Phase II will measure the dose rates and will be reported to CNSC staff in accordance with the facility operations report.

Personnel radiation exposures associated with the storage and placement of L&ILW will be managed within the framework of the existing Radiation Protection Program (N-PROG-RA-0013).

Table 2.7.a: List of Radiation Protection Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
Radiation Protection Regulations	SOR/2000-203	No Impact

Table 2.7.b: Impact from the Construction and Operation of the PCSS on PWMF's Radiation Protection and ALARA Licensing Basis Documents

OPG Radiation Protection Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Operation of the PCSS
Occupational Radiation Protection Action Levels for Nuclear Waste Management Facilities	N-STD-RA-0045	No Change
Radiation Protection	N-PROG-RA-0013	No Change

2.8 Conventional Health and Safety

Licence Condition 8.1 states “*the licensee shall implement and maintain a conventional health and safety program*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.8.a: Regulatory Requirements Related to Conventional Health and Safety

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
General Nuclear Safety and Control Regulations	SOR/2000-202	Continued compliance

Table 2.8.b: Impact from the Construction and Operation of the PCSS on PWMF's Conventional Safety Program Licensing Basis Documents

OPG Conventional Safety Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Operation of the PCSS
Employee Health and Safety Policy	OPG-POL-0001	No Change
Environment Health and Safety Managed Systems	OPG-PROG-0005	No Change

2.9 Environmental Protection

2.9.1 Environmental Protection

Licence Condition 9.1 states “*the licensee shall implement and maintain an environmental protection program, which includes a set of action levels. When the licensee becomes aware that an action level has been reached, the licensee shall notify the Commission within seven days*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.9.a: List of Environmental Protection Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Addition of the PCSS
Environmental Protection: Environmental Principles, Assessments and Protection Measures	REGDOC-2.9.1, Version 1.2 Section 4.6 (2020)	Environmental-related assessment (Enclosure 2 of this submission) was conducted in accordance with requirements.
Environment management of nuclear facilities: Common requirements of the CSA N288 series of Standards	CSA N288.0 (2022)	Environmental-related assessment (Enclosure 2 of this submission) was conducted in accordance with requirements

Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities	CSA N288.1 (2020)	Environmental-related assessment (Enclosure 2 of this submission) was conducted in accordance with requirements
Performance Testing of Nuclear Air-Cleaning Systems at Nuclear Facilities	CSA N288.3.4 (2013 R2022)	Environmental-related assessment (Enclosure 2 of this submission) was conducted in accordance with requirements
Environmental monitoring program at nuclear facilities and uranium mines and mills	CSA N288.4 (2019)	Environmental-related assessment (Enclosure 2 of this submission) was conducted in accordance with requirements
Effluent and emissions monitoring programs at nuclear facilities	CSA N288.5 (2022)	Environmental-related assessment (Enclosure 2 of this submission) was conducted in accordance with requirements
Environmental risk assessments at nuclear facilities and uranium mines and mills	CSA N288.6 (2022)	Environmental-related assessment (Enclosure 2 of this submission) was conducted in accordance with requirements
Groundwater protection programs at Class I nuclear facilities and uranium mines and mills.	CSA N288.7 (2015)	Environmental-related assessment (Enclosure 2 of this submission) was conducted in accordance with requirements
Establishing and implementing action levels for releases to the environment from nuclear facilities	CSA N288.8 (2017 R2022)	Environmental-related assessment (Enclosure 2 of this submission) was conducted in accordance with requirements

Table 2.9.b Impact from the Storage of the addition of the PCSS on PWF's Environmental Protection Licensing Basis Documents

OPG Environmental Protection Licensing Basis Document Title	OPG Document Number	Impact from the Addition of the PCSS
Environment Health and Safety Managed Systems	OPG-PROG-0005	No Change
Environment Policy	OPG-POL-0021	No Change
Management of the Environmental Monitoring Programs	N-PROC-OP-0025	No Change
Monitoring of Nuclear and Hazardous Substances in Effluents	N-STD-OP-0031	No Change
Environmental Risk Assessment Report for Pickering Nuclear	P-REP-07701-00007	No Change

Derived Release Limits and Environmental Action Levels for Pickering Nuclear	P-REP-03482-00006	No Change
Action Levels for Environmental Releases - Pickering Nuclear	P-REP-03482-00007	No Change

2.9.2 Effluent and Emissions Control (Releases)

OPG is committed to complying with the requirements of the CSA Standard N288 series documents, as required in the PWMF LCH. The licensee shall control radiological releases to ALARA, thereby minimizing dose to the public resulting from PWMF/PCSS operation.

The PWMF adheres to approved Derived Release Limits (DRLs) under PNGS, which are defined in CSA Standard N288.1 as the release rate that would cause an individual of the most highly exposed group to receive and be committed to a dose equal to the regulatory annual dose limit, due to release of a given radionuclide to air or surface water during normal operation of a nuclear facility over the period of a calendar year.

Because radiological releases are very small in comparison with the DRLs and Action Levels, lower Internal Investigation Levels (IILs) are used to demonstrate and maintain adherence to the ALARA principle. There will be no changes to the DRLs, Action Levels or IILs as a result of the PCSS. Consistent with current performance, the cumulative public dose resulting from the PCSS will remain well below 1% of the regulatory public dose limit of 1,000 μ Sv per year.

During operation and maintenance of the PCSS, radiological waste will be contained and as a result, no radiological emissions are expected during normal operations. There will be gamma radiation fields emitted during the transfer of waste storage containers and once waste is stored in the PCSS during operation. The design of the PCSS will provide shielding, which will be verified upon the completion of the structure design.

2.9.3 Environmental Management System (EMS)

OPG's OPG-POL-0021, "*Environmental Policy*" requires that OPG maintain an Environmental Management System (EMS) consistent with the ISO 14001, "*Environmental Management System Standard*".

Operation of the PCSS will continue to be in accordance with OPG's EMS as described in OPG-PROG-0005, "*Environment Health and Safety Managed Systems*" and OPG-POL-0021. The EMS provides specific directions on how the Environmental Policy is implemented while meeting the expectations of OPG-POL-0032, "*Safe Operations Policy*", N-POL-0001, "*Nuclear Safety & Security Policy*", and N-CHAR-AS-0002, "*Nuclear Management System*".

2.9.4 Continued Validity of Prior Submissions to the CNSC/Licensing Documents

92896-REP-00701-00019 R001, "*Predictive Environmental Risk Assessment for Pickering Component Storage Structure*" (Enclosure 2 of this submission) provides the results of the assessment that reviewed the following licensing documents:

Environmental Assessments (EAs):

- 92896-REP-07701-00002, "*Pickering Waste Management Facility Phase II Final Environmental Assessment Study Report*" (Reference 2-3)
- NK30-REP-07701-00002, "*Refurbishment and Continued Operation of Pickering B Nuclear Generating Station Environmental Assessment*" (Reference 2-4)

Environmental Risk Assessment (ERA) and Predictive Effects Assessment (PEA):

- P-REP-07701-00007 R001 "*Environmental Risk Assessment Report for Pickering Nuclear*" (Reference 2-5)
- P-REP-07701-00002, "*Predictive Effects Assessment for Pickering Nuclear Safe Storage*" (Reference 2-6)

2.9.5 Environmental Assessment Follow-Up Program

Licence Condition 9.2 states "*the licensee shall implement an environmental assessment follow-up program*" and the details in the PWMF LCH outline the regulatory requirements. This licence condition was specific to expanding the capacity of the PWMF by constructing and operating two additional storage buildings (#3 and #4) at the PWMF Phase II site. The EA process for that project identified the need for an EA follow-up program for the PWMF Phase II project. The follow up items listed in 92896-REP-07701.8-00001, "*Environmental Assessment Follow-up Plan*" (Reference 2-7) were completed and are reported annually with the most recent Annual Compliance Report, 92896-REP-00531-00072-R000 "*Pickering Waste Management Facility – Fourth Quarter Report and Annual Compliance Report for 2023*" (Reference 2-8).

The construction and operation of the PCSS will not impact the EA follow up program and as such, this licence condition is not applicable.

Table 2.9.c Impact from the Construction and Operation of the PCSS on PWMF's Environmental Assessment Follow-Up Plan Licensing Basis Documents

OPG Environmental Protection Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Impact of the PCSS
Pickering Waste Management Facility Phase II – Environmental Assessment Follow-Up Plan	92896-REP-07701.8-00001	No Change

2.10 Emergency Management and Fire Protection

2.10.1 Emergency Preparedness Program

Licence Condition 10.1 states “*the licensee shall implement an emergency preparedness program*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.10.a: List of Emergency Management Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Impact of the PCSS
Nuclear Emergency Preparedness and Response, Version 2	REGDOC-2.10.1 (2016)	No Change

Table 2.10.b: Impact from the Construction and Operation of the PCSS on PWMF’s Emergency Management Licensing Basis Documents

OPG Emergency Management and Fire Protection Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Impact of the PCSS
Radioactive Materials Transportation Emergency Response Plan	N-STD-RA-0036	No Change
Consolidated Nuclear Emergency Plan	N-PROG-RA-0001	No Change

2.10.2 Fire Protection Program

Licence Condition 10.2 states “*the licensee shall implement a fire protection program*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.10.c: List of Fire Protection Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
Fire protection for facilities that process, handle, or store nuclear substances	CSA N393-22 (2022)	No Change
National Building Code of Canada (2020)	NRC	No Change
National Fire Code of Canada (2020)	NRC	No Change

Table 2.10.d: Impact from the Construction and Operation of the PCSS on PWMF's Fire Protection Licensing Basis Documents

OPG Emergency Management and Fire Protection Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Operation of the PCSS
Fire Protection	N-PROG-RA-0012	No Change

2.11 Waste Management

2.11.1 Waste Management Program

Licence Condition 11.1 states *"the licensee shall implement a waste management program"* and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.11.a: List of Waste Management Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
Waste Management Volume 1: Management of Radioactive Waste	REGDOC-2.11.1	The interim storage of L&ILW waste complies with the requirements in this CNSC regulatory document.
General principles for the management of radioactive waste and irradiated fuel	CSA N292.0 (2019)	The interim storage of L&ILW waste complies with the requirements in this CSA standard.
Management of low and intermediate-level radioactive waste	CSA N292.3 (2014)	The interim storage of L&ILW waste complies with the requirements in this CSA standard.

Table 2.11.b: Impact of the Construction and Operation of the PCSS on PWMF's Waste Management Licensing Basis Documents

OPG Waste Management Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Operation of the PCSS
Segregation and Handling of Radioactive Waste	N-PROC-RA-0017	No Change
Management of Waste and Other Environmentally Regulated Materials	OPG-STD-0156	No Change
Nuclear Waste Management	W-PROG-WM-0001	No Change
Radiation Protection	N-PROG-RA-0013	No Change

2.11.2 Decommissioning Plan

Licence Condition 11.2 states “*the licensee shall maintain a decommissioning plan*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.11.c List of Decommissioning Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
Decommissioning	REGDOC-2.11.2 (2021)	The PWMF Preliminary Decommissioning Plan (PDP) will comply to these requirements and reflect implementation of these requirements.
Decommissioning of facilities containing nuclear substances	CSA N294-19 (2019)	The PWMF PDP complies to these requirements.

Table 2.11.d: Impact of the Construction and Operation of the PCSS on PWMF's Decommissioning Licensing Basis Documents

OPG Waste Management Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Operation of the PCSS
Decommissioning Program	W-PROG-WM-0003	No Change.
Preliminary Decommissioning Plan Pickering Waste Management Facility	92896-PLAN-00960-00001	PWMF PDP updates for the PCSS will be included for the submission of the 2027 Financial Guarantee in accordance with RegDoc 2.11.2.

2.11.3 Preliminary Decommissioning Plan

A PDP, 92896-PLAN-00960-00001, "*Preliminary Decommissioning Plan – Pickering Waste Management Facility*" is in place for the PWMF. The PWMF PDP complies with regulatory requirements of CSA N294-19, "*Decommissioning of Facilities Containing Nuclear Substances*". The PDP is updated every 5 years, with the next update scheduled for submission to CNSC staff in 2027. The next PDP update will reflect the implementation of REGDOC-2.11.2, "*Decommissioning*" and the addition of the PCSS.

As per the requirements in LC 11.2, OPG is required to maintain annual financial guarantee for the decommissioning of OPG Class 1 facilities, including the PWMF, in accordance with CNSC REGDOC-3.3.1, "*Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities*". Decommissioning cost estimates in support of the OPG Financial Guarantees (FG) are updated on a five-year cycle in accordance with CNSC REGDOC-2.11.2, CNSC REGDOC-3.3.1, and CSA Guide N294. The financial impact related to the PCSS will be included in the next 2027 FG submission associated with the updated PDP.

2.12 Security

2.12.1 Security Program

Licence Condition 12.1 states "*the licensee shall implement and maintain a security program*" and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

2.12.a: List of Security Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
Nuclear Security Regulations	SOR/2000-209	Continued compliance
Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical, and Psychological Fitness	REGDOC-2.2.4 (2018)	Continued compliance.
High Security Facilities, Volume II: Criteria for Nuclear Security Systems and Devices	REGDOC-2.12.1 (2018)	Continued compliance.
Site Access Security Clearance	REGDOC- 2.12.2 (2013)	Continued compliance.

2.12.b: Impact from the Construction and Operation of the PCSS on PWF's Security Program Licensing Basis Documents

OPG Security Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Operation of the PCSS
Pickering Waste Management Facility Phase II Security Report	92896-REP-08160-00001	No Change
Pickering Waste Management Facility Security Report Addendum	92896-REP-08160-00001 ADD 001	No Change
Nuclear Security	N-PROG-RA-0011	No Change
Cyber Security	N-PROC-RA-0135	No Change
Nuclear Waste Management Cyber Essential Assets	W-LIST-08161-00001	No Change

2.12.2 Facilities and Equipment

The construction and operation of the PCSS will not require changes to security related facilities or equipment because it will be storing L&ILW.

2.12.3 Response Arrangements

The construction and operation of the PCSS will not require changes to security response arrangements or processes.

2.12.4 Construction

Licence Condition 12.2 states “*The licensee shall not carry out the activities referred to in paragraph (iii) of Part IV of this licence that relate to completed construction activities in paragraph (iv) of Part IV of this licence until the submission of the proposed security arrangements and measures for the new building, or any potential modifications to the protected area that may be associated with this new building, that is acceptable to the Commission or a person authorized by the Commission.*”

The construction of the PCSS will not require security arrangements, measures, or modifications to the protected area.

2.13 Safeguards and Non-Proliferation

2.13.1 Safeguards Program

Licence Condition 13.1 states “*the licensee shall implement and maintain a safeguards program*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.13.a: List of Safeguards and Non-Proliferation Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
Safeguards and Nuclear Material Accountancy	CNSC REGDOC-2.13.1 (2018)	Continued compliance

Table 2.13.b: Impact from the Construction and Operation of the PCSS on PWMF's Safeguards Program Licensing Basis Documents

OPG Safeguards and Non- Proliferation Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Operation of the PCSS
Safeguards and Nuclear Material Accountancy	N-PROG-RA-0015	No Change
Safeguards and Nuclear Material Accountancy Implementation	N-STD-RA-0024	No Change

2.14 Packaging and Transport

2.14.1 Packaging and Transport Program

Licence Condition 14.1 states “*the licensee shall maintain a packaging and transport program*” and the details in the PWMF LCH outline the regulatory requirements. The information provided in the last PWMF licence renewal application is still valid (Reference 2-1).

Table 2.14: Impact from the Construction and Operation of the PCSS and storage of L&ILW on PWF's Packaging and Transport Licensing Basis Documents

OPG Transportation and Packaging Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Operation of the PCSS
Radioactive Material Transportation	W-PROG-WM-0002	No Change
Radioactive Materials Transportation Emergency Response Plan	N-STD-RA-0036	No Change
Radiation Protection	N-PROG-RA-0013	No Change

2.15 Facility Specific

2.15.1 Construction Plans

Licence Condition 15.1 states “*The licensee shall submit an environmental management plan, a construction verification plan and the project design requirements prior to the commencement of construction activities described in paragraph (iv) of Part IV of this licence.*”

Table 2.15: List of Construction Plans Related Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction of the PCSS
Fire protection for facilities that process, handle, or store nuclear substances	CSA N393-13	The PCSS design will adhere to these requirements.
NRC National Building Code of Canada (2015)	N/A	The PCSS design will adhere to the NRC National Building Code of Canada (2020) requirements.
NRC National Fire Code of Canada (2015)	N/A	The PCSS design will adhere to the NRC National Fire Code of Canada (2020) requirements.

The submission of environmental management plan, construction verification plan and design requirements will be provided to CNSC staff prior to the targeted commencement date of construction activities. This submission is tracked under REGM # 28267121.

2.15.2 Commissioning Report

Licence Condition 15.2 states “*The licensee shall not carry out the activities referred to in paragraph (ii) of Part IV of this licence that relate to completed construction activities in paragraph (iv) of Part IV of this licence until the submission of a commissioning report that is acceptable to the Commission or a person authorized by the Commission.*”

OPG shall not operate the PCSS until a commissioning report has been submitted that is acceptable to the Commission or a person authorized by the Commission.

The PCSS final commissioning report will be provided to CNSC staff for acceptance prior to the targeted operation date of the PCSS. This submission is tracked under REGM # 28267122.

3.0 Other Matters of Regulatory Interest

3.1 Public Information and Engagement

OPG believes in timely open and transparent communication to maintain positive and supportive relationships and confidence of key stakeholders. OPG's Corporate Relations and Communications organization adheres to the principles and process for external communications as governed by the nuclear standard N-STD-AS -0013, "*Nuclear Public Information and Disclosure*".

Table 3.1.a List of Public Information and Disclosure Related Regulatory Requirements

Licensing Basis Document Title	Document Number	Impact from the Construction and Operation of the PCSS
Public Information and Disclosure	REGDOC-3.2.1 (2018)	Continued compliance

Table 3.1.b Impact from the Construction and Operation of the PCSS on PWF's Public Information and Disclosure Licensing Basis Documents

OPG Transportation and Packaging Licensing Basis Document Title	OPG Document Number	Impact from the Construction and Operation of the PCSS
Nuclear Public Information and Disclosure	N-STD-AS-0013	No Change

OPG provides responses to issues and questions raised by stakeholders and the public, and tracks issues and questions to identify trends in order to further refine proactive communications. Two-way dialogue with community stakeholders and residents is facilitated through personal contact, community newsletters, speaking engagements, advertising, and educational outreach.

Through this regular outreach of an on-going nature, OPG continues to provide members of the public and interested parties with information regarding the activities carried out at the PWF.

3.2 Community Committees

The Pickering Community Advisory Council (CAC) is made up of citizens, representatives of non-government organizations and members of local government staff who examine a number of issues associated with the existing and future activities of the Pickering Nuclear site. The CAC assists Pickering NGS in identifying and responding effectively to the concerns of the community. The Council's purpose is to identify community issues and concerns and define the actions members believe will be required to continuously improve operations at the site and promote the well-being of the community, among other purposes. The Council's advice focuses on, but is not limited to, the effects of Pickering NGS operations on the environmental, health, safety, social and economic interests of the community.

In addition to the CAC, OPG has a representative on the Durham Nuclear Health Committee (DNHC). DNHC is a committee of Durham Regional Council chaired by the Region's Commissioner and Medical Officer of Health. The DNHC is a forum for discussing and addressing potential radiation and environmental human health impacts. OPG Nuclear staff make regular presentations to the DNHC on a variety of environmental, community outreach and operational issues.

3.3 Community Publications

OPG provides a community newsletter called "*Neighbours*" on a quarterly basis that is circulated by mail to residents throughout Durham Region (specific to the proximity of the respective nuclear power reactor stations). This provides an update of activities and events that occur at the respective stations.

This forum will be used as an opportunity to communicate and engage the public by providing updates on major OPG initiatives at Pickering NGS including PWMF.

3.4 Indigenous Engagement

OPG acknowledges the Aboriginal and Treaty Rights as recognized in the Constitution Act, 1982. Under its Indigenous Relations Policy, OPG regularly engages with Indigenous Nations and communities with established, asserted rights, and/or interests in the areas surrounding OPG operations.

OPG's Pickering NGS and PWMF are located on Williams Treaties First Nations (WTFN) traditional and Treaty Territory. Located in Pickering (just east of Toronto), it is one of the largest nuclear stations in the world and has been safely and reliably providing Ontario with electricity for decades.

OPG values the relationship it holds with the WTFN and remains committed to meaningful engagement with these Rights Holders. Rights Holders are defined as those who have signed treaties over the lands upon which the Pickering NGS is located. The team at the Pickering NGS and the PWMF have begun, and will continue to, engage with the WTFN. Other Indigenous Nations and communities who have an interest in its current nuclear operations and future projects, such as the PCSS will also be notified and engaged as necessary to respect the constitutionally protected rights and interests that exist. Through ongoing engagement, OPG will aim to identify concerns and thoughts on the future of the Pickering NGS and PWMF. Engagement will involve frequent dialogue and regular updates regarding ongoing operations, economic opportunities, and environmental monitoring activities, both general and technical.

A list of Indigenous Nations and communities OPG has or will be engaging with are provided below. WTFN are legally recognized as Treaty Rights Holders through the Williams Treaties settlement

process and continue to have Treaty Rights and interests with respect to OPG's waste operations at the PWMF:

- Williams Treaties First Nations - Rights Holders
 - Alderville First Nation
 - Curve Lake First Nation
 - Hiawatha First Nation
 - Mississaugas Scugog Island First Nation
 - Beausoleil First Nation
 - Georgina Island First Nation
 - Rama First Nation

The following Indigenous Nations and communities have expressed interest in OPG sharing information related to the PWMF:

- Six Nations of the Grand River
- Huron-Wendat Nation, Quebec
- Mohawks of the Bay of Quinte (MBQ)
- Métis Nation of Ontario Region 8

OPG has a long-standing and ongoing relationship with the WTFN and so, during Quarter 1 of 2024, meetings were held for the activities related to Pickering Nuclear site and engagement with the WTFN was focused on providing information regarding activities at the Pickering NGS and the PWMF. This included collaborating with the Nations on a draft Pickering Indigenous Engagement Plan (IEP), which will serve as a guide to discussions, engagement and involvement with regards to all developments at the Pickering NGS and the PWMF. The final working version of the IEP was shared with the Nations in May 2024. A subsequent kick-off workshop for WTFN was conducted to provide an overview of the activities including the PCSS and provided an opportunity for the Nations to give feedback, ask questions and voice concerns, as well to advance the opportunity for ongoing dialogue through collaboration on all aspects of the IEP outlined in an established Memorandum of Understanding (MOU).

OPG will continue to proactively engage the WTFN and all interested Indigenous Nations and communities through various activities such as staff briefings, community information sessions, written communication and/or workshops as outlined in the Pickering NGS IEP. The objective is to ensure there is an established forum for two-way dialogue with Indigenous Nations and communities around the PWMF which provides capacity support to discuss key topics of Indigenous interest related to the licence amendment application.

Over the course of the engagement activities, other Indigenous Nations and communities, not currently identified in the Pickering NGS IEP, may express interest in the Pickering NGS and the PWMF and OPG will work with the CNSC staff and the Indigenous Nation or community to determine a path forward. Furthermore, some Indigenous Nations and communities may determine they are not interested in further engagement on Pickering NGS and/or PWMF activities and OPG will respect their requests. These changes may be reflected in future revisions of the IEP.

4.0 Conclusion

The initiative to construct the PCSS that will store L&ILW components on an interim basis is essential for OPG to support the refurbishment of Pickering NGS Units 5 through 8 and decommissioning activities. OPG is requesting an amendment of the PWMF WFOL-W4-350.00/2028 to construct and operate the PCSS for interim storage of L&ILW generated at Pickering NGS.

OPG is responsible for continued safe operation of the PWMF and confirms that the construction and operation of the PCSS will be implemented based on a robust safety case. The proposed activities to support the construction and operation PCSS will not compromise continued safe operation at PWMF nor the public and employee safety, and environmental protection.

The safety case for this project can be summarized as follows:

- **Design:** OPG has and will continue to follow its Engineering Change Control process, as described in N-PROG-MP-0001, "*Engineering Change Control*", for ensuring the design complies with applicable regulatory requirements as defined in the LCH, LCH-W4-350.00/2028, and that configuration management will be maintained.
- **Continued Safe Operation:** The safety case, 92896-REP-01320-00019 R000, "*Pickering Component Storage Structure Safety Assessment*", provided as Enclosure 1 of this submission, demonstrates that the operation of the PCSS and storage of L&ILW components will have a negligible effect on the safe operation, public and worker safety.
- **Environmental Protection:** The predictive environmental risk assessment completed for PCSS, 92896-REP-00701-00019 R001, "*Predictive Environmental Risk Assessment for Pickering Component Storage Structure*", provided as Enclosure 2 of this submission, concludes that the construction and operation of the PCSS will have negligible impact on the environment.
- **Licensing Basis:** The construction and operation of the PCSS will have a negligible impact on PWMF's licensing basis, governance, programs, and processes. Attachment 1 of this submission provides the compliance matrix for the Nuclear Safety Control Act and associated regulations required for the amendment of the PWMF WFOL.

- References:**
- 2-1. OPG letter, K. Aggarwal to M. Leblanc, "Application for Renewal of Pickering Waste Management Facility Operating Licence," October 28, 2016, CD# 92896-CORR-00531-01031.
 - 2-2. CNSC letter, K. Campbell to K. Aggarwal, "OPG WMF – Discontinuation of Quarterly Operations Reports for OPG's Waste Management Facilities," May 3, 2024, e-Doc 7274580, CD# W-CORR-00531-02005.
 - 2-3. OPG letter, K. Nash to B. Belfadhel, "Pickering Waste Management Facility Phase II Project – Submission of Final Environmental Assessment Study Report," December 19, 2003, CD# 92896-CORR-00531-00205.

- 2-4. OPG letter, D. Patrick McNeil to T. Schaubel, "Pickering B Environmental Assessment (EA) for Proposed Refurbishment and Continued Operation - Submission of Final EA Study Report", December 17, 2007, CD# NK30-CORR-00531-04644.
- 2-5. OPG letter, J. Franke to R. Richardson, "Pickering NGS - Revised Environmental Risk Assessment Report for Pickering Safe Nuclear and OPG Responses to CNSC Comments", April 17, 2023, e-Doc 7021982, CD# P-CORR-00531-23186.
- 2-6. OPG letter, R. Lockwood to A. Viktorov, "Environmental Risk Assessment Report for Pickering Nuclear and Predictive Effects Assessment for Pickering Nuclear Safe Storage", April 28, 2017, e-Doc 5241174, CD# P-CORR-00531-04982.
- 2-7. OPG email, A. Khan to K. Klassen, "PWMF FP II Follow-up Plan," February 8, 2008, CD# 92896-CORR-00531-00972.
- 2-8. OPG Letter, H. Rambukkana to T. Kalindjian, "Pickering Waste Management Facility Quarterly Operations Report, Fourth Quarter and Annual Compliance Report for 2023," March 26, 2024, CD# 92896-CORR-00531-01502.

APPENDIX A

Proposed Amendment to PWMF WFOL-W4-350.00/2028

Current WFOL W4-350.00/2028	Requested Amendment to WFOL W4-350.00/2028 (Revised proposed amendment in bold and italic)
IV) LICENSED ACTIVITIES: This licence authorizes the licensee to: (i) operate the Pickering Waste Management Facility ("the facility") located at the Pickering Nuclear Generating Station, City of Pickering, Regional Municipality of Durham, Province of Ontario; (ii) possess, transfer, use, process, package, manage, and store nuclear substances that are required for, associated with or arise from the activities described in (i); (iii) transport Category II nuclear materials that are associated with the activities described in (i) on the site of the Pickering Nuclear Generating Station; (iv) carry out the site preparation, construction, or construction modifications at the facility associated with the authorized additional processing and storage buildings, when on completion will result in a total of no more than 1 dry storage container processing building and no more than 6 used fuel dry storage buildings; and, (v) possess and use prescribed equipment and prescribed information that are required for, associated with or arise from the activities described in (i), (ii), (iii), and (iv).	IV) LICENSED ACTIVITIES: This licence authorizes the licensee to: (i) operate the Pickering Waste Management Facility ("the facility") located at the Pickering Nuclear Generating Station, City of Pickering, Regional Municipality of Durham, Province of Ontario; (ii) possess, transfer, use, process, package, manage, and store nuclear substances that are required for, associated with or arise from the activities described in (i); (iii) transport Category II nuclear materials that are associated with the activities described in (i) on the site of the Pickering Nuclear Generating Station; (iv) carry out the site preparation, construction, or construction modifications at the facility associated with the authorized additional processing and storage buildings, when on completion will result in a total of no more than 1 dry storage container processing building and no more than 6 used fuel dry storage buildings; and, (v) possess and use prescribed equipment and prescribed information that are required for, associated with or arise from the activities described in (i), (ii), (iii), and (iv). <i>(vi) carry out the site preparation, construction, or construction modifications and operate the Pickering Component Storage Structure for interim storage of Low and Intermediate Level Waste from Pickering NGS.</i>

ENCLOSURE 1

OPG letter, K. Aggarwal to C. Salmon, "Pickering Waste Management Facility - Application for Waste Facility Operating Licence WFOL-W4-350.00/2028 Amendment to Construct and Operate the Pickering Component Storage Structure"

CD# 92896-CORR-00531-01544 P

Pickering Component Storage Structure Safety Assessment

92896-REP-01320-00019 R000

(119 total pages)

The following document is the Redacted Report of Pickering Component Storage Structure Safety Assessment (92896-REP-01320-00019-R000)

REPORT



PICKERING COMPONENT STORAGE STRUCTURE SAFETY ASSESSMENT

PV209/RP/0001 R01

March 18, 2024

Prepared for

Ontario Power Generation

Security Classification: Kinectrics Confidential

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Certification Statement

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1.0 Introduction

Ontario Power Generation (OPG) currently operates the Nuclear Sustainability Service Pickering Waste Management Facility (PWMF). The PWMF is composed of 2 sites. The PWMF Phase I site is located within the Pickering Nuclear Generating Station (PNGS) protected area, south-east of Pickering NGS Unit 8, adjacent to the east side of the station security fence [1]. The PWMF Phase II site is located approximately 500 m north-east of the site in the East Complex. The PWMF Phase I site consists of the following sub-facilities: Used Fuel Dry Storage for interim storage of Pickering used fuel in Dry Storage Containers (DSCs); and Retube Component Storage for interim storage of PNGS A irradiated reactor components in Dry Storage Modules (DSMs). The PWMF Phase II site contains a security kiosk, DSC Storage Buildings 3 and 4 and the site for additional DSC storage.

OPG is planning to construct the Pickering Component Storage Structure (PCSS) on the PWMF Phase II site directly to the northeast of SB3, and directly north of the future SB5. The PCSS will fall under the ownership of Pickering Waste Management. The structure will be used to support the refurbishment of Pickering B.

2.0 Objectives and Scope of Work

To support the construction of the PCSS, a safety assessment must be prepared, similar to what has been prepared for other waste storage buildings at the Pickering site. The assessment will consist of the following scopes of work:

1. Normal Operations Safety Assessment
2. Malfunctions/Accident Safety Assessment
3. ALARA Assessment

3.0 Safety Assessment Methodology

The methodology to be used for each piece of the safety assessment for the PCSS are outlined in the sub-sections below. The methodology used is informed by and consistent with OPG's Guideline For Safety Assessment [2].

3.1 Normal Operations Safety Assessment

3.1.1 Public Dose from Chronic Emissions

The emissions from the PWMF during normal operations and the doses to public were calculated recently [3]. In this work, the emissions from the expanded PWMF were evaluated based on the latest emission data for PWMF and the potential emissions from the PCSS taking into account the design of the PCSS. On this basis, it would be determined if the previous assessment sufficiently represented the radiological impact on public health resulting from the expanded PWMF.

3.1.2 Public and Worker Dose from External Gamma Radiation

An MCNP assessment was performed to calculate the external dose rates from the PCSS. This assessment followed the two stage MCNP calculation method outlined in the OPG reference methodology for heavily shielded containers [4]. The first stage is to generate a single container

surface source for each waste type and container using MCNP's surface source write function. The second stage is to use the surface sources generated for the waste containers to calculate a full site dose rate. OPG provided the MCNP model used to perform an analysis of the dose rates due to used fuel within SB 3, 4, and a conceptual layout for SB5 [5]. This model was used as the basis for the external dose calculations.

3.1.2.1 Single Container MCNP Models

For the first stage of this methodology, three single container MCNP models were developed:

- A Retube Waste Container (RWC) containing Pressure Tubes (PTs) or Calandria Tubes (CTs) or Calandria Tube Inserts (CTIs). This container is known as the RWC-PT
- An RWC containing End Fittings (known as an RWC-EF)
- A Pickering B Steam Generator (SG)

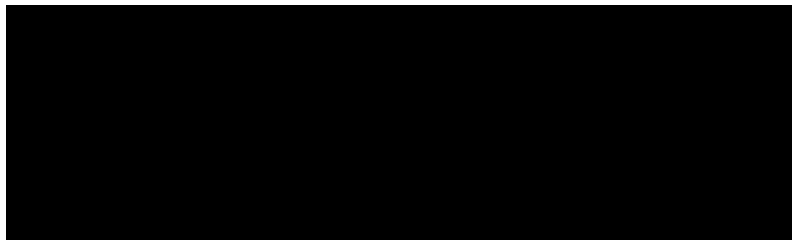
The models for the RWC-PT and SG were developed from scratch based on inputs provided by OPG. Only a single RWC-PT model was required to address the modelling of an RWC containing PTs, CTs, or CTIs since those containers all have the same dimensions and are assumed to produce dose rates at the Waste Acceptance Criteria (WAC). The model for the RWC-EF was provided by OPG from a shielding analysis of the preliminary design for the container described in Reference [6].

Source terms for each container type were developed and scaled to meet the WAC provided by OPG in the Task Order Request for this project [7]. Following the scaling, a surface source write run was performed in MCNP to create a surface source for use in full building calculations (stage 2 of the MCNP reference methodology).

RWC-PT Geometry

The dimensions assumed for the RWC-PT at the conceptual stage were provided by OPG in Reference [8]. The container was assumed to be a simple symmetric carbon steel box with dimensions as shown in Table 1.

Table 1: Dimensions for RWC-PT [8]

A large black rectangular box redacting the content of Table 1.

Unless otherwise noted, redactions are made according to exemptions from Freedom of Information and Protection of Privacy Act (FIPPA) S. 18 and Access to Information and Privacy (ATIP) S.13.

The MCNP model for this container was a straightforward box, as shown in Figure 1. The waste stored in the box was treated as a homogenous mass, as with other analysis of RWC-PTs from other OPG waste facilities [9], since the PTs and CTs stored in the container will be cut up and compacted into coupons and stored in the central cavity.

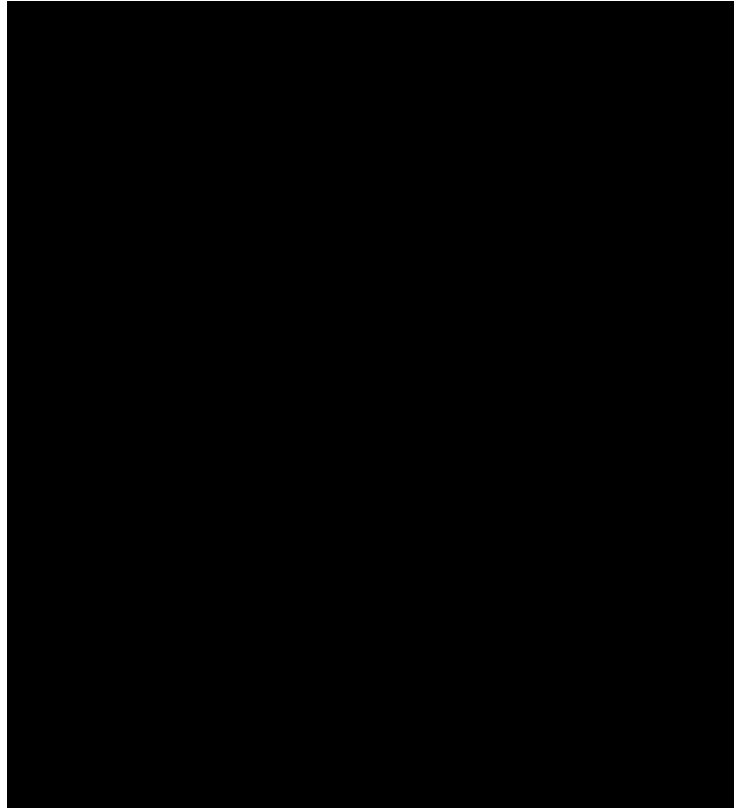


Figure 1: RWC-PT MCNP Model

RWC-EF Geometry

The MCNP model of the RWC-EF used in the shielding analysis for the conceptual design of the container in Reference [6] was provided by OPG. The geometry was left unchanged from the previous shielding analysis. [REDACTED]

[REDACTED], as shown in Figure 2.

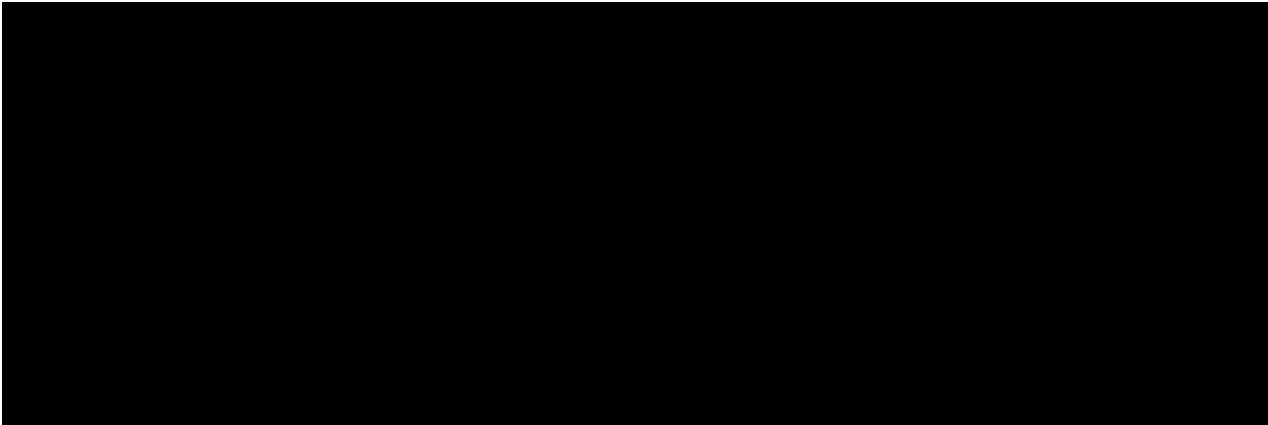


Figure 2: RWC-EF MCNP Model

Steam Generator Geometry

A simplified model of the SGs was created in MCNP based on the dimensions from the general arrangement drawing [10]. The SG is a complex assembly of thousands of tubes and plates. To simplify the modelling, a similar approach was taken as with previously modelled SGs from the

Western Waste Management Facility (WWMF) [9]. The major modelling simplifications were as follows:

- The main components modelled were the u-tube bundle, the tubesheet, the head drum, and the shell.
- The shell was assumed to have constant thickness, the thinnest dimensions available for thickness was used.
- The u-tube bundle was represented by a single homogenized cylinder with a spherical cap.
- The head drum components were modelled as a single homogenized cylinder.
- The tubesheet was modelled as a single homogenized cylinder.
- The gap between the u-tube bundle and the shroud was assumed to be 0.5 inches.
- The nozzles on the SG were not modelled. At the WWMF, metal plates were welded to the nozzles so that the dose emanating from the nozzles was not different than the rest of the SG body. It was assumed this will also be the case for Pickering B.

The geometry of the MCNP model of the Pickering B SG is shown in Figure 3.

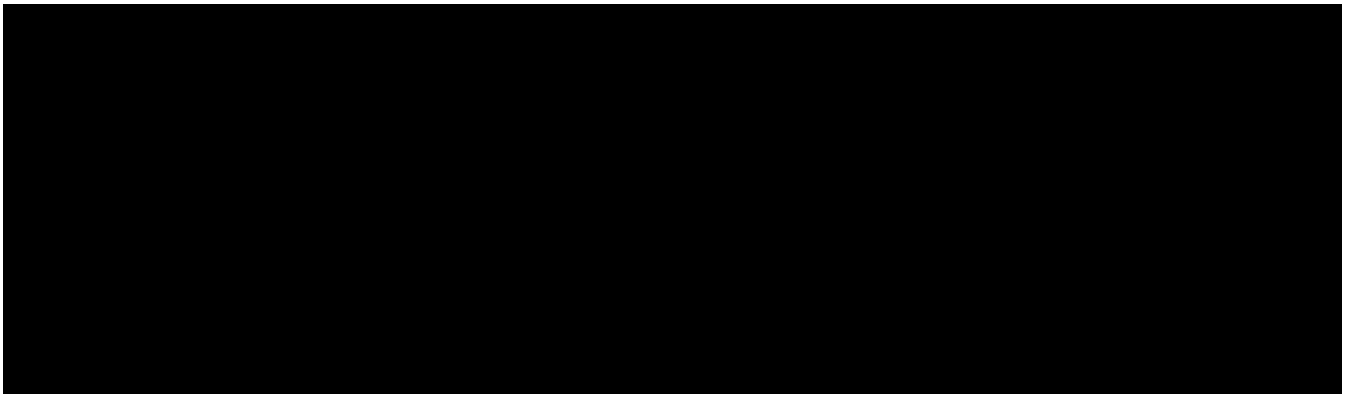


Figure 3: MCNP Model of Pickering B SG

Materials

A detailed description of the materials used in the single container MCNP models is provided in Appendix D.

Source Terms

The source activity of each waste container and SG was scaled to ensure that the dose rates around the containers were consistent with OPG's WAC. To do so, tallies were added at contact and at 1 m for each container.

OPG's Waste Acceptance Criteria are as follows:

- RWCs:
 - Case 1 – 200 mrem/h on contact and 10 mrem/h at 1 m
 - Case 2 – 200 mrem/h on contact, 20 mrem/h on the sides, 40 mrem/h on the top and bottom at 1 m

- SGs:
 - 40 mrem/h at 1 m

MCNP's surface source write (SSW) card was used to create surface source files for use in the full building calculations (stage 2 of the MCNP reference methodology). The details of the source for each container are outlined below.

RWC-PT Source Term

The source region for the RWC-PT was the entire homogenized PT/CT volume inside the container. As a simplifying assumption for the purpose of scaling the source strength to the WAC, the source spectrum was treated as entirely composed of Co-60. For Case 1, no source biasing was used, and the entire source was treated as homogenous. The source strength was scaled until the WAC was achieved at either contact or at 1 m.

For Case 2, to achieve a higher dose rate on the top and bottom, the source was biased towards the top and the bottom so that the ratio of dose rates at the side and the top was consistent with the WAC.

For the purpose of performing the source calibration, tallies were placed outside the container at the centre of each of the RWC's faces, at both contact (5 cm) and at 1 m.

RWC-EF Source Term

For the RWC-EF, the existing source used in the conceptual design shielding analysis of the RWC-EF was re-used. It is described in Section 2.3.3 of Reference [6]. The source for each component in the end fitting assembly was modelled explicitly. The only difference from the previous source term was that the source strength was scaled until the WAC was achieved at either contact or at 1 m.

For the purpose of performing the source calibration, tallies were placed outside the container, centered on each of the six sides of the container and placed at 5 cm and at 1 m from it. The tallies placed at 5 cm correspond to the contact point and were moved 5 cm from the container to avoid having a tally located at a boundary between two materials. For the bottom and the lid of the container, second dose points were added to confirm that the maximum dose rate was considered for the scaling.

Steam Generator Source Term

The source regions used in the SGs were the homogenized u-tube bundle, the tubesheet, and the homogenized head drum. As with the RWC-PT, the source spectrum was modelled as Co-60 and the strength was adjusted until the WAC was achieved.

For the purpose of performing the source calibration, tallies were placed outside the SG at 5 cm (corresponding to contact with the SG) and at 1 m from the SG shell side. A total of four dose points (two sets of two dose points) diametrically opposite were used to calibrate the source.

3.1.2.2 Full Building MCNP Calculations

The second stage of the MCNP calculations was performed by updating the previously prepared MCNP model of the PWMF, which was outlined in Reference [5]. This model of the PWMF included what's known as Phase II of the PWMF, including buildings SB3 and SB4, as well as the conceptual design for future building SB5. It did not include Phase I of the PWMF. The model was updated to include the PCSS as well as the RWC and SG container models described in Section 3.1.2.1 above.

As shown in Figure 4, the proposed location for the PCSS is directly to the northeast of SB3, and it will be directly north of the future SB5. The co-ordinates for the 4 corners of the PCSS were provided in email from OPG [11] and are also shown in Figure 4.

The distance from the proposed location for the PCSS to the northeast corner was then estimated by entering the building corner co-ordinates and measuring the distance to the northeast corner of SB3 using Google Earth. These distances were used to place the PCSS geometry in the MCNP model relative to the other buildings, as shown in Figure 5.

Label	X	Y	Lat	Long
PCSS	656385	4852755	43.811322	-79.0556
PCSS	656366	4852812	43.811839	-79.055817
PCSS	656418	4852829	43.811982	-79.055162
PCSS	656437	4852772	43.811466	-79.054946



Figure 4: Proposed Location of the PCSS [11]

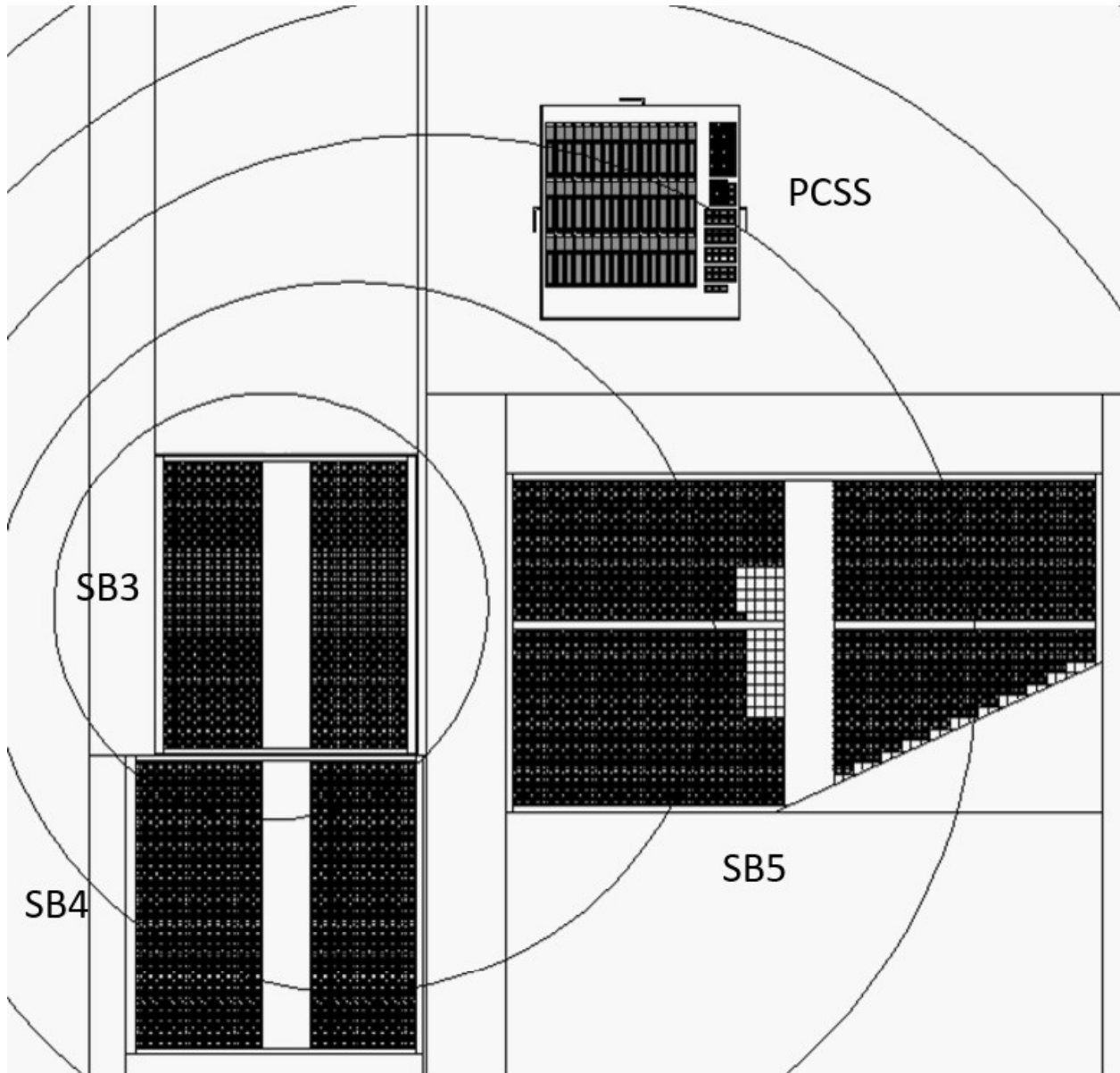


Figure 5: MCNP Model of PWMF with PCSS

The design of the PCSS is not complete. To aid OPG in evaluating different shielding design options, three configurations were considered for the analysis of the PCSS. The base case considered a PCSS design based on the Darlington Waste Management Facility (DWMF) Retube Waste Storage Building (RWSB), which has concrete shielding panels and an industrial roof [12]. Three sensitivity cases were then also considered. The first sensitivity case considered a building with a shielded roof, similar to the Steam Generator Storage Building (SGSB) at the WWMF [13]. The second sensitivity considered the same building design as the base case, but with additional shielding added to the area around the overhead door which serves as the main entry point for waste packages into the building. The purpose of adding this second sensitivity case was to demonstrate that with additional shielding around the door, the dose rates can be controlled As Low As Reasonably Achievable (ALARA). The last sensitivity case considered a reduced SG dose rate of 10 mrem/hr at a distance of 1 m. The geometry for

these cases is described below. For all cases, the geometry of SB3, SB4, and SB5 were left unchanged from the previously developed model described in Reference [5].

Base Case

The configuration of the PCSS considered in the base case was based on the DWMF RWSB. To do this, the wall and roof thicknesses for the PCSS were taken from the shielding analysis of the DWMF in Reference [12]. Concrete shielding panels with a thickness of [REDACTED] and a height of [REDACTED] were used around the entire building. Above the shielding panels, an industrial roof was modelled with [REDACTED] of rockwool insulation between a [REDACTED] steel sheet on the inside, and a 0.46 mm steel sheet on the outside. The floor of the building was modelled as 30 cm thick concrete. The total length of the building modelled was [REDACTED] and the total width modelled was [REDACTED]. These dimensions were calculated from the co-ordinates provided by OPG in Figure 4. As with the other buildings in the MCNP model of the PWSF, the area outside of the PCSS was modelled as dirt with no vegetation or gradient modelled.

The doors for the building were assumed to be similar to the RWSB. One personnel door was added to the centre of each of the north, west, and east walls. These personnel doors included a shielded labyrinth on the exterior of the building to reduce streaming through the unshielded door. An overhead door was added on south wall with an adjacent personnel door. No labyrinths were added to the south wall as it was assumed this would not be compatible with the loading of steam generators into the building. The personnel doors were modelled with a height of [REDACTED] and a width of [REDACTED]. The overhead door was modelled with a height of [REDACTED] and a width of [REDACTED]. The labyrinths were made of [REDACTED] thick concrete, the same as the shielding panels, and extended to a height of [REDACTED]. The geometry of the base case PCSS is shown in Figure 6.

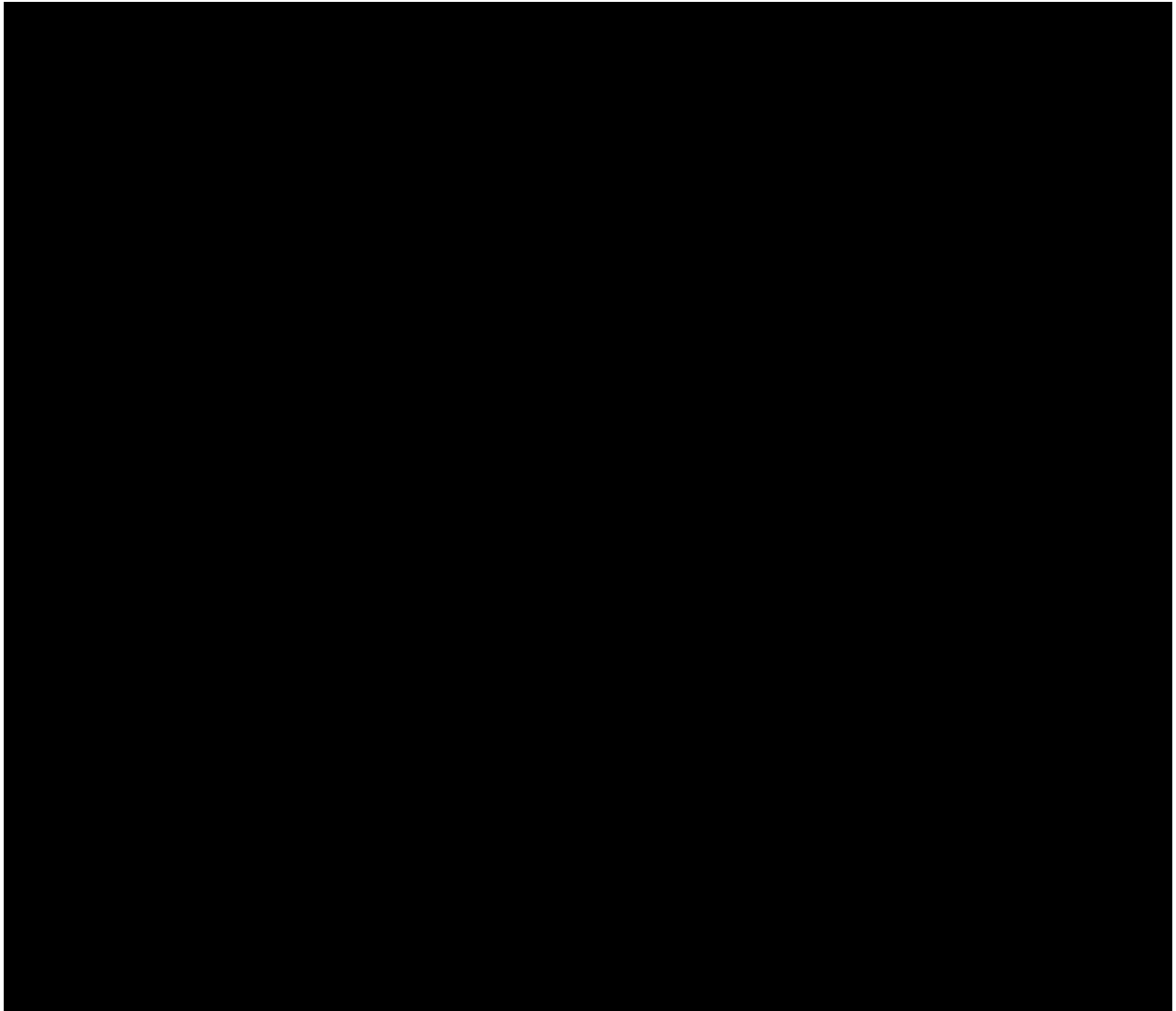


Figure 6: Geometry of PCSS, Base Case

Sensitivity 1: Shielded Roof

For the first sensitivity case, a PCSS with a shielded roof was considered. This configuration is based on the design of the SGSB and the WWMF. The shielding analysis of the SGSB in Reference [13] was used as the basis for the MCNP modelling of this sensitivity case. This configuration maintained the same PCSS dimensions, doors, labyrinths, and concrete shielding panel thickness [REDACTED] as the base case but extended them up to a height of [REDACTED]. The roof was modelled as [REDACTED] thick ordinary concrete. The shielded roof geometry for this sensitivity case is shown in Figure 7.

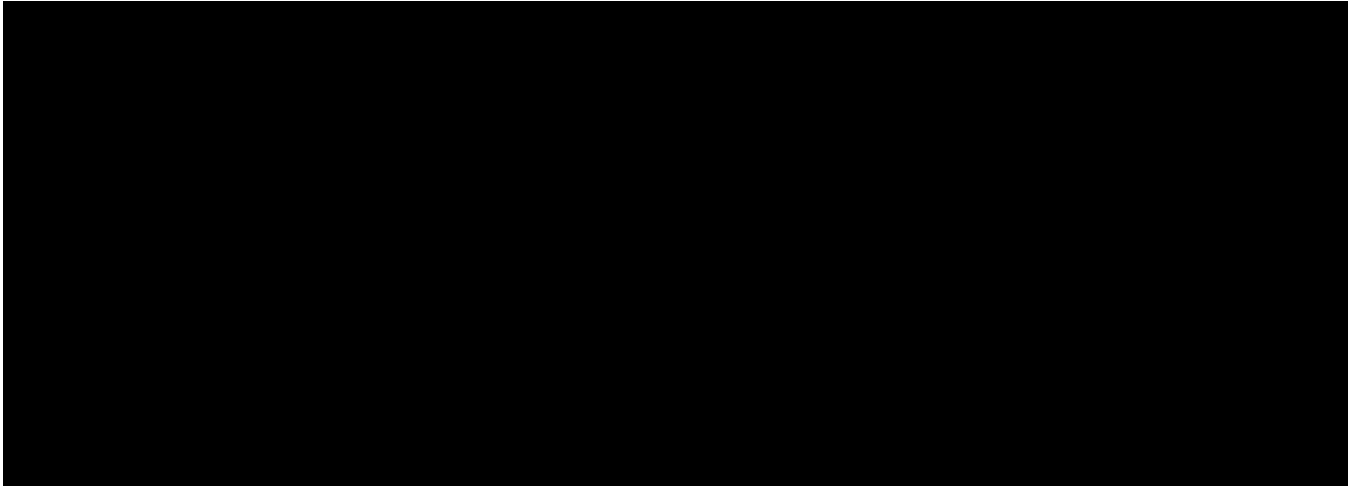


Figure 7: Shielded Roof Sensitivity Case Geometry

Sensitivity 2: Shielded Overhead Door

The second sensitivity case considered added shielding to the overhead and personnel doors. The shielding configuration considered was similar to a sensitivity case analyzed for the SGSB at the WWMF in Reference [14]. A concrete wall representing a temporary wall of 8" thick hollow cinder blocks (with an effective shielding thickness of 10.6 cm of concrete) was added 5 cm away from the overhead door. It extends 15 cm past the edge of the overhead and personnel doors and to a height of 555 cm. As with the base case, the industrial roof was considered for this case. The geometry of the shielding added to the overhead door is shown in Figure 8.

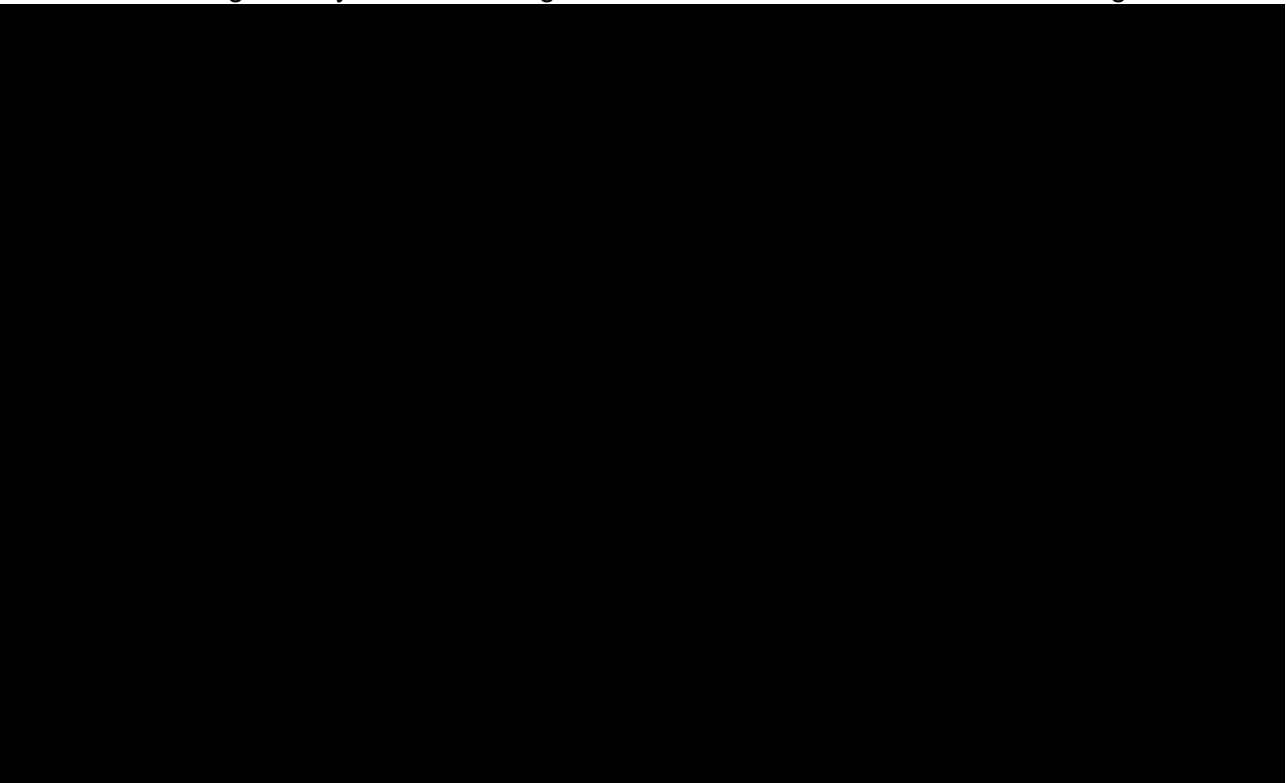


Figure 8: Geometry of Shielded Door Sensitivity Case

Sensitivity 3: 10 mrem/hr SG Dose Rate

The third sensitivity case considers an SG dose rate below the 40 mrem/hr at 1 m assumed in the base case and first two sensitivity cases. For this sensitivity case, the dose rate from the SGs was reduced to 10 mrem/hr at 1 m. This was achieved by dividing the MCNP results for the SG by a factor of 4, and keeping the uncertainty the same. This is mathematically equivalent to reducing the source strength within MCNP itself.

Materials

A detailed description of the materials used in the full building (PCSS) MCNP model is provided in Appendix D.

Layout of Waste Containers Within PCSS

The conceptual layout for the wastes stored in the PCSS was provided by OPG in Reference [15], which is shown in Figure 9. All waste containers were kept a minimum of 1 m from the walls of the PCSS. For the RWCs, a space of 50 cm in the north/south direction was kept between containers within the same group, and a space of 110 cm was kept between groups of containers. In the east/west direction, a space of 24 cm was kept between RWC-PTs, and a space of 30.935 cm kept between RWC-EFs. For the SGs, a separation of 14 cm between SGs was used in the east/west direction, and a separation of 10 cm was used in the north/south direction. The SGs were modelled as essentially laying on the ground (3 cm off the ground).

The number and location of containers was taken from Figure 9. The RWC-PTs were stacked 2 containers high, and the RWC-EFs were stacked 3 containers high. The only difference is that the conceptual layout shows a stack containing a single RWC-EF (labelled EF64 in the figure). For flexibility, it was assumed in the model that this would be a full 3-high stack of RWC-EFs. Therefore, the total number of containers included in the model were 66 RWC-EFs, 76 RWC-PTs (note that for the MCNP modelling, RWCs containing PT/CTs are not treated differently than those containing CTIs), and 48 SGs.

The MCNP surfaces and cells from the containers and SGs used to generate the surface sources in Section 3.1.2.1 were incorporated into the full building.

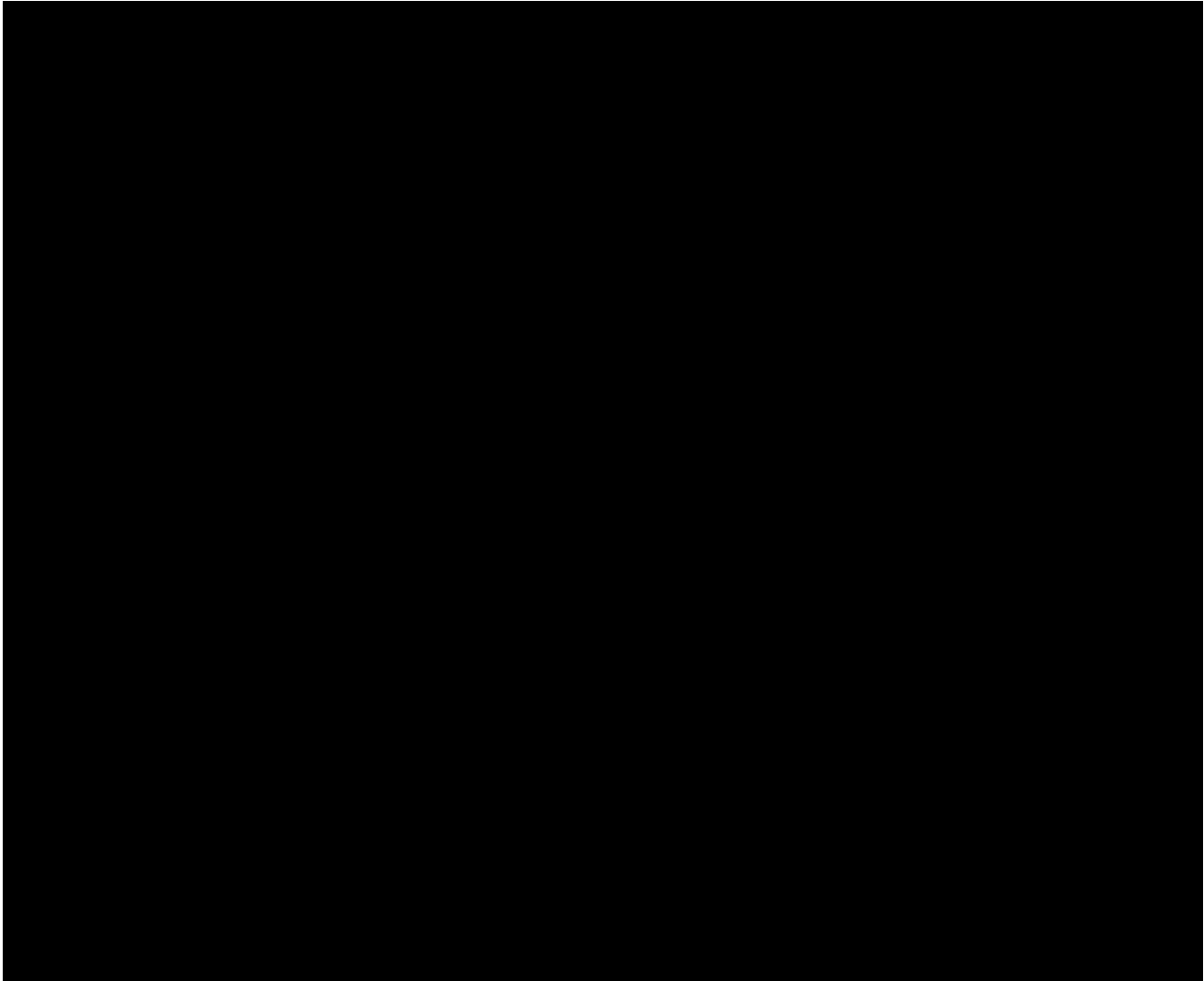


Figure 9: Conceptual Layout of Wastes within PCSS [15]

Other Buildings and Wastes

The models and layouts for SB3, SB4, SB5, and the DSCs within them were left unchanged from the previous MCNP model of the PWMF in Reference [5]. The DSC surface sources that were used in the current analysis were those generated in Reference [16].

Dose Points

The existing dose points from the previously developed model of the PWMF [5] were re-used for this analysis. The title and location of the main site dose points are shown in Figure 10. The dose acceptance criteria for these dose points are discussed in Section 3.4.

A new tally was added to the model for the purpose of determining where a facility fence might need to be located. This tally extended from 2 m south and 2 m west of the southwest corner of the PCSS to 50 m north and 50 east of the PCSS. This tally is shown schematically in Figure 11.

The previous model included many tallies, not all of which were needed for this analysis. They were left in the input files, however the main tallies of interest for this work are listed in Table 2. These include the site dose points, as well as the PCSS mesh tally, and the mesh tally which surrounds the dry storage buildings SB3/SB4/SB5, which is shown in Figure 12. The dose conversion factors that were used for each of the tallies are listed in Table 2, and these dose conversion factors are discussed in Section 3.1.2.4.

Table 2: Description of MCNP Tallies

Dose Point	Dose Conversion Factors	Description
PW10	ICRP 116 AP	1ft below TMB roof peak (height 41 ft above TMB floor)
PW24	ICRP 116 ROT	Montgomery Park Rd turnaround
PW26	ICRP 116 ROT	Bend in bike path northeast of PWMF Phase II
LS03	ICRP 116 ROT	Off shoreline
LS04	ICRP 116 ROT	Off shoreline
LS05	ICRP 116 ROT	Lake 282 m off shoreline
LS06	ICRP 116 ROT	Lake 144 m off shoreline
LS07	ICRP 116 ROT	Lake, where shoreline intersects with land site boundary
-	ICRP 116 AP	Mesh tally around SB3/SB4/SB5
-	ICRP 116 AP	Mesh tally around PCSS

*AP=Anterior-Posterior, ROT=Rotational



Figure 10: PWMF Site Dose Points

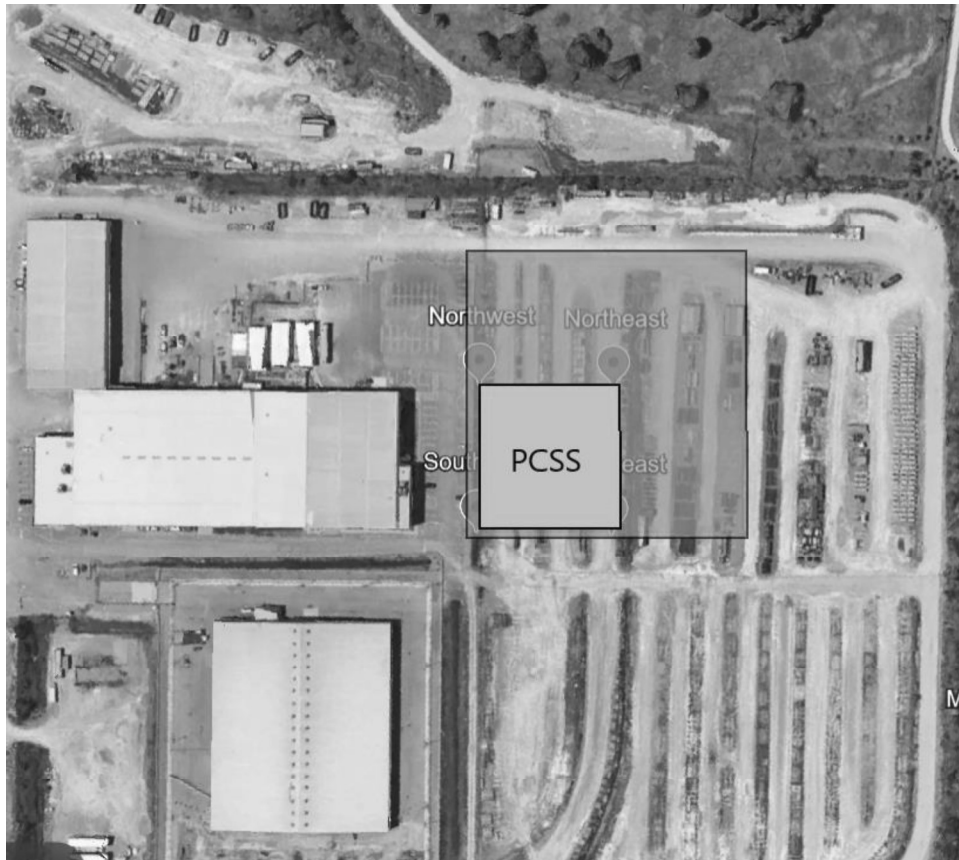


Figure 11: Mesh Tally Around PCSS



Figure 12: Mesh Tally Around SB3/SB4/SB5

3.1.2.3 Cross-Section Libraries

The cross-section libraries used in both the single container and full building MCNP calculations were those installed on the Kinectrics technical computing platform for use with MCNP. They rely primarily on the ENDF/B-VI R8 and ENDF/BVII.1 data libraries [17]. Consistent with the previous MCNP model of the PWMF site, the cross-section library used in this work was the MCLIB04 photon library, based on ENDF/B-VI cross sections.

3.1.2.4 Dose Conversion Factors

The Dose Conversion Factors (DCF) used in both the single container and full building MCNP calculations were the International Commission on Radiation Protection (ICRP) 116 Anterior-Posterior DCF [18] for the on-site tallies, and ICRP 116 Rotation DCF for the site boundary dose points. These are internationally recognized and accepted conversion factors and are specifically identified in the OPG reference methodology for heavily shielded containers [4].

3.2 Malfunctions/Accidents Safety Assessment

OPG guidelines for safety assessment in support of safety report updates for OPG waste facilities [2] were used for screening of potential accident scenarios, radionuclide inventory and release estimates, and dose assessment including public dose and worker dose resulting from malfunctions and accidents. REGDOC-2.4.4 [19] was adopted and applied in this assessment as well.

3.2.1 Hazard Identification, Screening and Classification of Bounding Accidents

Hazard screening of construction, transfer, handling and storage activities was carried out based on analysis of the activities involved, the characterization of the waste of concern (i.e., SG and RWCs), OPEX and the OPG internal hazard [20] and external hazard [21] screening guides. The following general steps will be performed as part of the hazard identification and screening process [2]:

- Perform hazard identification study,
- Pre-screening of internal and external hazards, and
- Detailed qualitative and quantitative event screening.

If the frequency of occurrence estimated for any postulated accident scenario is less than 10^{-6} events per year (refer to CSA N292.0:19 [22] and REGDOC-2.4.4 [19]), it is considered incredible and is not considered for further assessment.

The hazards include human induced hazards and external hazards. Transfer hazards from the station to the PCSS were considered.

As required by REGDOC-2.4.4 [19], the credible events will be classified into the following facility states:

- Anticipated Operational Occurrence (AOO),
- Design-Basis Accident (DBA), and
- Design Extension Conditions (DEC).

The frequency ranges of these states were as per Appendix C.2 of REGDOC-2.4.4 [19].

3.2.2 Radiological Releases

To calculate the radiological releases to the environment, estimates of the radionuclide inventories for SG and RWC are required:

- Inventories for SG: Gamma spectroscopy survey information from PNGS boilers with the secondary/primary side drained was taken into account to derive the source term for SG. Specifically, Co-60 activities from the gamma spectroscopy survey results for PNGS boilers were compared with the previous work [23] and the bounding value was used to determine the inventory of SG (refer to Table 4-9 of [23]).
- Inventories for RWC: Bounding fuel channel source terms was used to derive the source term for RWC, accounting for the total inventory in the RWC. Specifically, bounding inventories for the RWCs at WWMF was used (refer to Table 5-9 of Reference [23]) in this work. These source terms were derived for the WWMF which has similar reactor component materials and a similar container design, and were considered conservative and acceptable for PNGS.

The release fractions for airborne radionuclide releases of L&ILW were calculated using the following equation [2]¹:

$$\text{Airborne Source Term} = MAR \times DR \times ARF \times RF \times LPF$$

Where

MAR = Material-at-Risk (Bq),

DR = Damage Ratio,

ARF = Airborne Release Fraction (or Airborne Release Rate for continuous release),

RF = Respirable Fraction, and

LPF = Leak Path Factor.

The radionuclide releases are a product of the inventory and release fraction of the respective radionuclides. The ARF, RF, and LPF used will be similar to previous assessments from the WWMF.

3.2.3 Dose to Public from the Postulated Malfunctions/Accidents

ADDAM analysis was performed to calculate doses to public resulting from the airborne releases to the environment following accidents and malfunctions. The modelling was performed as follows:

- ADDAM input files for the bounding scenarios identified above were prepared. Specifically, the release activity data files were based on the analysis of source term generated above using the methods described above. The ADDAM dataset was based on that used in the previous PWMF assessment [3] with the exception of the meteorological data. The meteorological data used in Reference [3] was for the year 2021. That data is not compliant with the requirements of CSA N288.2 as it does not represent the most recent one-year period. Meteorological data for the Pickering site for

¹ Note the scaling factors used for ALARA assessment (refer to Section 3.3.2) were not applied here, which makes the source term estimate more conservative.

the period of 2017-2021 was recently prepared in Reference [24]. This data meets the requirements of CSA N288.2 and was therefore used for this assessment.

- The receptors selected for the dose assessment were those in all habitable sectors of interest including the site boundary and representative group locations defined in Environmental Monitoring Program (EMP) for Pickering site [3]. Specifically, the receptors selected were consistent with the previous work, that is, those identified in Reference [3].

The 95th percentile individual dose for an exposure period of 30 days was calculated, consistent with the recommendations of REGDOC-2.4.1 and CSA N288.2-19. Note in this work, the release duration was extended to 100 hours with a negligible, small tail representing 0.01% of the estimated release to avoid zero doses for some sectors due to infrequent wind directions and short duration release. This is aligned with the recommendations made in [25].

3.2.4 Dose to Workers from the Postulated Malfunctions/Accidents

The doses to workers resulting from exposure to radioactivity during the postulated accidents were calculated based on the bounding scenario identified. Three exposure pathways were considered, that is, inhalation which includes skin absorption, cloudshine (immersion) and groundshine. Excel spreadsheet calculations were carried out for dose calculations based on the assumed releases, exposure time, inhalation rate, and other parameters. The equations for the calculation of doses from these pathways were the same as those used in the previous update of the PWMF Safety Assessment [3] and are given below:

Dose from Inhalation:

$$D_{inhalation} = \sum_{n=1} (R_n \times BR \times sk_{a,n} \times DCF_{inhalation,n}) \times T/V$$

Where

$D_{inhalation}$ = worker dose from inhalation (Sv)

R_n = released activity of nuclide n during the exposure time (Bq)

BR = worker's inhalation rate (m³/s)

$sk_{a,n}$ = skin absorption factor for nuclide n ($sk_{a,n}$ = 1.5 for tritium as HTO and 1 for other radionuclides)

$DCF_{inhalation,n}$ = inhalation dose coefficient of nuclide n (Sv/Bq)

T = exposure time (s)

V = contaminated cloud volume (m³)

Dose from Cloudshine:

$$D_{cloudshine} = \sum_{n=1} (R_n \times DCF_{cloudshine,n}) \times T/V$$

Where

$D_{cloudshine}$ = worker dose from cloudshine (Sv)

$DCF_{cloudshine,n}$ = cloudshine dose coefficient of nuclide n (Sv-m³/(Bq-s))

Dose from Groundshine (if applicable):

$$D_{groundshine} = \sum_{n=1} (R_n \times DCF_{groundshine,n}) \times T/A$$

where

$D_{groundshine}$ = worker dose from groundshine (Sv)

$DCF_{groundshine,n}$ = groundshine dose coefficient of nuclide n (Sv-m²/(Bq-s))

A = area contamination (m²)

The total dose to workers was calculated as:

$$Total\ Dose = D_{inhalation} + D_{cloudshine} + D_{groundshine}$$

The estimated doses to workers were compared against the dose criteria specified in Section 3.4.

3.3 ALARA Assessment

The objective of the ALARA assessment was to:

- assess potential individual and collective doses to workers resulting from the placement of wastes into the preliminary waste storage configuration option shown in Figure 9.
- determine whether they comply with the regulatory limits, applicable OPG governance and PWMF licensing requirements.
- to provide recommendations to ensure that doses resulting from the chosen option are ALARA.

The individual and collective doses estimated refer to operations taking place at the PCSS. Doses incurred during the removal and transportation of waste to the PWMF were not included in this work, nor were doses incurred from waste segmentation. The task involved the estimation of potential individual and collective worker dose for the following cases:

- I. The handling and emplacing of one SG, one EF RWC, and one PT/CT/CTI RWC exclusive of surrounding waste packages (per the WAC);
- II. Handling and emplacing of all SGs, EF RWCs, and PT/CT/CTI RWCs.

It was assumed that the waste in the PCSS is the same regardless of whether the building will be used to support Pickering-B retube or decommissioning (i.e., only one ALARA assessment is performed).

It was also assumed that data from previous ALARA assessments for the WWMF and DWMF (such as transfer operations to be performed, durations, frequencies, personnel, etc.) can be used in the ALARA assessment for the PCSS.

Note that it was assumed that the SGs and RWCs are sealed prior to all transfer operations within the scope of this ALARA assessment. As such, internal uptakes are expected to be negligible and no accounting for internal doses (i.e., committed effective doses) was considered.

3.3.1 Container Dose vs. Distance Estimates

The ALARA assessment accounted for activities which take place at varying distances from the RWCs and SGs. It was therefore necessary to produce a rough estimate of the dose rate as a function of distance for each container type. This was done by creating a simplified MicroShield model for each container type. The gamma spectra was created using the radionuclide inventories for the limiting waste type (the same inventories outlined in Section 3.2.2). The dose rate for each container type was then scaled to the WAC for each container, and the dose rate was calculated at distances of contact, 30 cm, 1 m, and 5 m.

3.3.2 Dose Calculations

The external gamma dose received by workers, while storing SGs and RWC in the PCSS is determined by the average external gamma dose rate during the task multiplied by the exposure time for the task. A given task may be broken down to sub tasks so as to better approximate the distance and dose rates.

The individual dose for each task was calculated as follows:

$$Dose(mSv) = DoseRate(mSv \cdot h^{-1}) \times Exposure\ Time\ per\ task(h) \\ \times \# \text{ times task is conducted}$$

While most of the space inside the PCSS will be taken up by the 48 SG cartridges, these are anticipated to be emplaced after the RWCs.

The proposed RWCs layout is currently such that the RWC-EFs are stacked three high and the RWC-PT/CT/CTIs are stacked two high (see Figure 9). Only a small amount of PCSS space is to be taken-up by the 140 RWCs.

There are preparatory tasks prior to handling the package that result in minor exposures and these have been accounted for (e.g., starting-up the ventilation system, walkdown, inspection of forklift, etc.).

The tasks required for handling and emplacement result in more significant exposures, of course, and these are described below.

3.3.2.1 Retube Waste RWCs

The following steps are carried out in order to store 140 RWCs inside the PCSS.

- Receive and inspect the Pickering-B RWCs and confirm dose rates
- Remove tie-downs
- Perform contamination scan of the forklift and personnel prior to exit from PCSS

- Align Forklift and Remove RWC from Flatbed Truck
- Move RWC inside PCSS and Emplace at appropriate location

Note that, in the case of RWC- EFs, these will be stacked three high and the RWC-PT/CT and RWC-CTIs will be stacked two high.

3.3.2.2 SG Cartridges

The following steps are required to store singly-stacked SG cartridges inside the PCSS.

- Setting-up the rigging (gantry and track system) inside PCSS (see Figure 13);
- Receiving the 48 SG cartridges from the Pickering-B;
- Transferring SG cartridges on to the storage saddles inside the PCSS;



Figure 13: Gantry Crane

3.4 Dose Acceptance Criteria

The radiation safety requirements under normal operation of the PWMF are the following [1]:

- $\leq 0.5 \mu\text{Sv/h}$ outside the RCS and UFDS areas, on a quarterly average basis, based on the CNSC dose limit of 1 mSv per year for a member of the public, over a maximum of 2,000 hours per year occupancy for non-NEWs (Nuclear Energy Workers).
- For a member of the public, the dose constraint is $\leq 100 \mu\text{Sv}$ per year at the Pickering site boundary. This is an administrative dose target of ten percent of the CNSC dose limit of 1 mSv per year.
- For NEWs, the dose limit is 50 mSv in any single year and 100 mSv over 5 years.

The radiation requirements considered under a malfunction or credible accident scenario are the following [1]:

- For the public including non-NEWs, the dose limit at or beyond the OPG property boundary due to a malfunction/credible accident scenario shall be 1 mSv.
- For NEWs, the dose target for NEWs due to a malfunction/credible accident scenario shall be 50 mSv.

The criteria listed above apply to all events, including AOO, DBA or DEC.

The occupancy times for the site are assumed to be 2000 hr/year for dose points located on land, and 1000 hr/year for dose points located on Lake Ontario. The resulting acceptance criteria for each of the normal operation external gamma radiation dose points is outlined in Table 3.

Table 3: Dose Acceptance Criteria

Dose Points	Annual Dose Acceptance Criteria	Occupancy	Hourly Dose Acceptance Criteria
PW24, PW26	100 μ Sv/yr	2000 hr	0.05 μ Sv/hr
LS03, LS04, LS05, LS06, LS07	100 μ Sv/yr	1000 hr	0.1 μ Sv/hr
PW10, mesh tallies (outside of buildings)	1 mSv/yr	2000 hr	0.5 μ Sv/hr

The ALARA assessment considered the Exposure Control Levels (ECLs) and Administrative Dose Limits (ADLs) which are set in OPG procedure N-PROC-RA-0019 [26]. Adherence to these levels and limits maintains control on personal dose when working in a radioactive area. ECLs are set lower than ADLs to alert employees and supervisors that dose control measures are required to ensure the ADLs are not exceeded. ECLs and ADLs are presented in Table 4 and Table 5.

Table 4: OPG Exposure Control Levels

Organ or Tissue	Nuclear Energy Worker (NEW)	Pregnant NEW rem/balance of pregnancy	Nursing NEW rem/CY for balance of nursing	Non-NEWs (Public) (rem/CY)
Whole Body (Effective Dose) Including tritium committed dose	1 rem/CY	0.010	1 (no radioactive work with risk of tritium exposure or internal contamination is allowed)	0.010
Skin	25 rem/CY	N/A	25	N/A
Hands and Feet	25 rem/CY	N/A	25	N/A
Eye Lens	3 rem/CY	N/A	3	N/A

Table 5: OPG Administrative Dose Limits

	Whole Body Dose Limits in Ontario Power Generation (rem/CY)	
	Ontario Power Generation Employees	Contract and Building Trades Union Employees(1)
NEW	2	4
NEW with a lifetime Whole Body dose greater than 50 rem	1	N/A
Non-NEW	0.050	0.050
Whole Body Dose Limits (rem/rolling 5 CY)		
NEW	5	9

3.5 Use of Software

3.5.1. MCNP

The code that was used for the normal operation dose analysis was MCNP 6.1. MCNP is a general-purpose continuous energy Monte Carlo code that can be used for simulating photon and neutron transport phenomenon. MCNP is qualified for static calculations using k-code or source term methods for various CANDU-related analyses. It is a Grade 1 code based on Section 4.2 of the Kinectrics Software Qualification Procedure, AWI-4-30 [27]. It is qualified for use in radiation shielding applications, as documented in Reference [28]. MCNP 6.1 was used to model photon transport in this analysis, and MCNP 6.1 was found to be suitable for this application as per the code applicability report [29].

3.5.2. ADDAM

ADDAM-IST v1.4.2, the latest version of the ADDAM-IST code, was used in this work [30]. ADDAM is a safety analysis computer program developed by Atomic Energy of Canada Limited for use by the CANDU Owners Group community. ADDAM calculates doses to the public due to a postulated accident release of radioactive material to the atmosphere from a nuclear facility in the form of gases, vapours or particulates, taking into account the following processes:

- Plume rise;
- Downwash;
- Modification of effective height release due to building entrainment;
- Plume broadening due to building entrainment;
- Fumigation;
- Reflection at an elevated inversion;
- Plume transport;

- Plume diffusion;
- Wet deposition;
- Dry deposition;
- Plume depletion;
- Exposure to cloudshine;
- Exposure to groundshine;
- Internal exposure due to inhalation.

ADDAM calculates doses for various organs, age groups, and receptor locations, and are categorized by different release pathways including stack, inlet, leakage, or hole and different exposure pathways of inhalation, cloudshine, and groundshine. The calculations of atmospheric dispersion and doses were based on the CSA N288.2-M91 standard [31].

The ADDAM 1.4.2 qualification report [32] documents all qualification activities performed by CANDU Owner Group (COG) and concludes that ADDAM v1.4.2 is qualified for this work. A recent code assessment documented in Reference [33] has confirmed that ADDAM is also in compliance with CSA N288.2-14. Following the issue of the latest revision of the standard (CSA N288.2:19), an impact assessment of ADDAM against CSA N288.2:19 is currently being prepared under COG Work Package 50115. The code applicability for ADDAM for this work is summarized in the previous assessment [3].

3.5.3 MicroShield

The code used in the ALARA assessment was MicroShield 9.05 [34]. MicroShield is a general-purpose point-kernel code that can be used for simulating photon shielding problems. MicroShield is qualified for static calculations for various CANDU-related analyses. It is a Grade 3 code based on Section 4.2 of the Kinectrics Software Qualification Procedure, AWI-4-30 [27]. It is qualified for use in radiation shielding applications, as documented in Reference [35].

4.0 Key Technical Assumptions

Assumption #1

The only types of waste expected to be stored at the PCSS are steam generators and fuel channel components from the Pickering Nuclear Generating Station.

Basis/ Rationale: This is similar to the storage of retube and refurb components at both the Darlington and Western Waste Management Facilities.

Assumption #2

The geometry, materials, layouts, and DSC fuel decay times used in Reference [5] was assumed for the MCNP modelling of Storage Buildings 3/4/5.

Basis/ Rationale: This is the most recent MCNP dose rate assessment of the PWMF and should be used for consistency.

Assumption #3

For calculation of worker dose resulting from SG/RWC drop event, the worker was assumed to be present in the vicinity of the location where the accident occurs, wearing no Personal Protective Equipment (PPE). The worker's response time to leave the accident location under emergency back-out conditions was assumed to be 120

seconds. For the earthquake event, it is assumed that workers at the PWMF will be able to evacuate. Therefore, the dose consequence to the worker would be similar to the dose calculated for members of the public.

Basis/ Rationale: It is conservative and consistent with the existing PWMF Safety Report [1] and WWMF Safety Assessment [36].

Assumption #4

The radionuclides considered in the malfunction and accident assessment is consistent with the previous work [23].

Basis/Rationale: The previous work [23] represented the results of comprehensive study and the radionuclides in that work was considered representative.

Assumption #5

The SG radionuclide inventory was based on direct measurements and using calculated scaling factors based on the measured Co-60 activity, which was further compared with the scaling factor reported in other work [23] . Radionuclides were not estimated using scaling factors based on used fuel radionuclides inventories or predicted using fission product release and activation models.

Basis/Rationale: This approach is justified on the basis of the low scaling factors in Table A-2 of Reference [23], based on used fuel radionuclides inventories or predicted using fission product release and activation models.

Assumption #6

The activity scaling factor based on the ALARA assessment was not applied to source term estimates.

Basis/Rationale: The scaling factor based on the ALARA assessment reduces the waste inventory. Therefore, the results are more conservative without applying the scaling factor to the source term estimate.

Assumption #7

A Fire Hazard Assessment (FHA) for the PCSS was not prepared during the time frame of this project. The FHA report for similar storage buildings on another waste management facility [37] was used instead.

Basis/Rationale: An FHA report is required for the screening process for fire scenarios and any consequence assessment (dose calculation). The buildings at another waste management facility are of similar design and contain similar waste, ignition sources, etc. and so are expected to be similar to the eventual PCSS FHA.

Assumption #8

For the earthquake event, it is assumed that workers at the PWMF will be able to evacuate. Therefore, the dose consequence to the worker would be similar to the dose calculated for members of the public.

Basis/Rationale: This assumption is consistent with worker dose assessment for earthquake event for other waste management facility safety assessment [36].

Assumption #9

It is assumed that 50% of the PCSS is occupied by RWCs and only this portion of the PCSS was taken into account the calculation of cumulative aircraft crash frequency for

safety containers [38]. The crash frequency for the rest of the building used for the storage of SGs was calculated separately.

Basis/Rationale: Based on the arrangement of RWCs and SGs in the PCSS, RWCs will occupy less than 30% of the PCSS. Therefore, the assumption of 50% described above is conservative. In addition, the calculation of cumulative frequency only applies to safety related packages including DSCs, DSM and RWCs, which is consistent with other assessment [36].

5.0 Normal Operations Safety Assessment

5.1 Total Public Dose

The maximum individual dose to members of the public can be calculated by adding together the maximum individual dose from chronic releases which is $1.88\text{E-}03 \mu\text{Sv}$ per year (see Section 5.2), and the dose rate from external gamma radiation at the most conservative public dose point (PW26). As shown in Section 5.3.2 below, the dose rates calculated from external gamma radiation at PW26 for all cases except for the 10 mrem/h SG sensitivity cases with a shielded roof in Section 5.3.2.4, are above the acceptance criteria of $0.05 \mu\text{Sv/h}$ which equates to $100 \mu\text{Sv}$ per year (assuming 2,000h occupancy). The lowest dose rate from external gamma radiation calculated at PW26 was $0.0228 \mu\text{Sv/h}$ (Shielded Roof Case 1 - Sensitivity in Table 21), which equates to $45.6 \mu\text{Sv}$ per year. Therefore, the dose contribution from chronic releases is negligible compared to the dose contribution from external gamma radiation. The administrative dose target of $100 \mu\text{Sv}$ per year is exceeded due to the dose from external gamma radiation, except for the 10 mrem/h SG sensitivity cases with a shielded roof which are discussed in Section 5.3.2.4 .

5.2 Public Dose from Chronic Emissions

The chronic emissions from the PWMF during normal operations and the doses to public were calculated recently [3]. The locations of the receptors of concerns are shown in Figure 14 and Figure 15.

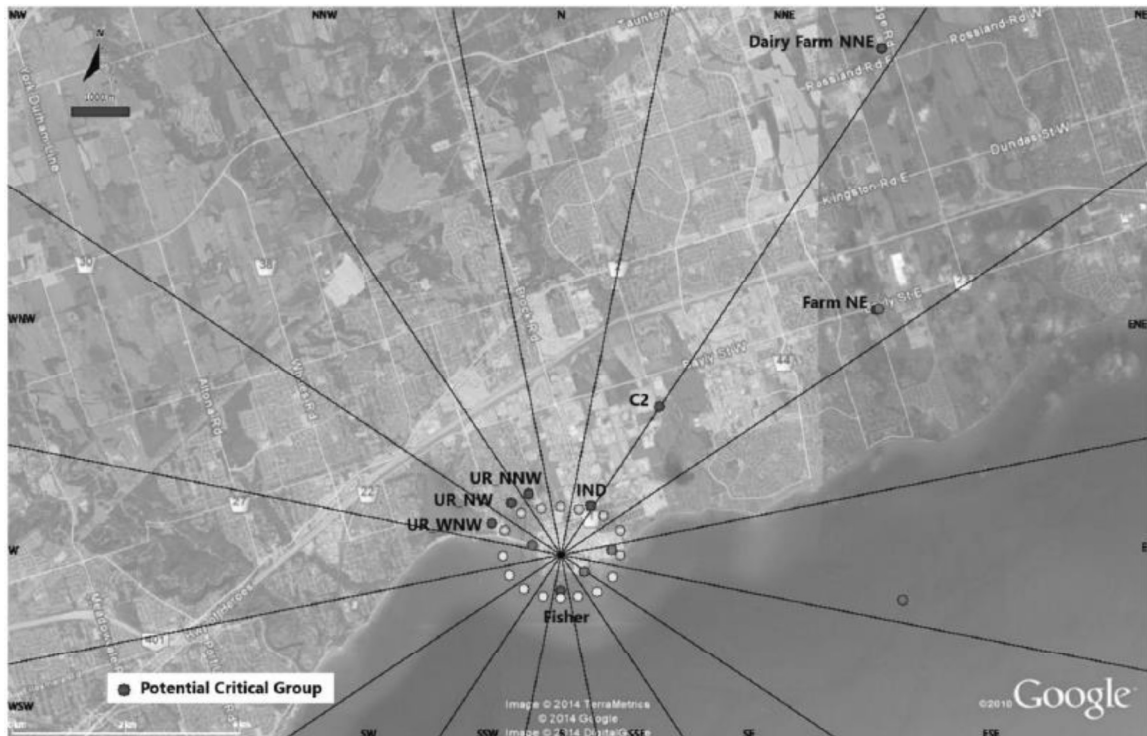


Figure 14: Locations of Representative Persons [3].

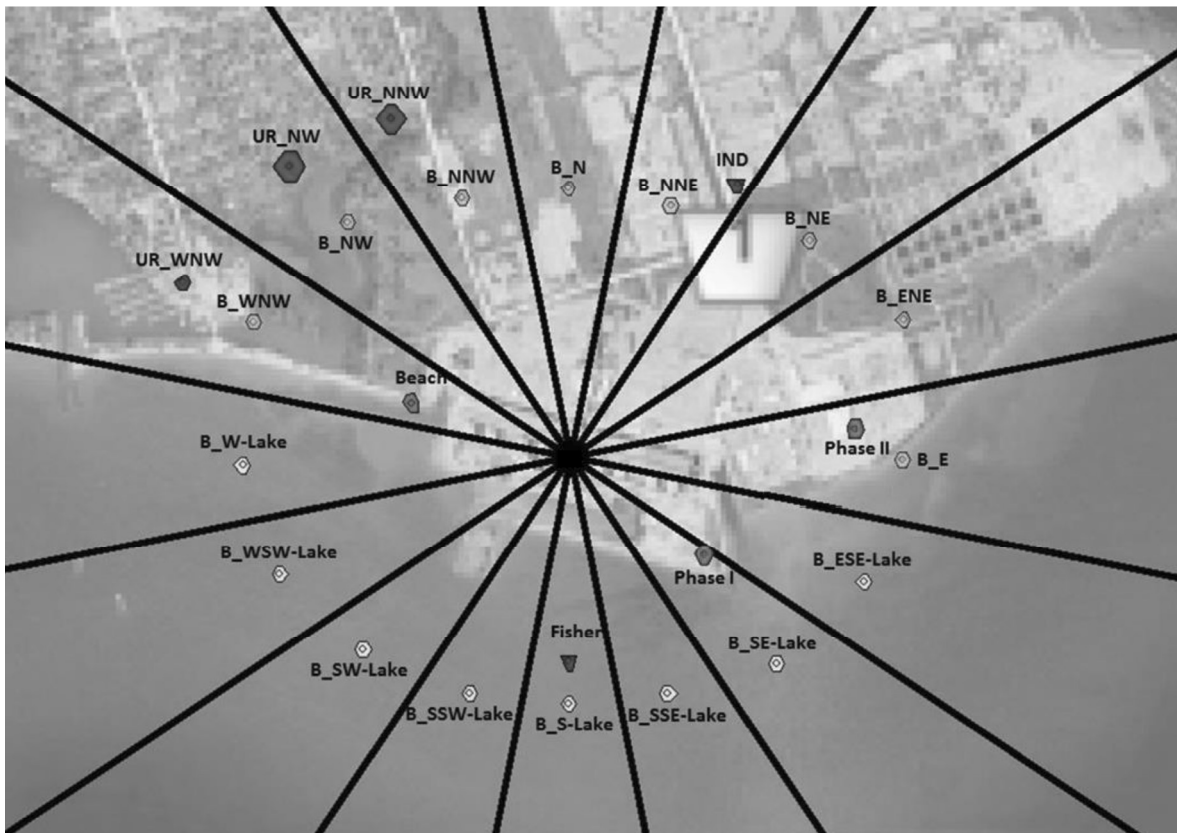


Figure 15: Locations of Representative Persons, Showing Details on Hypothetical Locations [3]

The dose calculation accounted for the following aspects:

- Update of chronic emission estimate to include the latest measurements.
- A revision of the IMPACT models to incorporate the latest meteorological data, representative persons, routine emission, and the latest code version.
- Incorporation of information from the DSC Storage Building (SB) 4 safety assessment [39].

The results are shown in Table 6 [3]. As shown in the table, the maximum individual dose at the landside receptor locations from chronic releases is 1.88E-03 μSv per year, which occurs for an infant at the dairy farm group, NNE from the PWMF facility. The maximum individual dose at the lakeside receptor locations from chronic releases is 1.00E-03 μSv per year for a child, which occurs at the hypothetical receptor location at SSE direction from the PWMF. These doses are both less than the administrative dose target of 100 μSv per year as discussed in Section 3.4.

Table 6: Public Dose during Normal Operation of PWMF [3]

Location	Annual individual dose ($\mu\text{Sv/a}$)		
	Adult	Child	Infant
B_E	4.63E-04	5.29E-04	4.51E-04
B_ENE	2.19E-04	2.49E-04	2.17E-04
B_NE	1.65E-04	1.87E-04	1.66E-04
B_NNE	5.84E-05	6.63E-05	5.80E-05
B_N	7.49E-05	8.48E-05	7.51E-05
B_NNW	9.15E-05	1.03E-04	9.35E-05
B_NW	9.97E-05	1.11E-04	1.04E-04
B_WNW	1.20E-04	1.33E-04	1.25E-04
B_W-Lake	4.51E-05	5.32E-05	4.03E-05
B_WSW-Lake	5.52E-05	6.51E-05	4.93E-05
B_SW-Lake	7.22E-05	8.51E-05	6.45E-05
B_SSW-Lake	1.35E-04	1.59E-04	1.21E-04
B_S-Lake	3.15E-04	3.72E-04	2.82E-04
B_SSE-Lake	8.51E-04	1.00E-03	7.60E-04
B_SE-Lake	7.53E-04	8.88E-04	6.72E-04
B_ESE-Lake	3.41E-04	4.02E-04	3.05E-04
Fisher	2.86E-05	3.37E-05	2.55E-05
C2	1.35E-04	1.52E-04	0.00E+00
IND	5.02E-05	0.00E+00	0.00E+00
UR_NNW	8.29E-04	8.66E-04	7.23E-04
UR_NW	9.15E-04	9.55E-04	8.05E-04
UR_WNW	1.06E-03	1.11E-03	9.40E-04
Dairy Farm NNE	1.21E-03	1.15E-03	1.88E-03
Farm NE	8.21E-04	5.24E-04	4.46E-04

It should be noted that the above dose calculations were based on the radiological emissions up to the end of 2021 taking into account the postulated releases during DSC processing and postulated releases from DSMs during storage. The releases in 2022 [40] [REDACTED] per year, were lower than 2021 values of [REDACTED] per year [41], which was further bounded by the historical emission value used in the assessment [3]. Also it is expected that there are no emissions from SB5 to be built within the PWMF area for the storage of DSCs [39]. Furthermore, the preliminary design of the PCSS is based on Steam Generator Storage Building (SGSB)/ Retube Component Storage Building (RCSB) at the WWMF and it is expected that there will be negligible releases to the air and water from PCSS under normal conditions. In addition, the characteristics of public receptors as described in 2022 assessment [3] is up to date. Given all these factors, the dose calculations performed in the previous assessment sufficiently represented the radiological impact on the public, taking into account the operation of the proposed PCSS. Therefore, no revision to public dose calculations is required at this time.

5.3 Public and Worker Dose from External Gamma Radiation

5.3.1 Single Container MCNP Dose Rates

The dose rates that were calculated using the single container MCNP models are discussed in the subsections below. These models were then used to generate the surface sources that were used for the full building calculations.

5.3.1.1 RWC-PT

The calibration for Case 1 and Case 2 are shown in

Table 7. For Case 1, the WAC was first achieved at the 1 m distance for the long side of the container. The 1 m dose rates were all generally much closer to the WAC than the contact dose rates. For Case 2, the WAC was also achieved first at 1 m. The ratio of 40 mrem/hr on top and bottom with 20 mrem/hr on the sides was achieved. After biasing the source towards the top and bottom of the container, the contact dose rates on the sides were quite low, in fact below the 1 m dose rate.

Table 7: Dose Rate Calibration for RWC-PTs

Dose Point	Case 1 Dose Rate (mrem/hr)	Uncertainty	Case 2 Dose Rate (mrem/hr)	Uncertainty
Short Side (5 cm)	20.384	2.13%	11.974	5.23%
Short Side (1 m)	8.4145	0.41%	20.016	0.67%
Long Side (5 cm)	21.074	1.53%	12.002	5.81%
Long Side (1 m)	10.099	0.29%	20.272	0.74%
Top (5 cm)	11.82	3.07%	188.95	2.51%
Top (1 m)	0.5874	0.72%	40.217	0.35%
Bottom (5 cm)	11.859	3.09%	185.84	1.22%
Bottom (1 m)	0.58895	0.55%	40.467	0.57%

5.3.1.2 RWC-EF

The RWC-EF source activity was scaled twice:

- To reach 200 mrem/h on contact and 10 mrem/h at 1 m (Case 1)
- To reach 200 mrem/h on contact, 20 mrem/h on the sides, 40 mrem/h on the top and bottom at 1 m (Case 2).

The limiting criterion for both cases was the dose rate at 1 m. The limiting criterion for both cases occurred at 1 m. The dose rates calculated before and after scaling for each case are described in Table 8.

Table 8: Summary of Dose Rates Calculated for RWC-EF

Tally description	Case 1			Case 2		
	Waste Acceptance Criteria (mrem/hr)	Dose rate (mrem/hr)	Relative error	Waste Acceptance Criteria (mrem/hr)	Dose rate (mrem/hr)	Relative error
Contact back edge lid	200	24.26	5.39%	200	48.75	5.39%
Contact front edge lid	200	24.17	4.62%	200	48.58	4.62%
Contact right edge lid	200	39.20	15.29%	200	78.78	15.29%
Contact left edge lid	200	35.28	14.29%	200	70.89	14.29%
Contact bottom	200	27.76	2.79%	200	55.78	2.79%
Contact bottom (second point)	200	4.68	12.65%	200	9.41	12.65%
Contact Top Lid	200	26.87	2.80%	200	54.00	2.80%
contact Top Lid (second point)	200	10.63	19.14%	200	21.36	19.14%
1m back edge lid	10	3.79	0.91%	20	7.62	0.91%
1m front edge lid	10	4.02	0.82%	20	8.08	0.82%
1m right edge lid	10	9.49	2.10%	20	19.06	2.10%
1m left edge lid	10	9.38	2.15%	20	18.84	2.15%
1m bottom	10	4.34	0.88%	40	8.71	0.88%
1m Top Lid	10	5.40	2.04%	40	10.85	2.04%

5.3.1.3 Steam Generators

SG source activity was scaled to reach 40 mrem/h at 1 m. The dose rates calculated at various dose points are described in Table 9.

Table 9: Summary of Dose Rates Calculated for SGs

Tally description	Waste Acceptance Criteria (mrem/hr)	Dose rate (mrem/hr)	relative error
Contact	/	1.11E+02	11.60%
1m	40	4.00E+01	0.49%
Contact - second point	/	9.14E+01	2.67%
1m - second point	40	3.95E+01	0.33%

5.3.2 Full Building MCNP Dose Rates

An MCNP run was performed for each source in the base case, as well as the two sensitivities. For each case, the total dose rate was calculated by summing the contributions from all sources. The results for the DSCs were only run for the base case and re-used for the three sensitivity cases. This assumes that the dose rates from the DSCs are not significantly impacted by the design of the PCSS, which is reasonable as the dose from the DSCs to the site dose points is dominated by skyshine, and the dose to the areas around the SBs and the PCSS are dominated by the nearby wastes. Detailed results are presented in the sub-sections below.

5.3.2.1 Base Case

The best estimate dose rates for the base case site dose points are shown in Table 10 and Table 11. As with the previous analyses of the PWMF site [5] [16], the dose rates were highest at site dose points PW10, PW24, and PW26 all located on the land near the waste storage buildings. The dose rates were lower at the lake dose points, which are further from the buildings.

The Steam Generators contribute around 80% of the dose rate to the land dose points, indicating that they are not only the major contributor of the PCSS wastes, but also exceed the dose rate of all the DSCs combined for the site dose points on the land. The SGs contributed a smaller fraction to the site dose points on the lake, however they still contributed more than all other sources combined.

As expected, the dose rates were higher for Case 2 where the RWC-EF and RWC-PT container dose rates were higher. However, as the SGs form such a large part of the overall dose rate, the difference in RWC dose rates from the two cases did not have a large overall impact on the dose rates.

Table 10: Base Case Best Estimate Dose Rates, Land Dose Points

Dose Point	Dose Rate (μSv/hr)					
	PW24	Error	PW26	Error	PW10 ²	Error
Acceptance Criteria	5.00E-02	-	5.00E-02	-	5.00E-01	-
Steam Generators	8.44E-02	2.9%	1.84E-01	2.0%	1.74E+00	4.1%
RWC-EF Case 1	7.69E-04	2.0%	2.39E-03	1.2%	3.92E-02	12.5%
RWC-PT Case 1	7.48E-04	4.3%	1.55E-03	1.8%	6.30E-02	4.1%
Base Case 1	1.05E-01	2.6%	1.97E-01	1.8%	2.07E+00	3.5%
RWC-EF Case 2	1.54E-03	2.0%	4.81E-03	1.2%	7.87E-02	12.5%
RWC-PT Case 2	4.54E-03	3.1%	9.21E-03	1.7%	1.97E-01	9.9%
Base Case 2	1.10E-01	2.5%	2.07E-01	1.8%	2.24E+00	3.3%

² The tally for PW10 was mistakenly removed from the cases for SB4 and SB5. The dose contributions for these buildings were taken from the previous calculations in Reference [5]. This was considered acceptable as the PCSS is not located between the buildings and the tally.

Table 11: Base Case Best Estimate Dose Rates, Lake Dose Points

Dose Point	Dose Rate (μSv/hr)									
	LS03	Error	LS04	Error	LS05	Error	LS06	Error	LS07	Error
Acceptance Criteria	1.00E-01	-	1.00E-01	-	1.00E-01	-	1.00E-01	-	1.00E-01	-
Steam Generators	3.15E-05	7.3%	4.16E-04	6.4%	3.42E-03	6.7%	9.60E-03	5.0%	2.80E-02	2.8%
RWC-EF Case 1	1.15E-06	8.8%	1.88E-05	5.0%	5.76E-05	4.1%	1.17E-04	3.9%	2.85E-04	2.4%
RWC-PT Case 1	7.45E-07	5.0%	8.35E-06	3.7%	4.37E-05	3.3%	1.06E-04	3.1%	2.36E-04	2.4%
Base Case 1	4.88E-05	4.8%	7.00E-04	3.9%	5.20E-03	4.4%	1.38E-02	4.9%	3.89E-02	2.1%
RWC-EF Case 2	2.32E-06	8.8%	3.77E-05	5.0%	1.16E-04	4.1%	2.35E-04	3.9%	5.73E-04	2.4%
RWC-PT Case 2	1.85E-06	9.5%	2.71E-05	6.3%	2.15E-04	6.1%	5.41E-04	5.3%	1.43E-03	2.9%
Base Case 2	5.11E-05	4.6%	7.37E-04	3.7%	5.43E-03	4.3%	1.44E-02	3.4%	4.04E-02	2.0%

As outlined in the OPG methodology for shielding analysis of thick walled waste containers [4], the dose rates were compared against the dose acceptance criteria after adding 2σ to the best estimate to account for code uncertainty. This is shown in Table 12. The dose acceptance criteria for the base case are exceeded for dose points PW24, PW26, and PW10. This was largely the result of the SGs, as they exceeded the dose rate acceptance criteria on their own, though for PW26 and PW10, the dose acceptance criteria was nearly exceeded without the SGs as well.

Table 12: Base Case Best Estimate + 2σ Dose Rates

Dose Point	PW24	PW26	LS03	LS04	LS05	LS06	LS07	PW10 ²
	Dose Rate (μSv/hr)							
Acceptance Criteria	5.00E-02	5.00E-02	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	5.00E-01
Base Case 1	1.11E-01	2.05E-01	5.35E-05	7.55E-04	5.67E-03	1.52E-02	4.05E-02	2.21E+00
Base Case 2	1.15E-01	2.15E-01	5.58E-05	7.93E-04	5.90E-03	1.54E-02	4.20E-02	2.39E+00

The dose rates around the buildings for Base Case 1 were also plotted for the purpose of planning access fence locations. These are shown in Figure 16 for the area around the PCSS and Figure 17 for the area around the used fuel dry storage buildings. As shown, the dose rate around the PCSS does not drop below the acceptance criterion for non-NEW worker access (0.5 μSv/hr) within 50 m of the building. Around the dry storage buildings, the proposed fence lines for the buildings (shown in Figure 10) would no longer be sufficient to meet the acceptance criterion. This is especially the case along the north fence line closest to the PCSS, which exceeds the criterion for its entire length.

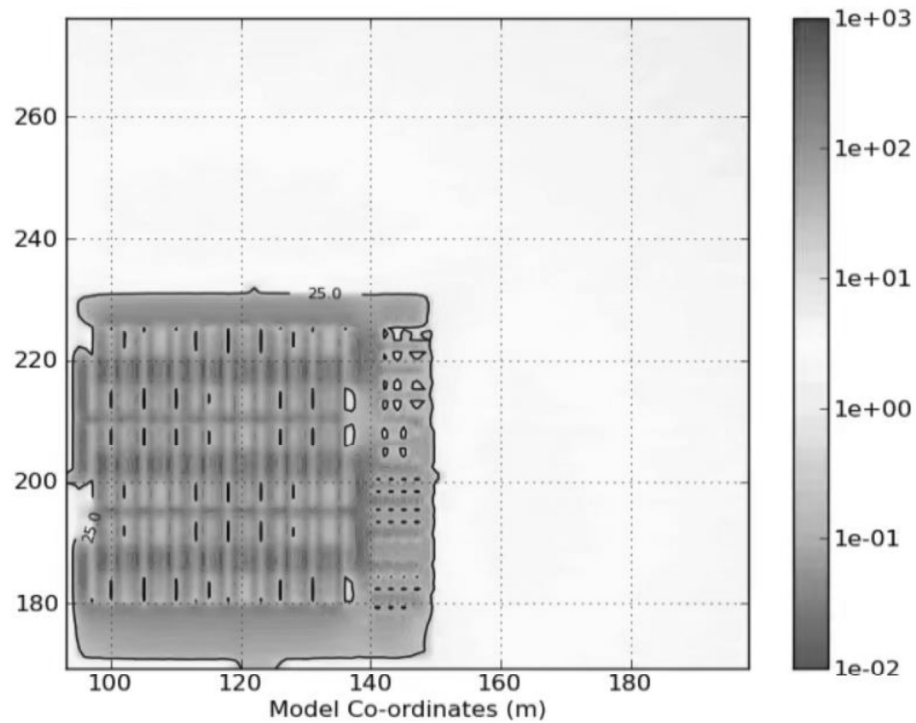


Figure 16: Base Case 1 Best Estimate Dose Rates ($\mu\text{Sv/hr}$) Around PCSS

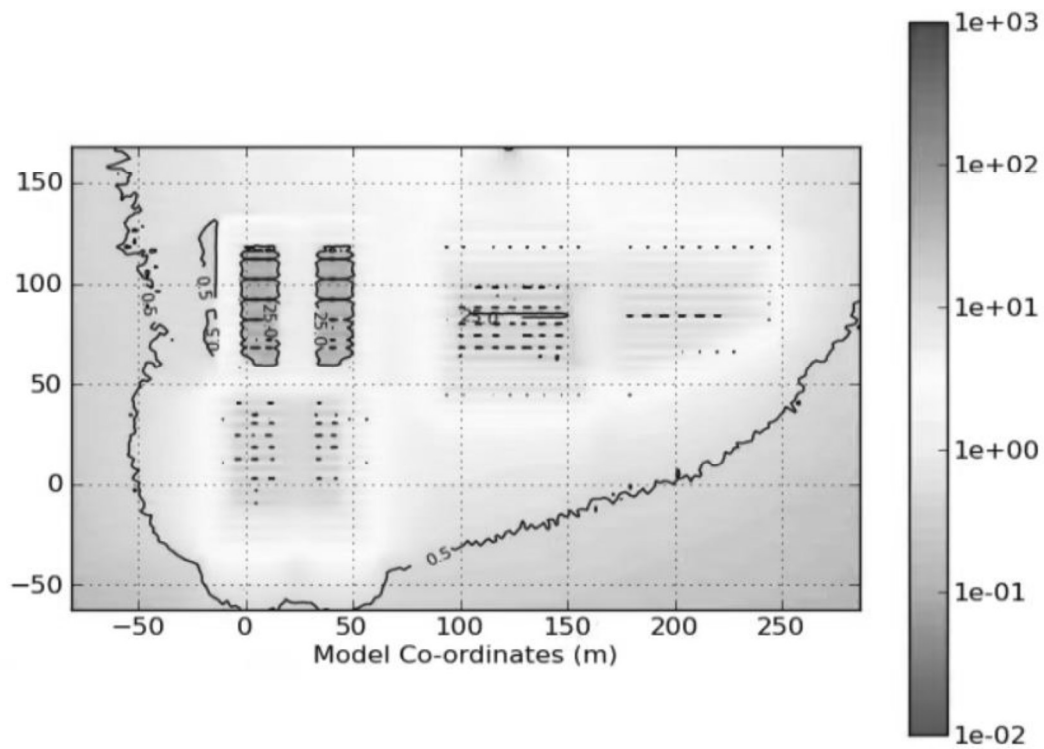


Figure 17: Base Case 1 Best Estimate Dose Rates ($\mu\text{Sv/hr}$) Around DSC Storage Buildings

5.3.2.2 Sensitivity 1: Shielded Roof

The best estimate door rates for the shielded roof cases are shown in Table 13 and Table 14. Compared to the base case, the shielded roof reduces the dose rates at the site dose points on the land by between 60-70%, and the lake dose points by 50-60%.

However, as shown in Table 15, the reduction in dose rate produced by the shielded roof is not enough to meet the acceptance criteria at all dose points. The dose rates at PW26 and PW10 both exceed the criteria.

Table 13: Shielded Roof Case Best Estimate Dose Rates, Land Dose Points

Dose Point	Dose Rate (µSv/hr)					
	PW24	Error	PW26	Error	PW10 ²	Error
Acceptance Criteria	5.00E-02	-	5.00E-02	-	5.00E-01	-
Steam Generators	1.92E-02	2.8%	4.53E-02	1.9%	5.03E-01	5.8%
RWC-EF Case 1	2.12E-04	4.7%	6.17E-04	2.2%	2.50E-03	7.3%
RWC-PT Case 1	2.68E-04	17.3%	3.49E-04	6.4%	2.49E-03	11.6%
Shielded Roof Case 1	3.88E-02	3.6%	5.62E-02	1.6%	7.38E-01	4.1%
RWC-EF Case 2	4.26E-04	4.7%	1.24E-03	2.2%	5.03E-03	7.3%
RWC-PT Case 2	1.33E-03	7.2%	2.83E-03	5.1%	1.97E-02	18.1%
Shielded Roof Case 2	4.01E-02	3.5%	5.93E-02	1.5%	7.57E-01	4.0%

Table 14: Shielded Roof Case Best Estimate Dose Rates, Lake Dose Points

Dose Point	Dose Rate (µSv/hr)									
	LS03	Error	LS04	Error	LS05	Error	LS06	Error	LS07	Error
Acceptance Criteria	1.00E-01	-	1.00E-01	-	1.00E-01	-	1.00E-01	-	1.00E-01	-
Steam Generators	5.78E-06	10.4%	8.72E-05	5.2%	7.51E-04	5.7%	2.24E-03	5.4%	6.38E-03	3.0%
RWC-EF Case 1	8.80E-08	27.3%	9.81E-07	14.3%	5.81E-06	5.7%	1.80E-05	6.4%	5.16E-05	4.5%
RWC-PT Case 1	7.19E-08	19.6%	8.73E-07	21.5%	4.86E-06	8.7%	1.40E-05	8.1%	4.80E-05	8.8%
Shielded Roof Case 1	2.14E-05	3.5%	3.45E-04	2.3%	2.45E-03	2.2%	6.29E-03	2.2%	1.69E-02	1.9%
RWC-EF Case 2	1.77E-07	27.3%	1.97E-06	14.3%	1.17E-05	5.7%	3.62E-05	6.4%	1.18E-04	3.8%
RWC-PT Case 2	2.77E-07	27.3%	5.40E-06	16.1%	3.52E-05	11.7%	1.14E-04	10.5%	4.30E-04	11.3%
Shielded Roof Case 2	2.17E-05	3.5%	3.51E-04	2.3%	2.48E-03	2.2%	6.41E-03	2.1%	1.73E-02	1.9%

Table 15: Shielded Roof Case Best Estimate + 2σ Dose Rates

Dose Point	PW24	PW26	LS03	LS04	LS05	LS06	LS07	PW10 ²
	Dose Rate (µSv/hr)							
Acceptance Criteria	5.00E-02	5.00E-02	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	5.00E-01
Shielded Roof Case 1	4.16E-02	5.79E-02	2.29E-05	3.61E-04	2.56E-03	6.57E-03	1.76E-02	7.97E-01
Shielded Roof Case 2	4.29E-02	6.11E-02	2.32E-05	3.67E-04	2.59E-03	6.69E-03	1.80E-02	8.18E-01

The addition of a shielded roof does reduce the distance required for access fencing around both the PCSS and the used fuel storage buildings. The fence around the PCSS would still have to extend more than 50 m from the north and east walls, but as shown in Figure 18, it is reduced compared to the base case.

As shown in Figure 19, around the used fuel storage buildings the shielded roof reduces dose rates below the acceptance criterion within the existing proposed fence lines to the west, south, and east of the storage buildings. However, the dose rates around the fence to the north of the storage buildings would exceed the criterion due to the dose contributions from the PCSS.

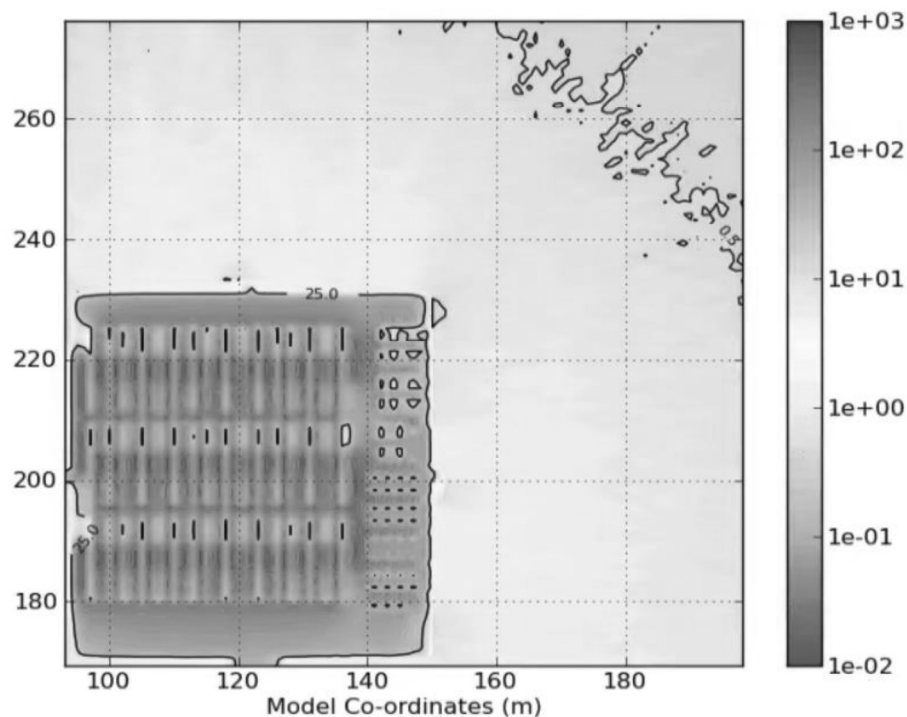


Figure 18: Shielded Roof Case 1 Best Estimate Dose Rates ($\mu\text{Sv/hr}$) Around PCSS

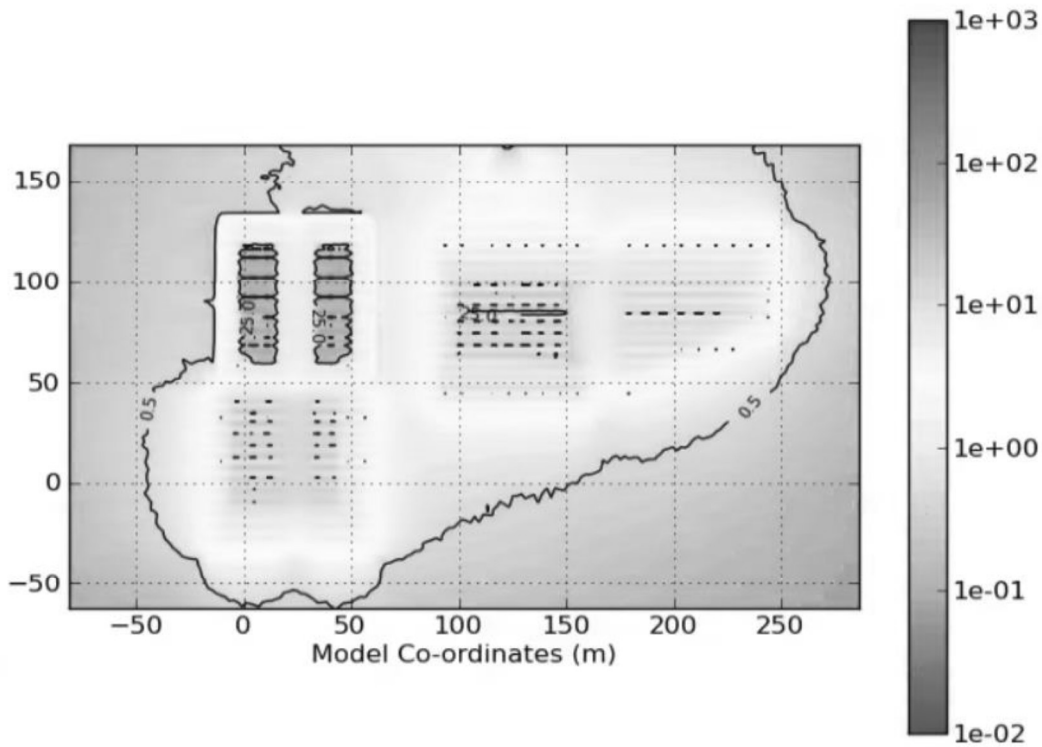


Figure 19: Shielded Roof Case 1 Best Estimate Dose Rates ($\mu\text{Sv/hr}$) Around DSC Storage Buildings

5.3.2.3 Sensitivity 2: Shielded Door

The best estimate dose rates for the shielded door case are shown in Table 16 and Table 17. At the site dose points, the dose rates from the shielded door case are very similar to the base case and are within the uncertainty of the calculation. This is to be expected since the main impact of the shielded door is to the areas immediately to the south of the PCSS around the overhead door.

As shown in Table 18, the same set of dose point exceed the acceptance criteria in the shielded door cases as the base case: PW24, PW26, and PW10, by the same margin.

Table 16: Shielded Door Case Best Estimate Dose Rates, Land Dose Points

Dose Point	Dose Rate ($\mu\text{Sv/hr}$)					
	PW24	Error	PW26	Error	PW10 ²	Error
Acceptance Criteria	5.00E-02	-	5.00E-02	-	5.00E-01	-
Steam Generators	9.38E-02	3.2%	1.89E-01	2.1%	1.97E+00	4.5%
RWC-EF Case 1	7.79E-04	2.0%	2.39E-03	1.2%	3.98E-02	15.0%
RWC-PT Case 1	6.64E-04	6.5%	1.54E-03	2.3%	6.93E-02	6.5%
Shielded Door Case 1	1.14E-01	2.8%	2.03E-01	1.9%	2.30E+00	3.9%
RWC-EF Case 2	1.56E-03	2.0%	4.81E-03	1.2%	7.99E-02	15.0%
RWC-PT Case 2	4.30E-03	5.1%	9.95E-03	4.2%	2.36E-01	14.6%
Shielded Door Case 2	1.19E-01	2.7%	2.13E-01	1.8%	2.51E+00	3.8%

Table 17: Shielded Door Case Best Estimate Dose Rates, Lake Dose Points

Dose Point	Dose Rate (µSv/hr)									
	LS03	Error	LS04	Error	LS05	Error	LS06	Error	LS07	Error
Acceptance Criteria	1.00E-01	-	1.00E-01	-	1.00E-01	-	1.00E-01	-	1.00E-01	-
Steam Generators	3.02E-05	8.2%	3.86E-04	4.4%	3.08E-03	3.7%	9.77E-03	3.6%	2.86E-02	2.5%
RWC-EF Case 1	1.14E-06	8.1%	1.81E-05	5.0%	5.65E-05	5.3%	1.15E-04	4.1%	2.83E-04	2.3%
RWC-PT Case 1	7.58E-07	7.2%	9.00E-06	8.2%	4.40E-05	5.4%	9.31E-05	4.1%	2.44E-04	3.5%
Shielded Door Case 1	4.76E-05	5.3%	6.69E-04	2.7%	4.86E-03	2.5%	1.40E-02	2.5%	3.95E-02	1.9%
RWC-EF Case 2	2.30E-06	8.1%	3.63E-05	5.0%	1.14E-04	5.3%	2.31E-04	4.1%	5.68E-04	2.3%
RWC-PT Case 2	1.79E-06	18.6%	3.10E-05	10.9%	1.95E-04	8.2%	5.47E-04	7.3%	1.45E-03	5.2%
Shielded Door Case 2	4.98E-05	5.1%	7.09E-04	2.6%	5.07E-03	2.4%	1.46E-02	2.4%	4.10E-02	1.9%

Table 18: Shielded Door Case Best Estimate + 2σ Dose Rates

Dose Point	PW24	PW26	LS03	LS04	LS05	LS06	LS07	PW10 ²
	Dose Rate (µSv/hr)							
Acceptance Criteria	5.00E-02	5.00E-02	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	5.00E-01
Shielded Door Case 1	1.21E-01	2.10E-01	5.26E-05	7.05E-04	5.10E-03	1.47E-02	4.11E-02	2.48E+00
Shielded Door Case 2	1.25E-01	2.21E-01	5.49E-05	7.46E-04	5.31E-03	1.53E-02	4.26E-02	2.70E+00

The primary impact of the shielded door is to the dose rates immediately to the south of the PCSS. As shown in both Figure 20 and Figure 21, the dose rates outside the PCSS overhead door are reduced compared to the base case. However, given the high overall dose rates from the PCSS, this local effect is not sufficient to reduce the dose rates on the proposed fence lines around the used fuel storage buildings below the acceptance.

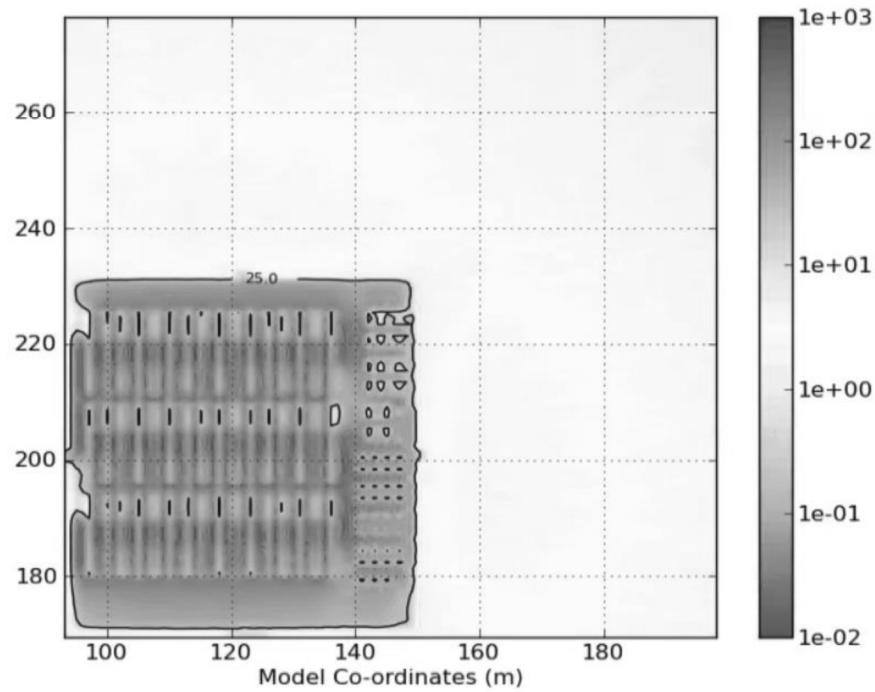


Figure 20: Shielded Door Case 1 Best Estimate Dose Rates ($\mu\text{Sv/hr}$) Around PCSS

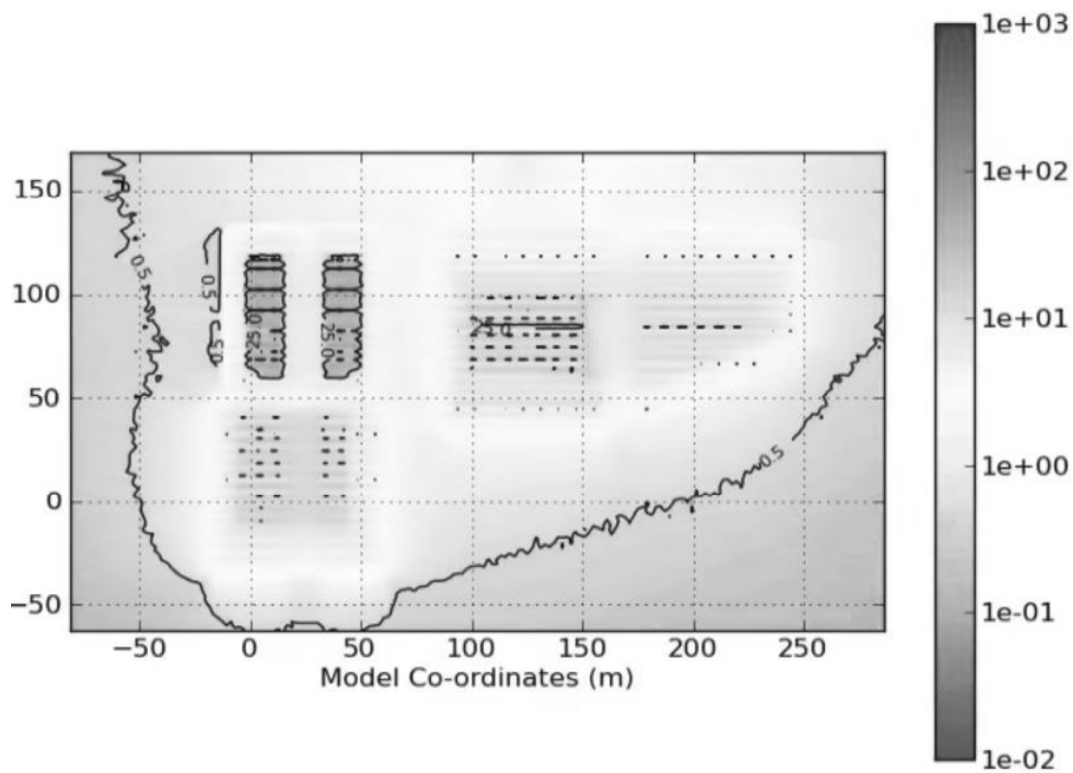


Figure 21: Shielded Door Case 1 Best Estimate Dose Rates ($\mu\text{Sv/hr}$) Around DSC Storage Buildings

5.3.2.4 Sensitivity 3: 10 mrem/hr SG Dose Rate

As described in Section 3.1.2.2, this sensitivity considers SG dose rates reduced from 40 mrem/hr at 1m to 10 mrem/hr at 1 m. The MCNP results for the SGs were reduced by a factor of 4 to achieve this change, while leaving the uncertainty for the SGs unchanged. This was done for the base case as well as the shielded roof and shielded door cases. The best estimate results for this sensitivity are shown in Table 19 and Table 20. The best estimate + 2 σ results are shown in Table 21. With the reduction in SG dose rate, the shielded roof cases have dose rates below the acceptance criteria at all dose points. Based on the ratio of dose rates observed between the dose points in Sensitivity 3 shielded roof case and the Sensitivity 1 shielded roof results from Section 5.3.2.2, the required fence line around the PCSS for Sensitivity 3 is estimated to be between 20m and 30m from the PCSS walls. The base case and the shielded door case however remain above the acceptance criteria at multiple points.

Table 19: 10 mrem/hr SG Sensitivity, Land Dose Points

Dose Point	Dose Rate ($\mu\text{Sv/hr}$)					
	PW24	Error	PW26	Error	PW10 ²	Error
Acceptance Criteria	5.00E-02	-	5.00E-02	-	5.00E-01	-
Base Case 1 – Sensitivity	4.17E-02	3.4%	5.98E-02	1.6%	7.66E-01	2.6%
Base Case 2 – Sensitivity	4.63E-02	3.1%	6.98E-02	1.4%	9.39E-01	3.1%
Shielded Roof Case 1 – Sensitivity	2.44E-02	5.4%	2.22E-02	1.4%	3.60E-01	2.9%
Shielded Roof Case 2 – Sensitivity	2.57E-02	5.1%	2.53E-02	1.1%	3.80E-01	2.1%
Shielded Door Case 1 – Sensitivity	4.40E-02	3.4%	6.10E-02	1.6%	8.29E-01	3.0%
Shielded Door Case 2 – Sensitivity	4.84E-02	3.1%	7.18E-02	1.5%	1.04E+00	4.2%

Table 20: 10 mrem/hr SG Sensitivity, Lake Dose Points

Dose Point	Dose Rate ($\mu\text{Sv/hr}$)									
	LS03	Error	LS04	Error	LS05	Error	LS06	Error	LS07	Error
Acceptance Criteria	1.00E-01	-	1.00E-01	-	1.00E-01	-	1.00E-01	-	1.00E-01	-
Base Case 1 - Sensitivity	2.52E-05	2.9%	3.87E-04	2.4%	2.64E-03	2.5%	6.65E-03	2.0%	1.79E-02	1.8%
Base Case 2 - Sensitivity	2.75E-05	2.8%	4.25E-04	2.3%	2.87E-03	2.4%	7.20E-03	1.9%	1.94E-02	1.7%
Shielded Roof Case 1 - Sensitivity	1.71E-05	2.8%	2.80E-04	2.4%	1.88E-03	1.9%	4.62E-03	1.5%	1.21E-02	2.3%
Shielded Roof Case 2 - Sensitivity	1.73E-05	2.6%	2.85E-04	2.3%	1.92E-03	1.8%	4.73E-03	1.3%	1.26E-02	2.2%
Shielded Door Case 1 - Sensitivity	2.49E-05	3.1%	3.80E-04	2.1%	2.55E-03	1.7%	6.68E-03	1.6%	1.81E-02	1.8%
Shielded Door Case 2 - Sensitivity	2.71E-05	3.2%	4.20E-04	2.1%	2.76E-03	1.7%	7.25E-03	1.6%	1.96E-02	1.7%

Table 21: 10 mrem/hr SG Sensitivity Best Estimate + 2σ Dose Rates

Dose Point	Dose Rate (μSv/hr)							
	PW24	PW26	LS03	LS04	LS05	LS06	LS07	PW10 ²
Acceptance Criteria	5.00E-02	5.00E-02	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	5.00E-01
Base Case 1 - Sensitivity	4.46E-02	6.16E-02	2.67E-05	4.06E-04	2.77E-03	6.92E-03	1.86E-02	8.06E-01
Base Case 2 - Sensitivity	4.92E-02	7.17E-02	2.90E-05	4.45E-04	3.01E-03	7.48E-03	2.01E-02	9.97E-01
Shielded Roof Case 1 - Sensitivity	2.70E-02	2.28E-02	1.80E-05	2.93E-04	1.96E-03	4.76E-03	1.27E-02	3.81E-01
Shielded Roof Case 2 - Sensitivity	2.83E-02	2.58E-02	1.83E-05	2.99E-04	1.99E-03	4.86E-03	1.31E-02	3.96E-01
Shielded Door Case 1 - Sensitivity	4.70E-02	6.30E-02	2.65E-05	3.96E-04	2.64E-03	6.89E-03	1.87E-02	8.79E-01
Shielded Door Case 2 - Sensitivity	5.14E-02	7.40E-02	2.88E-05	4.37E-04	2.86E-03	7.48E-03	2.02E-02	1.12E+00

5.3.3 Recommendations

As per the MCNP results shown above in Section 5.3.2, the only cases that were below the acceptance criteria for all dose points were the sensitivity cases that used SG dose rates of 10 mrem/h at 1 m and had a shielded roof on the PCSS. All other cases were over the dose acceptance criteria for at least one dose point. As the PCSS moves further into detailed design, the following recommendations should be considered for any future MCNP analysis:

- Refine source terms for all PCSS waste using more realistic values based on surveys.
- Credit any decay time in the derivation of source terms for each waste type.
- Re-evaluate the fence distances around the PCSS.
- Re-evaluate the layout of waste within the PCSS, and use older less radioactive waste to shield newer waste that has had less decay time wherever possible.

6.0 Malfunctions/Accidents Safety Assessment

6.1 Hazard Identification, Screening and Classification of Bounding Accidents

Hazards were identified and screened following the methodology specified in Section 3.2.1 for the following activities:

1. Construction of the PCSS;
2. On-site transfer of RWCs and SGs; and
3. Handling and storage of the RWCs and SGs.

The results are documented in the following subsections. A pre-screening of the identified hazards was performed for on-site transfer and handling and storage in the PCSS. Some events were eliminated during pre-screening if they can be determined to be not applicable without any additional analyses or they have negligible impacts on the safety of the PWMF. Hazards screened in are further assessed as part of the detailed screening analysis as documented in this section. The results of the pre-screening assessment are presented in Appendix A.

6.1.1 Malfunctions/Accidents during Construction of PCSS

Construction of the PCSS will consist of two stages; that is, site preparation and construction. Site preparation activities will include the following activities:

- Site clearing and grading,
- Fencing,
- Establishing a water management system,
- Creating material laydown areas, and
- General preparation for construction activities.

The construction of the PCSS will include the following activities:

- Surveying,
- Excavation,
- Foundations,
- Steel and equipment erection,
- Install building envelope,
- Hook-ups to existing utilities (power, water, sewer, communications), and
- Commissioning.

The malfunctions and accidents associated with site preparation and construction were identified and screened, and preventative and mitigation measures have been suggested. The results are summarized in Table 22 below. In summary, with the appropriate preventative and mitigation measures in place, the malfunctions/accidents associated with site preparation and construction of the PCSS will be prevented and the consequences, should those events occur, will be minimized and controlled.

Table 22: Malfunctions/Accidents during Site Preparation and Construction

Malfunctions/ Accidents	Description of the Scenarios	Preventative and Mitigation Measures/Screening Evaluation
Fire	The following fire accidents could occur: • Combustion of waste generated during site clearing, such as grass and trees; • Combustion of construction materials; • Fire at a temporary facility or equipment fire; • Fire during a vehicle accident; and • Fire during welding and cutting.	Fire will be limited to a local area. Emergency preparedness program, including fire extinguishers or other equipment, will be in place. This will minimize the consequences of a fire accident, should it occur.

Malfunctions/ Accidents	Description of the Scenarios	Preventative and Mitigation Measures/Screening Evaluation
Vehicle accidents	The following vehicle accidents could occur: • Collision with other vehicles, equipment, temporary buildings, or wildlife; and • Turnover of transportation vehicles such as haulage trucks or front-end loaders.	Safety programs for contractors will include safe driving procedures. All applicable transportation regulations will be followed in the movement of vehicles. Traffic control and speed limits will be in place. All of these will minimize the occurrence of vehicle accidents.
Electrical accidents	Electrical accidents, such as an electrical short circuit or electrical shock, could occur resulting from: • Misuse or poor maintenance of electrical equipment; • Damage to electrical equipment as a result of other project-related activities; • Staff access to live electrical equipment without authorization; and • Severe weather conditions, such as lightning.	Procedures will be in place to ensure the health and safety of workers and equipment, including proper maintenance of electrical equipment, Lock-out or tag out procedure, use of qualified workers and work permits. This will prevent the occurrence of electrical accidents.
Structural instability	Structural instability-related accidents could include: • Toppling of soil and waste rock piles; • Collapse or rolling of stacked pipes; • Collapse of scaffold, elevated plate form and ladder; • Heavy equipment crashes; and • Collapse of buildings under construction.	Safe work code of practice will be followed, including appropriate housekeeping and pipe handling work instruction. All activities will be carried out within a regulatory environment and conforming to design and construction protocols. This will minimize the occurrence of structural instability events.
Material handling accidents/ equipment failure	Material handling accidents/equipment failure could occur, including: • Material dropping from scaffold or elevated platform, or failure of crane or other lifting equipment; • Loss of control of mobile equipment/equipment collision; • Uncontrolled loading impacting equipment or personnel; • Material rolling or sliding; and • Utility damage (for example, water line, communication system) due to unexpected ground disturbance	Stringent safety requirements or procedures will be followed. For example, cranes will have a significant safety factor in terms of lifting capability. All applicable regulatory requirements related to safe rigging and hoisting will be met. An experienced contractor with a proven safety record in undertaking heavy lifts will be used, where applicable.

Malfunctions/ Accidents	Description of the Scenarios	Preventative and Mitigation Measures/Screening Evaluation
Spill of fuel, lubricants, oils and chemicals used for construction such as cement, paints, solvents or sealants.	Spill of these materials could take place. The scenarios include: • During a vehicle accident, tanker truck or gas tank of the vehicle is damaged and liquids (gasoline, diesel or liquid chemicals) in the tank spill. • The integrity of the on-site liquid storage equipment (tanks) is damaged as a result of extreme weather conditions or mechanical failure causing chemicals, lubricants and oil contained in the equipment to spill into the environment. • Spills could occur as a result of operational errors such as the leak of diesel fuel from a tanker truck or a storage tank while refueling equipment or vehicles.	Spill contingency plans as part of environmental management plan for the preparation and construction work should be in place. This will ensure prompt spill containment and clean-up. Given that the amount of spill could be limited, the effects would be minor or negligible after appropriate clean-up.
Occupational accidents	The following occupational accidents could occur, including: • Falls of workers from scaffold, ladder or elevated work locations, such as building under construction; • Slips, trips or falls on uneven or wet or icy surface; • Injury during welding and cutting or during material handling; • Extreme weather-related injury such as frostbite or heat exhaustion/stroke; • Accidents related to moving/rotating machinery or other equipment or tools; • Machinery-related accidents during the operation of drill, dozer or other equipment or accidents related to the use of hand tools; and • Injury due to falling objects, including from collapse of buildings.	Contractors will have extensive programs, policies and procedures to prevent occupational accidents. For example, workers will be properly trained prior to the execution of the work assigned. All activities will be carried out within a regulatory environment and conforming to design and construction protocols. This will minimize the potential of occupational injuries.
Explosion/ detonation	Explosions could occur because of: • Inadvertent detonation of explosive used during construction; and • Explosion of pressurized cylinder/tank.	All operations associated with materials that are potentially explosive will be carried out within a regulatory environment and conforming to design and construction protocols. This will minimize the potential of explosion.

Malfunctions/ Accidents	Description of the Scenarios	Preventative and Mitigation Measures/Screening Evaluation
Exposure to substances hazardous to health	Workers could be exposed to substances hazardous to health including toxic or controlled substances used during site preparation and construction.	Workplace Hazardous Materials Information System (WHMIS) will be in place. Workers will be properly trained for the use of these materials. Personal protective equipment will also help minimize the consequence of exposure to substances hazardous to health.

6.1.2 Malfunctions/Accidents during On-site Transfer of RWC and SG

The proposed route for transferring RWC and SG from PNGS to PCSS is illustrated in Figure 22. The malfunction and accidents during on-site transfer of RWC and SG was assessed below.



Note: The green line shows the transfer route assessed before and the red dotted line represents the new portion of the route for the transfer of SGs and RWCs to the PCSS.

Figure 22: Proposed Transfer Route for Transferring RWC and SG to PCSS

6.1.2.1 Drop of RWC or SG due to On-site Vehicle Accidents

The SGs could be transported to the PCSS on a Self-Propelled Modular Transporter (SPMT) or equivalent transfer vehicle. It is assumed that a maximum of twelve SGs will be transferred from the PNGS to the PCSS per year given there will be only one reactor refurbished at a time.

For RWCs, they are expected to be transported individually to the PCSS on a flatbed trailer or equivalent transfer vehicle, with tie-downs applied. It is assumed that a maximum of 25 RWCs will be transferred from the PNGS to the PCSS per year.

On-site transfer will not be conducted during poor weather conditions and the transfer vehicle will travel at a low rate of speed to ensure that the risk due to an on-site vehicle accident is minimized. However, there remains the risk that unforeseen conditions may lead to a collision that causes the transfer vehicle or RWC/SG being transferred to topple and results in the drop of the RWC/SG. Therefore, this event was screened in.

6.1.2.2 Transporter Operator Health-Related Emergency

The transporter operator could have a health-related emergency and lose consciousness during the transfer. However, the transporter operator is normally escorted by at least one additional individual. This second person could intervene to stop the transporter in such an event.

Furthermore, the transporter operates at the low speed. Even if operator illness were to result in the transporter leaving the road, a release of radioactivity from a RWC or packed SG is not expected, taking into account the design of the RWC or SG package. . For the worst-case scenario that the transporter toppled over, the radiological consequences would be bounded by the event of RWC or SG drop discussed in Section 6.1.2.1. Therefore, this event was screened out.

6.1.2.3 Fire

The route for transferring RWC and SG from PNGS to the PCSS is illustrated in Figure 22. It is similar to the route assessed in previous work [42] with the exception of the route represented in red dotted line in Figure 22. The potential for an accident due to a fire along the transfer route has been considered. The fire sources directly along the transfer route could include the P-10 gas cylinders outside of the Auxiliary Security Building within the Protected Area and invasive phragmites stands inside the ditches. Recommendations have been made to reduce the fire hazard such as relocation of the cylinder. The portion of transfer route which has not been specifically assessed (red dotted line in Figure 22) only extends less than 200 meters beyond the route which has been assessed. Some photos were recently taken along this portion of the transfer route (Appendix C). Based on the review of these photos, there are no additional fire sources identified along this portion of the transfer route.

The combustible materials originating from the transporter itself, including the diesel fuel in the tank, engine lubricating oil and hydraulic oil, could represent a fire hazard. However, it is expected that such a fire would be of short duration as a result of the fire detection and suppression systems in the transporter design and the expected response of the Pickering NGS Emergency Response Team (ERT).

RWCs will be constructed of non-combustible materials and the waste stored inside them is mostly non-combustible. All SG penetrations and openings will be welded with thick steel plates prior to transport to ensure all internal source term is contained. Furthermore, the outer surface of the RWCs and SGs will be decontaminated prior to transfer. Therefore, release of radioactive materials from RWCs and SGs due to a fire accident was screened out.

6.1.2.4 Adverse Road/Weather Conditions

Similar to the current practice, it is expected that procedural controls will be in place to prohibit on-site transfer under poor road/weather conditions or until potentially slippery conditions can be mitigated with appropriate measures such as sanding or salting of the transfer route. Even if the transporter were to lose traction on a slippery surface resulting in the vehicle leaving the road, a release of radioactivity from a RWC or SG is not expected given the robust design of a RWC or packed SG, which is intended to withstand transportation accident loads. For the worst-case scenario, the radiological consequences would be bounded by the event of RWC or SG drop. Therefore, this event was screened out.

6.1.2.5 Soil Failures/Slope Instability

In the event the on-site transfer of a RWC or SG takes longer than expected as a result of adverse road conditions due to soil failure or slope instability, a release of radioactivity from a RWC or SG is not expected given the robust design of a RWC or packed SG. For the worst scenario, the radiological consequences would be bounded by the event of RWC or SG drop. Therefore, this event was screened out.

6.1.2.6 Earthquake

The Pickering B Design Basis Earthquake (DBE) is defined as an earthquake with a peak ground acceleration (PGA) of 0.05 g and a frequency of reoccurrence once in 1000 years, using the 84th percentile seismic hazard curve for the Pickering site [43].

Since the transporter with a RWC or SG is not on the road 100 percent of the time, the combined occurrence of a DBE and the transporter being on the road simultaneously can be determined based on the following assumptions:

- A maximum of 25 RWCs and 12 SGs are transferred each year between the station and the PWMF PCSS given there is only one reactor being refurbished at a time.
- The greatest distance the transporter needs to travel between the station and the PCSS is less than 1 km.
- The transporter is conservatively assumed to take a longer time during transfer and be on the road for 1 hour to increase time-at-risk.

The frequency of a DBE occurring at a time when a SG or RWC is being transferred is:

$$(12 + 25) \frac{\text{transfers}}{\text{year}} \times \frac{1 \text{ hour}}{8760 \text{ hours per year}} \times (1 \times 10^{-3} \text{ events per year}) \\ = 4.22 \times 10^{-6} \text{ events per year}$$

The event frequency is greater than the cut-off frequency of 10^{-6} events per year, therefore this hazard cannot be screened out based on frequency.

If the earthquake occurs during the on-site transfer of a RWC or SG from the Station to the PCSS, the RWC or SG will not topple over due to the forces from the DBE if the seismic design requirement for SG and RWC is similar to that for DSC, for which the required horizontal and vertical PGA is 0.12 g [44], higher than the postulated Pickering B DBE with the peak PGA of 0.05 g. If the seismic design requirement does not meet this criterion, toppling over is likely. In addition, the transporter could topple over during the earthquake event which could affect the RWCs or SGs being transferred. However, this is bounded by the RWC or SG drop event. Therefore, this event was screened out.

6.1.2.7 Tornado

A tornado is a rotating thunderstorm with a vortex of air extending downward from a thundercloud, which normally occurs in unstable atmospheric conditions when warm moist air comes into contact with cold air. The Design Basis Tornado (DBT) has not been addressed for PNGS [45], thus, the DBT defined for the Darlington nuclear site [46] as defined as follows, was considered in this work:

- Rotational wind speed of 322 km/h,
- Translational wind speed of 96 km/h,
- Pressure drop of 9.6 kPa,
- Rate of pressure drop of 5.6 kPa/s and
- Radius of maximum rotational wind speed of 46 m.

These parameters are considered to be large enough to envelope any credible tornadoes in southern Ontario [46]. Based on the PNGS site wind speed frequencies [47], the DBT-definition rotational wind speeds (322 km/h) correspond to a mean frequency of 3.13×10^{-6} events per year. Therefore, the frequency of a tornado occurring at a time when a RWC or SG is being transferred is:

$$(12 + 25) \frac{\text{transfers}}{\text{year}} \times \frac{1 \text{ hour}}{8760 \text{ hours per year}} \times (3.13 \times 10^{-6} \text{ events per year}) \\ = 1.32 \times 10^{-8} \text{ events per year}$$

This value is significantly below the cut-off frequency of 10^{-6} per year, therefore this event was screened out.

6.1.2.8 Thunderstorms/Lightning

Thunderstorms can potentially involve lightning striking a SG or RWC on the transporter during on-site transfer. The effects of a lightning strike will increase the temperature of the affected SG or RWC and might result in an increased release of loose contamination from inside the packages; the packages will be cleaned of surface contamination prior to transport.

The impact of a lightning strike on the nuclear waste containers including RWC has been assessed [48]. In an unlikely event of a direct lightning strike to the RWCs during transfer, arcing will occur between the vehicle and the ground, dissipating the lightning energy. It was concluded that the shielding of the RWC will not be compromised and the containment will not be breached. The conclusion is also applied to SGs being transported.

However, the lightning may be hazardous for the driver or the electrical/electronic components of the vehicle. Even if operator incapacitation were to result in the transporter leaving the road, a release of radioactivity from a RWC or a SG is not expected given the design of the RWC or SG. For the worst-case scenario that the transporter toppled over, the dose consequences from this postulated scenario would be bounded by the RWC or SG drop event. Therefore, this event was screened out.

6.1.2.9 Flooding

The only possibility for flooding at the Pickering site would be as a result of extreme local meteorological events. However, procedures will be in place to require that RWCs or SGs not

be transferred during anticipated extremely adverse weather conditions. In addition, sufficient warning time should be available for site staff to prevent this scenario from occurring. For example, a station wide Public Address (PA) announcement will alert staff of heavy rain, electrical storm, or flooding advisory, at a 4-hour frequency until the severe weather advisory has ended [49].

If in an unlikely event, transport of a RWC or SG during an extreme rainfall were to occur, extensive flooding would likely affect the operation of the transporter. However, based on the study for the Darlington site which is applicable to Pickering site, the direct on-site rainfall (Probable Maximum Precipitation or PMP) would result in floodwater to a depth of approximately 20-30 cm [50], which would not be high enough to reach the platform of the transporter. Furthermore, there would be no detrimental effect on the RWCs as they are designed to have sealed containment envelope that prevent the ingress of water [51]. As such, the temporary flooding water would not enter the RWCs or SGs and result in any concern from the radiological safety perspective. Therefore, this event has been screened out.

6.1.2.10 Explosions along the Transfer Route

There are several potential sources of explosion along the transfer route of the RWCs or SGs from the station to PCSS. Therefore, the impact of an explosion along the transfer route must be assessed.

Explosion hazards along the onsite transfer route of the DSCs from the Phase I processing building to the Phase II storage building 4 have been assessed [52]. The following explosion hazard scenarios have been considered:

- Acetylene cylinder detonation
- Propane storage tank Boiling Liquid Expanding Vapour Explosion (BLEVE)
- Vapour cloud explosion (VCE) due to a propane storage tank rupture.

The combined explosion hazard frequency has been determined to be 5.2×10^{-8} per year, assuming about 1000 DSC shipments per year [52]. As shown in Figure 22, the RWC or SG transfer route from the Station to PCSS is partially overlapped with the transfer route of the DSCs which were assessed. Given the total RWC and SG shipment rate will be 37 per year, much less than that for DSCs, it is expected that the explosion hazard frequency will be lower than 5.2×10^{-8} per year, less than the cut-off frequency of 10^{-6} . Furthermore, based on the review of photos which were taken recently (see Appendix C, no additional explosion sources have been identified for the portion of the RWC/SG transfer route which has not been assessed before. Therefore, the explosion hazard was screened out based on frequency.

6.1.2.11 Turbine Missile Strike

The RWC or SG transporter travelling from the station to the PCSS could be potentially impacted by a low trajectory turbine missile originating from the accident unit. The frequency of low trajectory turbine missiles impacting nearby structures, systems and components (SSCs) was estimated to be 6×10^{-6} events per year [50].

It is estimated that RWCs and SGs will be transferred at the rate of 25 and 12 per year, respectively. Therefore, the frequency of turbine missiles impacting a SG or a loaded RWC when they are being transferred from PNGS to the PCSS is:

$$(12 + 25) \frac{\text{transfers}}{\text{year}} \times \frac{1 \text{ hour}}{8760 \text{ hours per year}} \times (6 \times 10^{-6} \text{ events per year})$$

$$= 2.53 \times 10^{-8} \text{ events per year}$$

The value is below the cut-off frequency of 10^{-6} per year. Therefore, this hazard was screened out.

6.1.2.12 Aircraft Crash

The aircraft crash frequency calculated for the on-site transfer was 2.53×10^{-10} events per year. The detailed calculations are presented in Appendix B. This value is lower than the cut-off frequency of 10^{-6} events per year. Therefore, this was screened out.

6.1.2.13 Toxic Gas Release - Chlorine Originated from Ajax Water Treatment Plant

The Ajax Water Treatment Plant (WTP), which uses chlorine cylinders for water treatment, is located at approximately 4.0 km from the PCSS. The Screening Distance Value (SDV) for chlorine is 4.4 km [50]. A portion of the RWC and SG transfer route and the PCSS are within this distance. Therefore, this hazard cannot be screened out based on distance.

An airborne chlorine leak from the Ajax WTP could have an impact on the transporter operator ability to keep the transporter safely on the road. The consequences will be similar to the scenario described in Section 6.1.2.2. Therefore, this event was screened out.

6.1.3 Malfunctions/Accidents during Handling and Storage

6.1.3.1 SG Drop during Handling in PCSS

SGs transferred from PNGS will be received, inspected, and moved into the PCSS after surveying and hotspots identification. The SGs will be off-loaded from the SPMT using a hydraulic jacking system or gantry crane system, lowered onto a sliding system and moved to their individual storage location. The total duration of these activities is assumed to be 22 hours per SG taking into account some contingency [36].

The jack and slide system is a simple and safe means for the vertical movement of very heavy loads and an accidental SG drop is not expected during this process. However, a load instability and the drop of the SG from a low height may result when being placed in its final location in the PCSS in the following unlikely events:

- the jacking band or support beams failure;
- hydraulic or mechanical failure of one or more jacks under load, or;
- due to unstable jacks, not positioned on a level surface.

An SG drop assessment has been carried out [53] and it was concluded that a short drop may cause some damage resulting in potential for radiological release, although the steam generator is a robust package with openings covered with thick plates welded in place. Therefore, this event is screened in for further assessment.

6.1.3.2 RWC Drop during Handling in PCSS

The RWCs might be handled in the PCSS using a heavy forklift. The RWC-PTs,

RWC-CTIs and the RWC-EFs may be stacked three high. The event of a RWC drop could occur during handling due to forklift hydraulic system failure and Forklift fork structural failure. The worst scenario could be the drop of an RWC from a 4-meter height onto a reinforced concrete surface.

For RWC-EF, the analysis has shown that some drop orientations resulted in larger gaps and longer gap time during impact [54]. However, it was concluded that these gaps are not sufficiently big to provide a line of sight to the RWC contents or to release any bulk contents. Only a minor amount of fines or dust could be released during such an event.

For RWC-PT/CT/CTI, the analysis has shown that the bolts did not fail due to excessive plastic strain, and gaps between the RWC main body and the shielding panels existed only briefly during the impact and they were very small [55]. It was concluded that the lid and shielding panels of the RWC remain sufficiently attached to the main body, preventing spilling of any bulk contents. Only minor amounts of swarf, fines, or dust will be released as a result of the drop.

The frequency of RWC drop was calculated as 1.6×10^{-5} events/year (6.33×10^{-7} failures/hour x 25 hours/year), taking into account the following information:

- Duration of placing one RWC to its storage location is conservatively assessed at 1 hour;
- Forklift hydraulic system failure is 5.83×10^{-7} per hour and Forklift fork structural failure is 5×10^{-8} per hour, for a total of 6.33×10^{-7} failures per hour [56]
- 25 RWCs will be moved to PCSS in a year.

If rearrangement of RWCs in PCSS is required, the frequency of the event is higher. Given this value is greater than the 10^{-6} cut-off frequency, this event is screened in for further assessment.

A handling accident involving dropping an RWC onto another RWC is also credible if the operator fails to keep the load in balance and the container tilts and drops back onto the RWC below. However, due to the low lift height relative to the lower level RWC, the hazard of dropping an RWC onto another RWC is bounded by drop of an RWC from 4 meters onto the concrete floor. Therefore, this event is screened out.

6.1.3.3 Collision with RWC or Other structures in the PCSS

RWC handling accident due to operator error using the forklift could result in a lifted RWC colliding with another RWC or other structure. However, the consequence of this scenario is bounded by that of the RWC drop since the impact of an RWC drop is expected to be higher compared to the scenario when the forklift collides with another structure within the PCSS. Therefore, this event is screened out.

6.1.3.4 Seal Failure during Storage

The lid/seal of the SG or RWC must fail for a radiological release to occur. However, all SG penetrations and openings will be welded with thick steel plates. Also, the RWC assembly has been designed to maintain its structural, containment, and shielding integrity with no significant degradation for a long design life. Therefore, it is highly unlikely that there would be any sealing failure leading to radiological consequences during their storage at PCSS.

In the unlikely event that the lid/seal of a SG or RWC fails, only gaseous components evolved from the solid crud/deposit materials in the SG or RWC, if any, would be released to the

environment. This postulated release would occur over a long period of time, which would allow for dispersion. Therefore, the worker and public dose would be bounded by the acute release due to the SG or RWC drop accident. As such, this event was screened out.

6.1.3.5 PCSS Fire

A fire hazard assessment has been conducted for similar facilities where RWCs and SGs are stored [37].

For Retube Component Storage Building (RCSB), large diesel-powered forklift trucks periodically located in the unloading area of the building present a credible ignition source. A pool fire resulting from leakage of the forklift truck fuel tank and subsequent hydraulic oil spill was determined to be the bounding fire hazard in the building. However, the evaluations concluded that the fire originating from a heavy-duty forklift truck will not affect the building.

Furthermore, the RWCs were constructed of non-combustible materials and the waste stored inside them is mostly noncombustible. Given the large thermal inertia of RWCs, any fires in the RCSB would take a long time, allowing time for manual suppression, before any overheating could be expected that may result in a release. Therefore, the fire hazard is screened out.

Similarly, the SGSB houses non-combustible waste which will not sustain a fire. The building is considered a low fire hazard as it does not contain any significant quantity of combustible content. The bounding fire hazard will be a pool fire resulting from a transport vehicle diesel fuel leakage/spill.

The fire evaluation concluded that the roof steel structure of SGSB will be impacted by the high temperatures; however, manual activation of the suppression system and the intervention of the Emergency Response Team will prevent the building from collapsing. Furthermore, the outer surface of the SGs has been de-contaminated prior to storage and all source term is located within the SGs. All SG penetrations and openings are welded with thick steel plates to ensure all internal source term is contained. Therefore, the evaluation concluded that even without any suppression or response from the Emergency Response Team, the generator casings would not fail, and the source term remains contained. As such, the fire accident was screened out.

The PCSS will be built similar to RCSB and SGSB discussed above and house a minimal amount of combustible material. The items stored within PCSS, SG packages and RWCs, are large, sealed concrete and steel containers with large thermal inertia. Therefore, it is expected that the conclusions of the FHA for the similar storage facilities apply to PCSS, which can be further confirmed by the FHA for the PCSS when it is available. As such, the fire accident was screened out.

6.1.3.6 Earthquake

For the purposes of the safety assessment, it was conservatively assumed that for the postulated earthquake scenario, the PCSS at its capacity in terms of waste storage could suffer extensive damage and collapse. All RWCs and SGs stored within the PCSS were affected and were considered material at risk. Airborne releases could occur following the breach of RWCs or SGs. Therefore, this event was screened in.

6.1.3.7 Tornado

Similar to the earthquake event, it is conservatively assumed for the purpose of safety assessment that the PCSS is not expected to withstand the forces from a DBT and the collapse of the PCSS may lead to the toppling of the stacked RWCs. The damage to the packages will be similar to the events described in Section 6.1.3.6. Therefore, this event was screened in.

6.1.3.8 Thunderstorms/Lightning

Thunderstorms can potentially involve lightning striking the PCSS. However, the PCSS will be designed to be equipped with appropriate grounding provisions. As such, its structural integrity, appropriate shielding and containment function will be maintained for severe atmospheric conditions, such as lightning. Therefore, this event was screened out.

6.1.3.9 Flooding

Water entry into the PWMF storage buildings originating from a PMP event is possible. However, the outer surface of SGs or RWCs have been decontaminated prior to the storage. In addition, the SG and RWC are sealed tight enough to prevent water from entering even if the water level was high enough to partially submerge a portion of the SG or RWC. For these reasons, PMP flooding does not represent radiological safety concern. Therefore, this event was screened out.

6.1.3.10 Turbine Missile Strike

According to Reference [50], the most significant missile is a large fragment of Disc 3 from a low-pressure turbine. However, the PCSS is located approximately 600 m northeast of Unit 8. The building is separated not only by the distance from the Unit 8 turbine, but also is shielded by various buildings located between the two facilities. Therefore, this hazard was screened out.

6.1.3.11 Explosion

As discussed in Section 6.1.2.10, explosion hazard exists along the RWC and SG transfer route. Based on the assessment [57], the peak side-on overpressure at the distance of 100 m from the sources of the explosion is no more than 7 kPa. As the PCSS is located at least 200 m away from these explosion sources and there are other facilities between the PCSS and these sources, the impact of the explosion on the PCSS can be screened out given the estimated overpressure level at the PCSS will be less than 6.9 kPa, the criterion specified by the US NRC [58]. Furthermore, the maximum thermal radiation due to propane fireball is expected to be less than 18 kW/m², less than the potential impact criteria of 35 kW/m².

6.1.3.12 Aircraft Crash

The cumulative aircraft crash frequency calculated for the Used Fuel Dry Storage Area (Phase I and Phase II), RCS Area and PCSS for RWCs is 9.78×10^{-7} events per year. For PCSS for SGs, the crash frequency is 8.64×10^{-8} events per year. The detailed calculations are presented in Appendix B. These values are lower than the cut-off frequency of 10^{-6} events per year. Therefore, this was screened out.

6.1.4 Summary of Malfunctions/Accidents Associated with Construction, Transfer, Handling and Storage

Based on the screening performed in Section 6.1.1 to 6.1.3, the following events were screened in for further assessment:

- Vehicle accident during the on-site transfer from PNGS to the PCSS (Section 6.1.2.1)
- Failure of handling equipment when the package being handled in the PCSS (Section 6.1.3.1 and 6.1.3.2)
- Earthquake resulting in PCSS collapse (Section 6.1.3.6)

Both vehicle accident during the on-site transfer and the failure of handling equipment when the package being handled in the PCSS could result in the drop of a SG or a RWC to the ground which was considered a DBA based on its frequency discussed in the previous sections. The earthquake event could result in the collapse of the PCSS which affects all RWCs and SGs stored in the PCSS. During these events, the SGs or RWCs could be partially damaged, resulting in a small amount of radioactive materials being released from the damaged SGs or RWCs to the environment. The workers in the nearby area and the public in the vicinity of the PNGS site could be affected. The detailed assessments of these events and the consequences are carried out and the results are documented in the following sections.

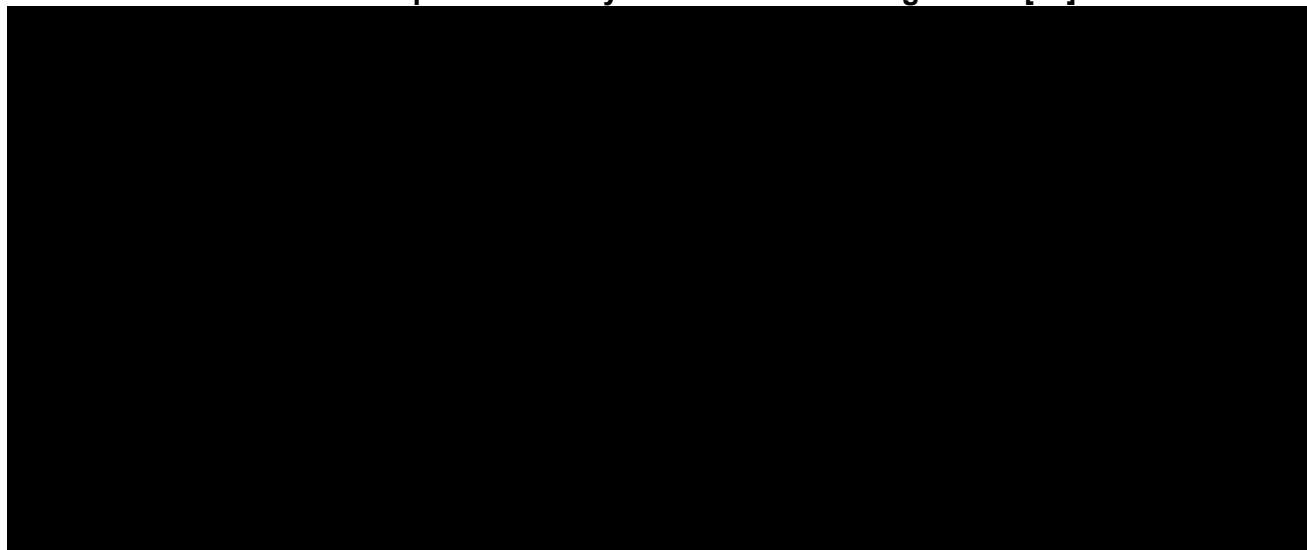
6.2 Radiological Releases

6.2.1 Radiological Releases due to SG Drop

The specific activities of Co-60 in SGs from Pickering B, based on gamma spectroscopy results, are presented in Table 23 [59]. Taking into account the total area of SG tubes of $1.83\text{E}+07 \text{ cm}^2$ [60], the highest Co-60 activity per SG in Pickering B is [REDACTED]³. Compared with the data from other sources as listed in Table 24, the highest Co-60 activity per SG is [REDACTED]⁴. Therefore, the radionuclide inventory per SG presented in Table 4-9 of [23] represents the bounding inventory of an SG. This is a conservative approach since the reduction of radionuclide inventory due to decay was not credited and the highest Co-60 activity per SG was used as the scaling factor. This inventory data as listed in Table 25 was then used in the dose assessment.

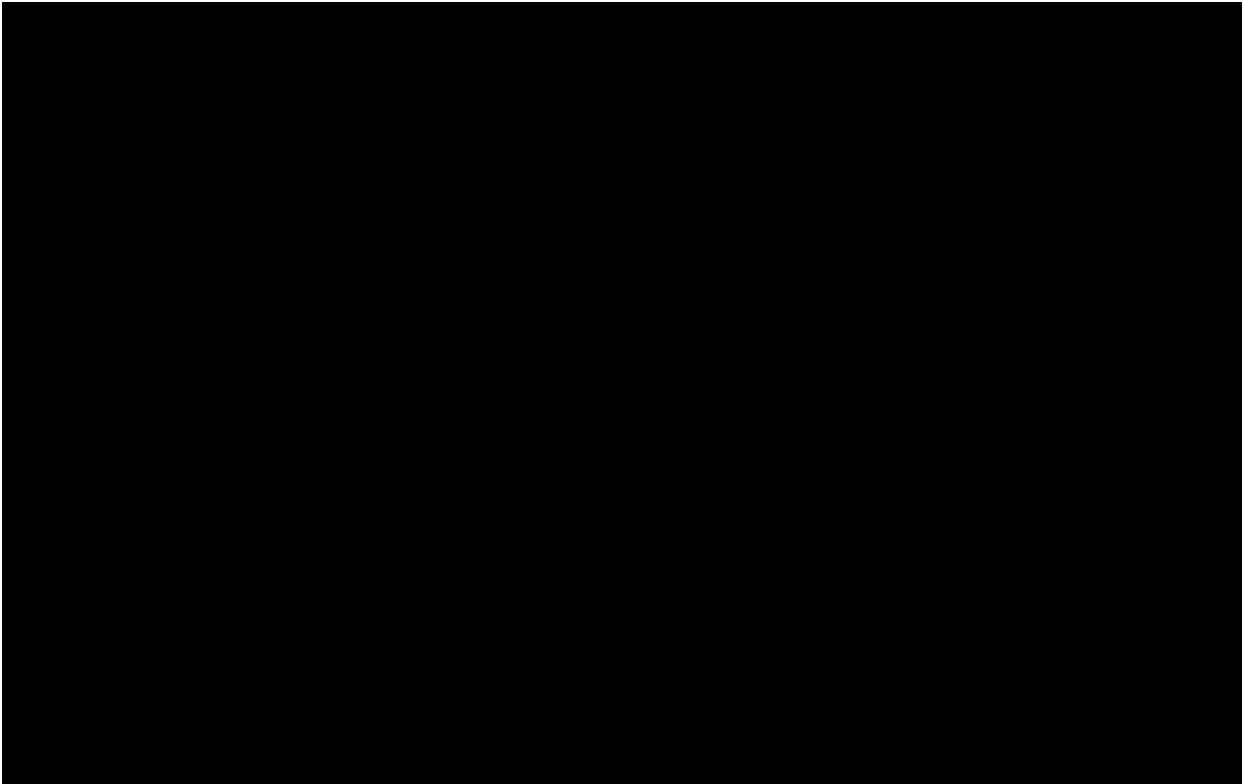
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Table 23: Specific Activity of Co-60 in Pickering B SGs [59]



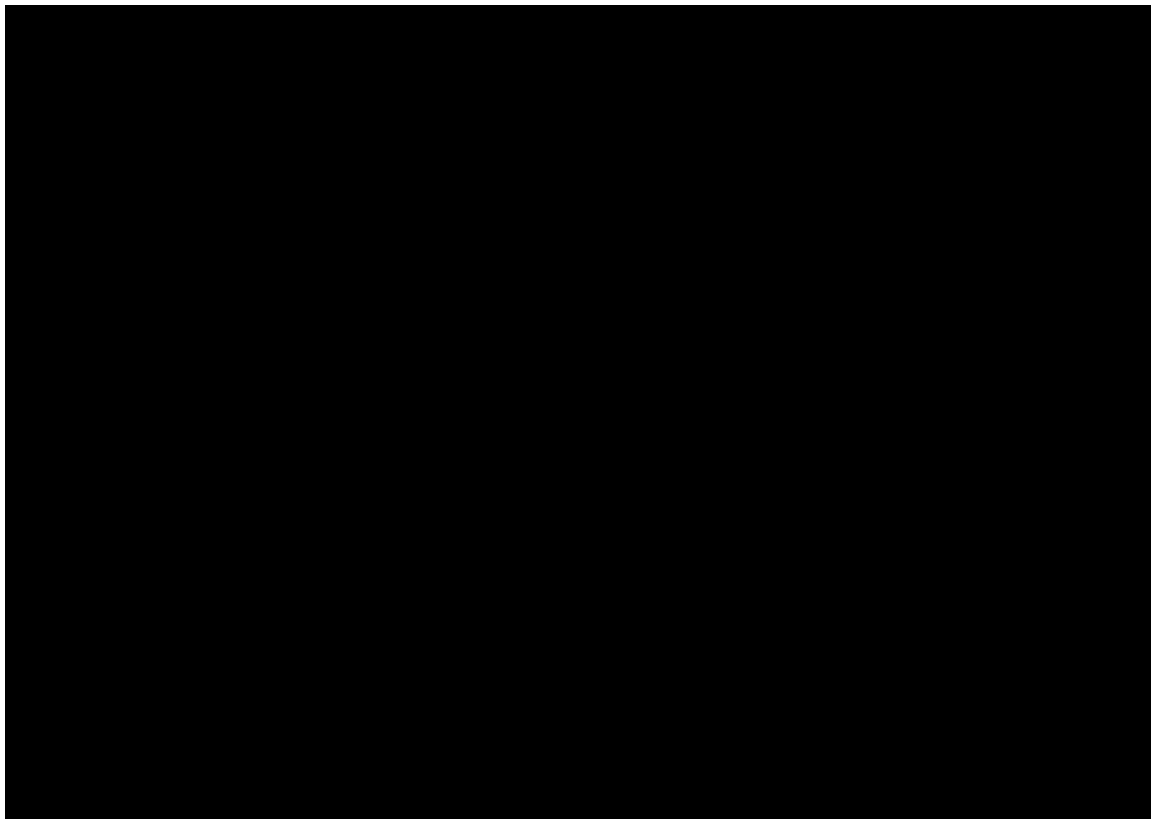
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Table 24: Co-60 Inventory in Steam Generator [based on Table A-17 of [23]

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Table 25: Bounding radionuclide Activity in Steam Generator (Table 4-9 of [23])

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Steam generators are reasonably robust containers and will survive a short drop with only some damage. Using the guideline given in the IAEA Safety Guide TS-G.1.1 for similar packages, the fraction of steam generator deposit that will be released from the container is assigned to be 1E-02 [36]. The $ARF * RF$ from this event was assumed to be 1.0E-04 which is the same as the value assigned to the suspension of powder due to debris impact. Therefore, a total release fraction of 1E-06 of the steam generator inventory, as summarized in Table 26, is applied to the SG drop scenario. Note the release fraction of 1E-06 applies to all radionuclides considered with the exception of C-14 and tritium. For C-14, it is assumed that all C-14 has been converted to carbon dioxide and is completely released. For tritium, the airborne release fraction is set to 2.7%, consistent with the SG drop scenario in the WWMF safety assessment report [36] [61].

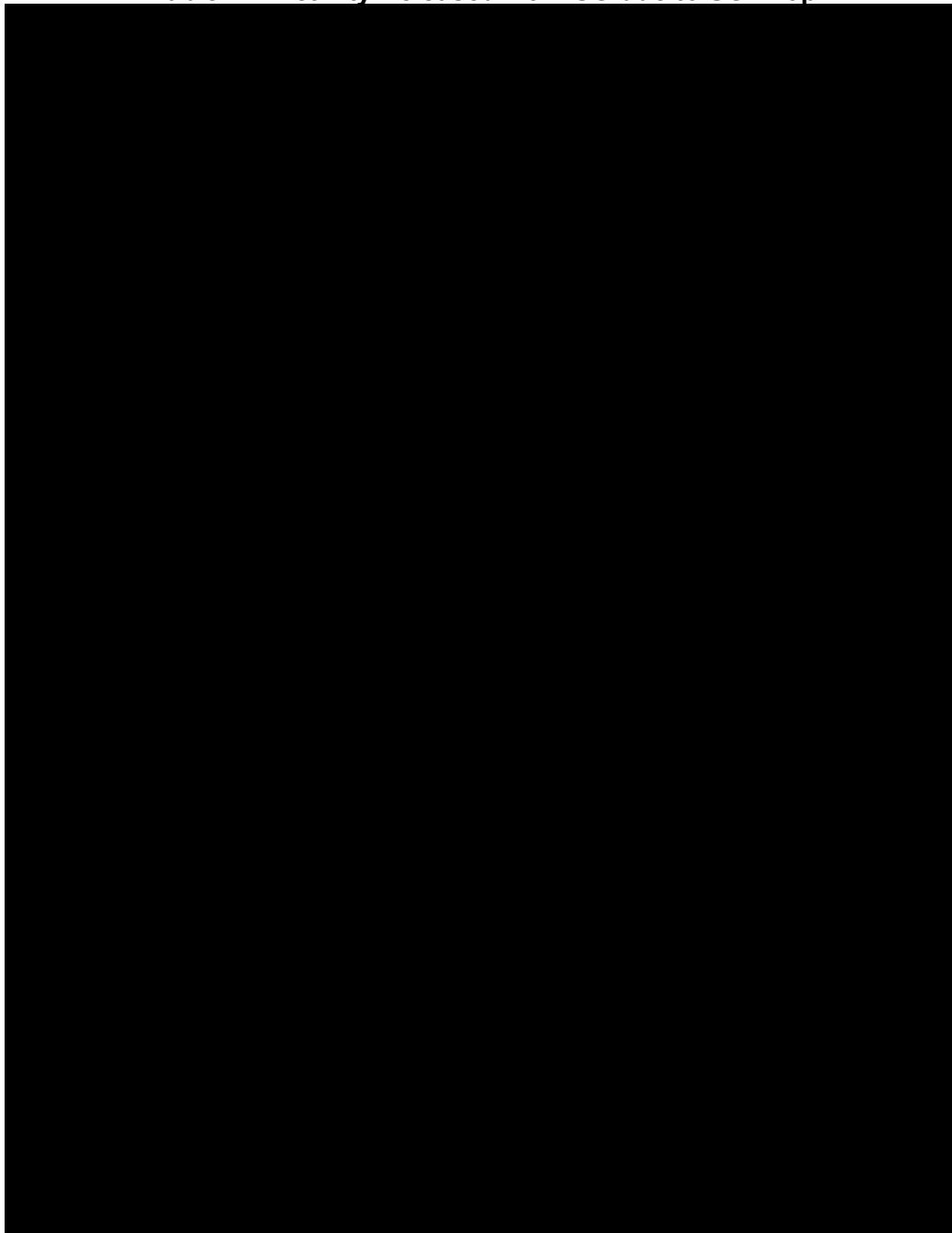
Table 26: Parameters used to Calculate Activity Release from SG

Parameter	Values	Note
Fraction to calculate MAR	1.0E-02	See discussion above
DR	1	Assumed value, conservative
ARF*RF	1.0E-04	See discussion above
LPF	1	Assumed value, conservative

Parameter	Values	Note
Total Release Fraction	- C-14: 1 - Tritium (HTO): 2.7E-02 - Other radionuclides: 1.0E-06	See discussion above

Accordingly, the radionuclide releases following a SG drop scenario were calculated and the results are listed in Table 27. In the dose assessment as discussed in Section 6.2.3, it was assumed that the duration of the release is one hour.

Table 27: Activity Released from SG due to SG Drop



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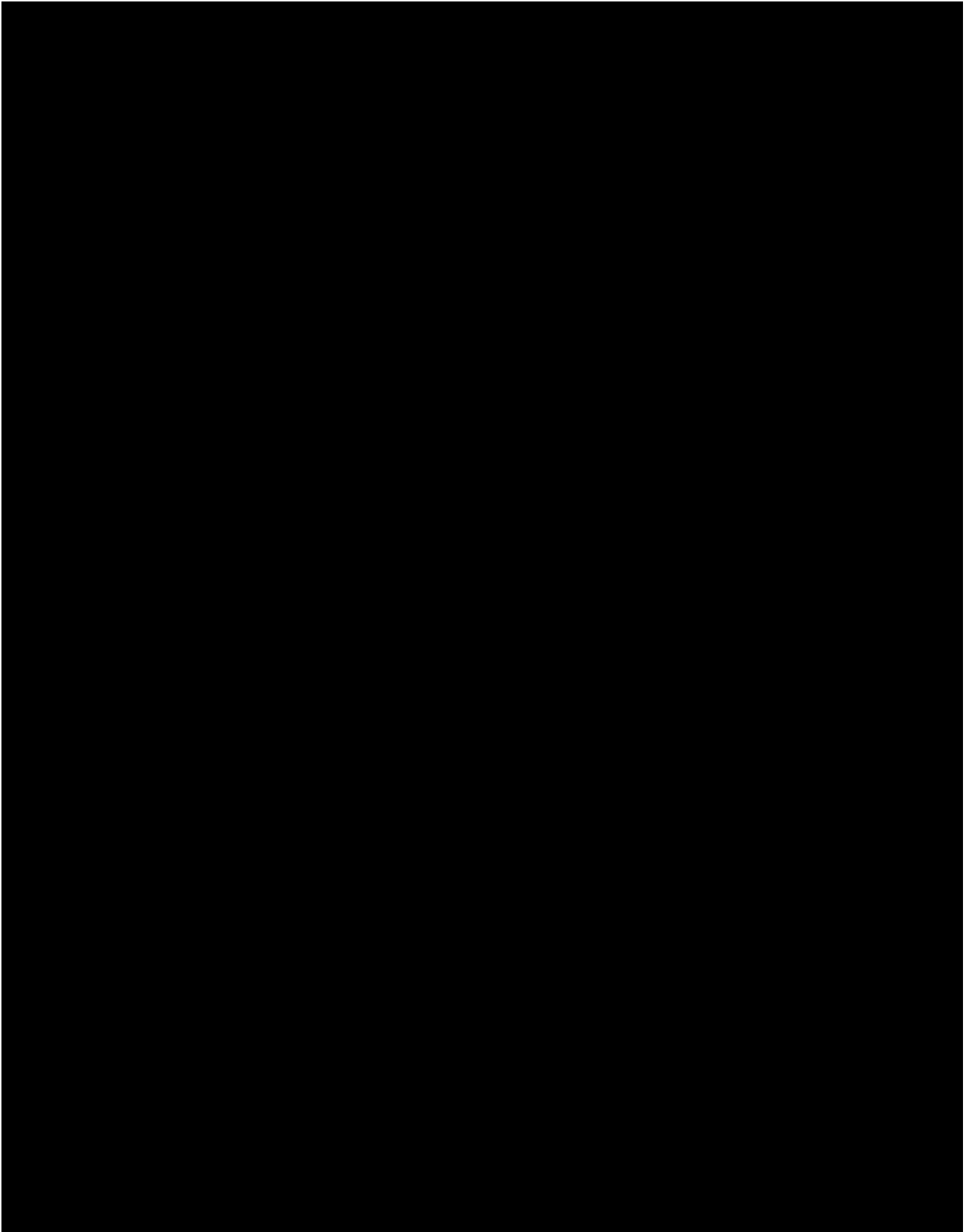
6.2.2 Radiological Releases due to RWC Drop

For the safety assessment, the radionuclide activities given in Table 5-9 of Reference [23] were selected as the limiting inventory for a RWC⁵. This is a conservative approach since the reduction of radionuclide inventory due to decay is not credited. The radionuclide inventory of the RWC is listed in Table 28. In the dose assessment as discussed in Section 6.3.2, it is assumed that the release duration is one hour.

Table 28: Bounding Radionuclide Activity in RWC

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⁵ Pickering specific RWC inventory is not available. Therefore, Table 5-9 of Reference [22], which was derived based on the historical data from different CANDU reactors as discussed in Reference [22], represented the bounding RWC inventory and was used in this work.



Retube wastes consist of cuttings of fuel channel components (PTs, CTs), CTIs and EFs. The potential source of airborne releases would come from the metal dust from the cuttings. An experimental study of fine particle ($< 850 \mu\text{m}$) distribution during volume reduction of PTs indicates that the less than 0.01% of the volume-reduced PTs became fine particles [62]. For conservatism, 0.02% of the base metal and 100% of the oxide deposits in RWCs were assumed to be in the form of fine particles which have the potential to be released to air.

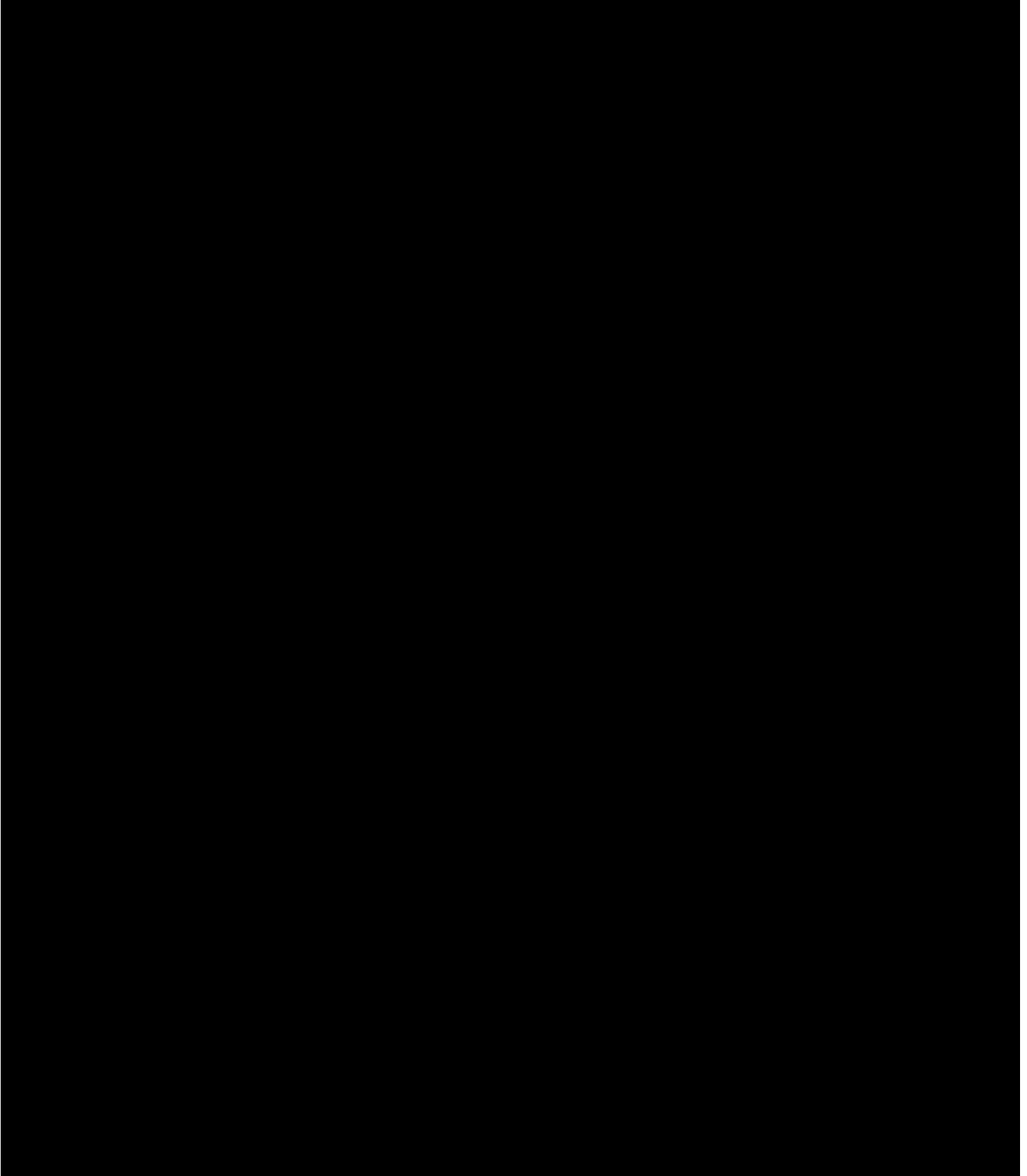
The RWCs are assumed to be reasonably robust containers and will survive a short drop with only some damage. Using the guideline given in the IAEA Safety Guide TS-G.1.1 for similar packages, the fraction of RWC content that will be released from the container is assigned to be $1\text{E-}02$. The bounding value of $1\text{E-}04$ for suspension of powder due to debris impact was applied. Therefore, a total release fraction of up to $1\text{E-}06$ of the RWC fine particles or surface deposit inventory is applied for RWC drop scenario. These parameters are summarized in Table 29. Similar to the SG drop event, the release fraction of $1\text{E-}06$ applies to all radionuclides considered with the exception of C-14 and tritium. For C-14, all C-14 is assumed to have been converted to carbon dioxide and all of it is released. For tritium, the airborne release fraction is set to $5.4\text{E-}06$ for base metal and 2.7% for oxide deposit [36] [61] .

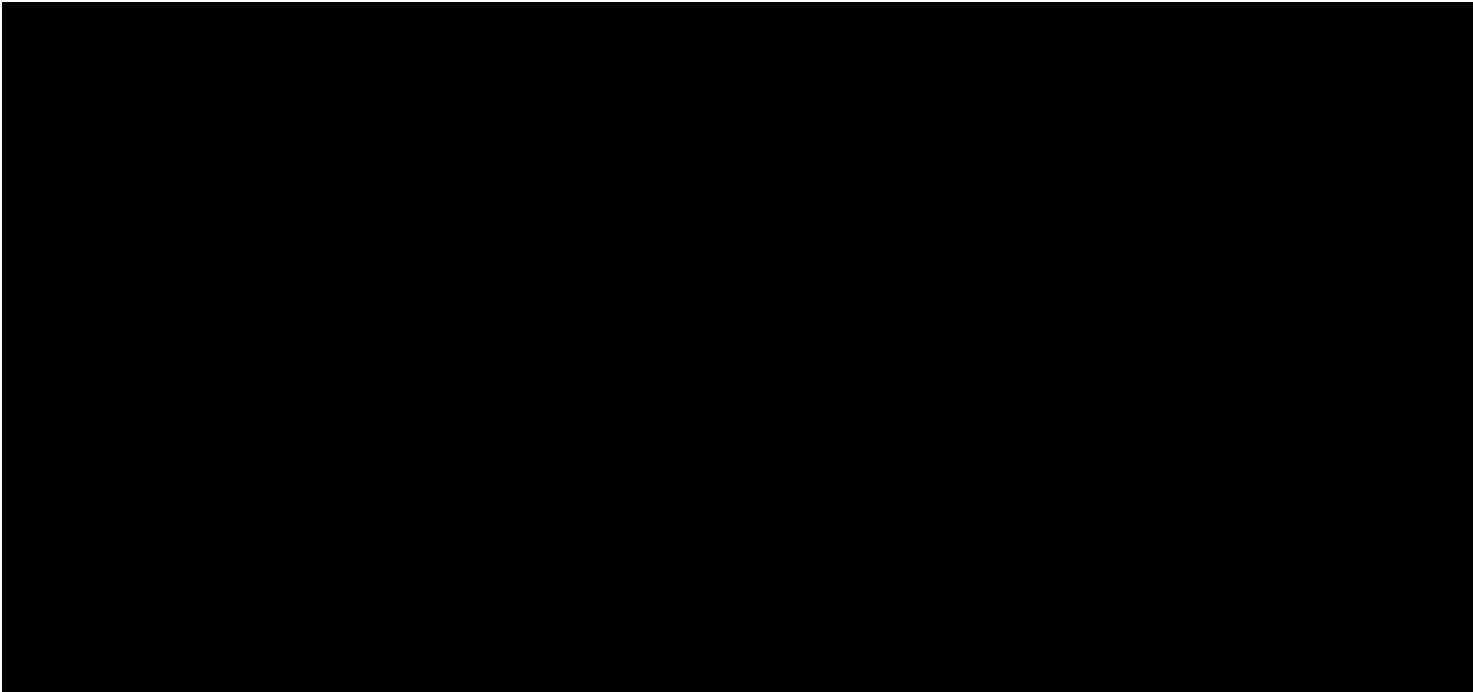
Table 29: Parameters used to Calculate Activity Release from RWC

Parameter	Values	Note
Fraction to calculate MAR	Base metal: $2.0\text{E-}06$	See discussion above.
	Oxide deposit: $1.0\text{E-}02$	
DR	1	Assumed value, conservative
ARF*RF	$1.0\text{E-}04$	See discussion above
LPF	1	Assumed value, conservative
Total Release Fraction	Base metal: • C-14: 1 • Tritium (HTO): $5.4\text{E-}06$ • Other radionuclides: $2.0\text{E-}10$	See discussion above
	Oxide deposit: • C-14: 1 • Tritium (HTO): $2.7\text{E-}02$ • Other radionuclides: $1.0\text{E-}06$	

Accordingly, the radionuclide releases following a RWC drop scenario were calculated based on the equation in Section 3.2.2 and the results are listed in Table 30.

Table 30: Radiological Releases from the RWC due to RWC Drop





6.2.3 Radiological Releases due to Earthquake

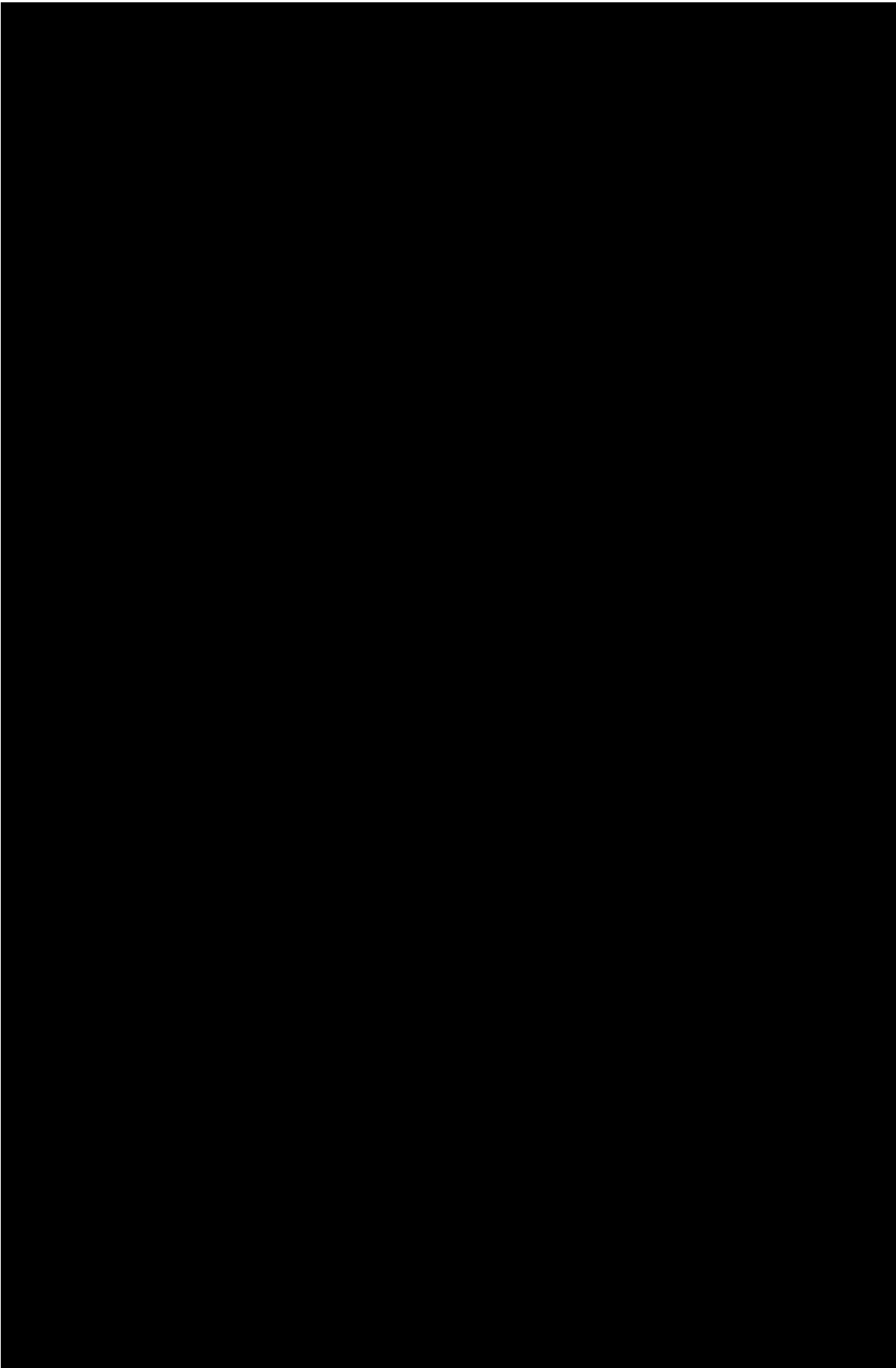
As discussed in Section, 6.1.3, for the earthquake event, the PCSS was assumed to collapse. All RWCs and SGs stored in the PCSS were assumed to be affected, resulting in airborne releases. For the purposes of the dose assessment, it was assumed that the following amounts of RWCs and SGs were stored in the PCSS when the earthquake event occurred:

- SG: 48
- RWC-PT: 32
- RWC-CT: 28
- RWC-CTI:16
- RWC-EF: 64

The airborne emissions were estimated based on the same approach used for RWC/SG drop event. The results are summarized in Table 31.

Table 31: Radiological Releases from PCSS resulting from Earthquake Event

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6.3 Doses to Public and Workers from the Postulated Malfunctions/Accidents

6.3.1 Doses to Public from the Postulated Malfunctions/Accidents

Radioactivity release resulting from the drop of a SG or a RWC was analyzed in Sections 6.2.1 and 6.2.2. On this basis, doses to the public resulting from these events were calculated following the methodology specified in Section 3.2.3. The inputs for dose calculation including assumptions are consistent with those summarized in Appendix B of the previous work [3]⁶. The results are presented in Table 32 to Table 36. From the tables, the highest dose to public resulting from SG or RWC drop event is 1.6 μSv due to the drop of a RWC-PT, which is less than the acceptance criterion of 1 mSv. The critical group is an adult from the hypothetical group located at landside (east) of Pickering nuclear site exclusion boundary.

Radioactivity release resulting from the earthquake event was analyzed in Section 6.2.3. The dose consequence is presented in Table 37. The highest dose to public is 80 μSv , also less than the acceptance criterion of 1 mSv. The critical group is the same as that for the RWC drop event.

The doses were generally converged with the exception of a few locations such as B_N, B_WSW-Lake and B_NNW. These locations were not converged even with a high bin number (5000) for approximating cumulative frequency distribution. Increasing the number of bins is expected to lower the non-converged doses so the reported doses are conservative.

Table 32: Doses to Public due to SG Drop

Receptors	95 th Individual Effective Dose (μSv)*	
	Adult	Infant
B_N	5.1E-05	7.5E-05
B_NNE	4.2E-02	3.1E-02
B_NE	1.4E-01	1.1E-01
B_ENE	2.2E-01	1.6E-01
B_E	3.2E-01	2.4E-01
B_ESE-Lake	9.9E-02	7.2E-02
B_SE-Lake	6.6E-02	4.9E-02
B_SSE-Lake	3.6E-02	2.7E-02
B_S-Lake	4.6E-02	3.7E-02
B_SSW-Lake	3.5E-02	2.9E-02
B_SW-Lake	1.7E-02	1.3E-02
B_WSW-Lake	6.4E-05	7.0E-05

⁶ The only exception is the meteorological data used for ADDAM analysis. As discussed in Section 3.2.3, the five-year data for the period of 2017 to 2021 was used.

Receptors	95 th Individual Effective Dose (μSv)*	
	Adult	Infant
B_W-Lake	1.1E-02	8.5E-03
B_WNW	1.3E-02	9.4E-03
B_NW	5.7E-05	3.5E-05
B_NNW	5.8E-05	5.2E-05
IND	4.6E-02	3.4E-02
Fisher	4.5E-02	3.6E-02
Beach	2.2E-02	1.6E-02
UR_WNW	1.0E-02	7.6E-03
UR_NW	4.2E-05	2.7E-05
UR_NNW	3.3E-05	2.1E-05
C2	7.9E-03	5.8E-03
Dairy Farm, NNE	1.1E-03	8.5E-04
Farm, NE	2.7E-03	2.0E-03

Table 33: Doses to Public due to RWC-PT Drop

Receptors	95 th Individual Effective Dose (μSv)	
	Adult	Infant
B_N	1.6E-03	1.6E-03
B_NNE	2.1E-01	2.2E-01
B_NE	7.3E-01	7.4E-01
B_ENE	1.1E+00	1.1E+00
B_E	1.6E+00	1.6E+00
B_ESE-Lake	5.0E-01	5.0E-01
B_SE-Lake	3.6E-01	3.6E-01
B_SSE-Lake	2.1E-01	2.1E-01
B_S-Lake	3.8E-01	3.9E-01
B_SSW-Lake	3.3E-01	3.4E-01
B_SW-Lake	1.0E-01	1.0E-01
B_WSW-Lake	1.5E-03	1.6E-03
B_W-Lake	5.3E-02	5.5E-02
B_WNW	6.1E-02	6.2E-02
B_NW	6.7E-04	7.0E-04
B_NNW	1.1E-03	1.2E-03
IND	2.3E-01	2.4E-01
Fisher	3.7E-01	3.8E-01
Beach	1.0E-01	1.0E-01
UR_WNW	4.8E-02	4.9E-02
UR_NW	5.1E-04	5.3E-04

Receptors	95 th Individual Effective Dose (µSv)	
	Adult	Infant
UR_NNW	6.8E-04	7.0E-04
C2	4.0E-02	4.1E-02
Dairy Farm, NNE	6.3E-03	6.3E-03
Farm, NE	1.6E-02	1.6E-02

Table 34: Doses to Public due to RWC-CT Drop

Receptors	95 th Individual Effective Dose (µSv)	
	Adult	Infant
B_N	4.6E-04	4.6E-04
B_NNE	6.2E-02	6.3E-02
B_NE	2.1E-01	2.1E-01
B_ENE	3.1E-01	3.2E-01
B_E	4.6E-01	4.5E-01
B_ESE-Lake	1.4E-01	1.4E-01
B_SE-Lake	1.0E-01	1.0E-01
B_SSE-Lake	6.1E-02	6.1E-02
B_S-Lake	1.1E-01	1.1E-01
B_SSW-Lake	1.0E-01	1.0E-01
B_SW-Lake	2.9E-02	2.9E-02
B_WSW-Lake	4.72E-04	4.83E-04
B_W-Lake	1.5E-02	1.6E-02
B_WNW	1.7E-02	1.8E-02
B_NW	3.7E-04	3.7E-04
B_NNW	1.9E-04	1.9E-04
IND	6.7E-02	6.8E-02
Fisher	1.1E-01	1.1E-01
Beach	2.9E-02	2.9E-02
UR_WNW	1.4E-02	1.4E-02
UR_NW	2.8E-04	2.8E-04
UR_NNW	1.2E-04	1.1E-04
C2	1.2E-02	1.2E-02
Dairy Farm, NNE	1.8E-03	1.8E-03
Farm, NE	4.7E-03	4.7E-03

Table 35: Doses to Public due to RWC-CTI Drop

Receptors	95 th Individual Effective Dose (µSv)	
	Adult	Infant
B_N	1.1E-05	1.1E-05
B_NNE	1.6E-03	1.6E-03
B_NE	5.3E-03	5.4E-03
B_ENE	7.9E-03	8.0E-03
B_E	1.14E-02	1.14E-02
B_ESE-Lake	3.6E-03	3.6E-03
B_SE-Lake	2.6E-03	2.6E-03
B_SSE-Lake	1.5E-03	1.5E-03
B_S-Lake	2.8E-03	2.8E-03
B_SSW-Lake	2.5E-03	2.5E-03
B_SW-Lake	7.3E-04	7.3E-04
B_WSW-Lake	1.16E-05	1.19E-05
B_W-Lake	3.8E-04	4.0E-04
B_WNW	4.3E-04	4.5E-04
B_NW	5.1E-06	5.1E-06
B_NNW	8.6E-06	8.6E-06
IND	1.7E-03	1.7E-03
Fisher	2.8E-03	2.8E-03
Beach	7.2E-04	7.3E-04
UR_WNW	3.5E-04	3.5E-04
UR_NW	7.5E-06	3.9E-06
UR_NNW	5.2E-06	5.4E-06
C2	2.9E-04	2.9E-04
Dairy Farm, NNE	4.6E-05	4.6E-05
Farm, NE	1.2E-04	1.2E-04

Table 36: Doses to Public due to RWC-EF Drop

Receptors	95 th Individual Effective Dose (µSv)	
	Adult	Infant
B_N	1.7E-06	2.2E-06
B_NNE	6.6E-04	8.4E-04
B_NE	2.3E-03	2.9E-03
B_ENE	3.5E-03	4.4E-03
B_E	5.0E-03	6.2E-03
B_ESE-Lake	1.6E-03	2.0E-03
B_SE-Lake	1.1E-03	1.3E-03
B_SSE-Lake	6.0E-04	7.5E-04

Receptors	95 th Individual Effective Dose (μSv)	
	Adult	Infant
B_S-Lake	8.4E-04	1.0E-03
B_SSW-Lake	6.8E-04	8.0E-04
B_SW-Lake	2.9E-04	3.6E-04
B_WSW-Lake	1.61E-06	2.03E-06
B_W-Lake	1.9E-04	2.4E-04
B_WNW	2.1E-04	2.6E-04
B_NW	8.6E-07	1.3E-06
B_NNW	8.3E-07	1.2E-06
IND	7.3E-04	9.0E-04
Fisher	8.2E-04	9.9E-04
Beach	3.5E-04	4.4E-04
UR_WNW	1.7E-04	2.1E-04
UR_NW	6.6E-07	9.7E-07
UR_NNW	5.1E-07	7.4E-07
C2	1.3E-04	1.7E-04
Dairy Farm, NNE	1.9E-05	2.4E-05
Farm, NE	4.6E-05	5.8E-05

Table 37: Doses to Public due to Earthquake Event

Receptors	95 Percentile Dose (μSv)	
	Adult	Infant
B_N	7.7E-02	7.3E-02
B_NNE	1.1E+01	1.0E+01
B_NE	3.6E+01	3.5E+01
B_ENE	5.5E+01	5.2E+01
B_E	8.0E+01	7.6E+01
B_ESE-Lake	2.5E+01	2.4E+01
B_SE-Lake	1.8E+01	1.7E+01
B_SSE-Lake	1.0E+01	9.8E+00
B_S-Lake	1.8E+01	1.8E+01
B_SSW-Lake	1.6E+01	1.5E+01
B_SW-Lake	5.0E+00	4.8E+00
B_WSW-Lake	7.5E-02	7.3E-02
B_W-Lake	2.7E+00	2.6E+00
B_WNW	3.1E+00	3.0E+00
B_NW	3.7E-02	4.1E-02
B_NNW	2.7E-02	2.8E-02
IND	1.2E+01	1.1E+01
Fisher	1.8E+01	1.7E+01

Receptors	95 Percentile Dose (μ Sv)	
	Adult	Infant
Beach	5.1E+00	4.9E+00
UR_WNW	2.4E+00	2.3E+00
UR_NW	2.8E-02	3.4E-02
UR_NNW	1.6E-02	1.7E-02
C2	2.0E+00	1.9E+00
Dairy Farm, NNE	3.1E-01	3.0E-01
Farm, NE	7.8E-01	7.5E-01

6.3.2 Doses to Workers from Postulated Malfunctions/Accidents

Radioactivity release resulting from the drop of a SG or a RWC was analyzed in Section 6.2. on this basis doses to worker resulting from these events were calculated following the methodology specified in Section 3.2.4. The inputs for dose calculation including assumptions are consistent with those summarized in Appendix B of the previous work [3]. The results are presented in Table 38. From the table, the highest dose to individual worker is 5.0 mSv due to the drop of a RWC-PT, which is less than the acceptance criterion of 50 mSv.

Table 38: Doses to Workers due to the Drop of SG or RWC

Event	Doses to Workers (mSv)
Drop of SG	1.0
Drop of RWC-PT	5.0
Drop of RWC-CT	1.5
Drop of RWC-CTI	0.04
Drop of RWC-EF	0.007

For the earthquake event, the PCSS was assumed to collapse. All RWCs and SGs stored in the PCSS were assumed to be damaged, resulting in airborne releases. Assuming the PWWF workers are able to evacuate, the dose consequence to the worker would be similar to the dose calculated for members of the public.

6.3.3 Summary of Dose Assessment for the Malfunctions and Accidents

The dose consequences resulting from the postulated malfunctions and accidents during on-site transfer, handling and storage of the RWCs and SGs in the PCSS are summarized in Table 39 and Table 40, respectively. As discussed in Sections 6.3.1 and 6.3.2, the doses to public and workers are all less than the dose acceptance criteria.

Note that no radioactive materials are involved during site preparation and construction of the PCSS. Therefore, there are no dose consequences resulting from the postulated malfunctions and accidents during that stage. As such, they are not presented in this section.

Table 39: Postulated Malfunction or Accidents during On-site Transfer of RWCs and SGs

Malfunction or Accident	Potential for occurrence (event /year)	Credible event (Y/N) -See Note 1	Classification (see Note 3)	Potential maximum dose to public (mSv)	Potential maximum occupational dose (mSv)
RWC/SG drop during on-site vehicle accident	See Note 2	Y	See Note 2	1.6E-03	5.0
Vehicle operator health-related emergency	See Note 2	Y	See Note 2	<1.6E-03	<5.0
Fire	See Note 2	Y	See Note 2	0	0
Adverse road/weather conditions	See Note 2	Y	See Note 2	<1.6E-03	<5.0
Soil Failures/Slope Instability	See Note 2	Y	See Note 2	<1.6E-03	<5.0
Earthquake	4.22 E-06	Y	DEC	<1.6E-03	<5.0
Tornado	1.32E-08	N	---	---	---
Thunderstorms /lightning	See Note 2	Y	See Note 2	<1.6E-03	<5.0
Flooding	See Note 2	Y	See Note 2	0	0
Explosions along the transfer route	<5.2E-08	N	---	---	---
Turbine Missile Strike	2.53E-08	N	---	---	---
Aircraft crash	2.53E-10	N	---	---	---
Toxic Gas Release	See Note 2	Y	See Note 2	<1.6E-03	<5.0

Notes:

1. The term credible is used for those events with the frequency of occurrence higher than 1E-06 events per year.
2. The hazard frequency was not calculated for this scenario. The event is considered credible based on its nature or if it is bounded by a credible event. The classification of DEC was assigned to such event for conservatism.
3. As per REGDOC 2.4.4 [19], the following classification was considered for applicability:
 - AOO: an event with a likelihood of occurrence greater than 10^{-2} per year
 - DBA: an event with a likelihood of occurrence less than 10^{-2} per year and greater than 10^{-5} per year
 - DEC: an event with a likelihood of occurrence less than 10^{-5} per year and greater than 10^{-6} per year

Table 40: Postulated Malfunction or Accidents during Handling and Storage in PCSS

Malfunction or Accident	Potential for occurrence (event/year)	Credible event (Y/N)	Classification (see Note 5)	Potential maximum dose to public (mSv)	Potential maximum occupational dose (mSv)
RWC/SG drop during handling in PCSS	>1.6E-05	Y	DBA	1.6E-03	5.0
Collision with RWC or other structures in the PCSS	See Note 2	Y	See Note 2	<1.6E-03	<5.0
Seal failure during storage	See Note 2	Y	See Note 2	<1.6E-03	<5.0
Fire	See Note 2	Y	See Note 2	0	0
Earthquake	See Note 2	Y	See Note 2	8.0E-02	8.0E-02 ⁴
Tornado	See Note 2	Y	See Note 2	<8.0E-02	<8.0E-02 ⁴
Thunderstorms/lightning	See Note 2	Y	See Note 2	0	0
Flooding	See Note 2	Y	See Note 2	0	0
Turbine missile strike	See Note 2	Y	See Note 2	0	0
Explosion	See Note 2	Y	See Note 2	0	0
Aircraft crash	9.87E-07 (See Note 3)	N	---	---	---

Notes:

1. The term credible is used for those events with the frequency of occurrence higher than 1E-06 events per year.
2. The hazard frequency was not calculated for this scenario. The event is considered credible based on its nature or if it is bounded by a credible event. The classification of DEC was assigned to such event for conservatism.
3. The calculated cumulative frequency of occurrence considers the Phase I, Phase II sites (SB3, SB4, SB5 and the portion of PCSS for RWCs) and DSM storage area together.
4. For worker dose during the earthquake, refer to the discussion in Section 6.3.2.
5. As per REGDOC 2.4.4 [19], the following classification was considered for applicability:
 - AOO: an event with a likelihood of occurrence greater than 10⁻² per year
 - DBA: an event with a likelihood of occurrence less than 10⁻² per year and greater than 10⁻⁵ per year
 - DEC: an event with a likelihood of occurrence less than 10⁻⁵ per year and greater than 10⁻⁶ per year

7.0 ALARA Assessment

The estimated collective doses and maximum individual doses from handling and emplacing of one SG, one RWC-PT/CT/CTI and one RWC-EF exclusive of surrounding waste packages corresponding to maximum package external dose rates at 1 m of 10 mrem/hr appear in Table 41.

There are 60 RWC-PT/CTs, 16 RWC-CTIs, 64-RWC-EFs and 48 SGs. The overall collective doses are 16.5, 3.7, 17.7, and 182.6 person-mSv, respectively, for a total collective dose of 221 person-mSv.

The ALARA assessment considers solely the emplacement activities. The results indicate that both the OPG ECL for a NEW of 1,000 mrem/yr (10 mSv/yr) as well as the regulatory limit for a NEW of 5,000 mrem/yr (50 mSv/yr) require that emplacement of RWCs and SGs in the PCSS would require that the task be divided among several workers. In particular, different work crews should be used for each of the following tasks:

- (i) Reception and Emplacement of the RWCs in the PCSS.
- (ii) Reception and Emplacement of the SGs on saddles in the PCSS;

A relatively simple method for reducing doses for emplacement activities would be the use of temporary shielding. Shielding blankets could be placed over the waste packages during transfer activities. Temporary shielding walls could also be erected within the PCSS to reduce doses from waste already emplaced whilst new waste is being brought in.

It would prove prudent to investigate whether further efficiencies in work activities could result in lower exposure times. To this end, the use of mock-up trials and/or the investigation of alternative waste package transfer methodologies should be considered.

Table 41: Handling and Emplacement of Single RWCs and SGs

Estimated Doses for Placement of RWCs and SGs in the PCSS											
Activity No.	Activity	Description	Location	Radiation Source and Distance	Dose Rate (mSv/hr)	Duration (h)	Crew Size	Repeated (# of Times)	Total Duration (h)	Individual Dose (mSv)	Collective Dose (person-mSv)
1.1	Preparation for RWC-PT/CTs	Start-up PCSS ventilation and lighting system, assume after every shift	Outside PCSS	Exit Door	1.14E-02	0.083	1	60	4.98	5.65E-02	5.65E-02
1.2		Walkdown PCSS to confirm/inspect location for RWC placement.	PCSS	RWC-PT/CT@1 m	1.00E-01	0.25	2	1	0.25	2.50E-02	5.00E-02
1.3		Inspect 40T Forklift	PCSS	Exit Door	1.14E-02	0.5	1	1	0.50	5.68E-03	5.68E-03
1.4		Start-up 40T Forklift, adjust forks, place sleeves on forks and move close to RWC-PT/CT package. Assume after every shift.	PCSS	Exit Door	1.14E-02	0.083	1	60	4.98	5.65E-02	5.65E-02
1.5		Ingress and egress of workers at start and end of each shift	PCSS	Exit Door	1.14E-02	0.083	2	60	4.98	5.65E-02	1.13E-01

Estimated Doses for Placement of RWCs and SGs in the PCSS											
Activity No.	Activity	Description	Location	Radiation Source and Distance	Dose Rate (mSv/hr)	Duration (h)	Crew Size	Repeated (# of Times)	Total Duration (h)	Individual Dose (mSv)	Collective Dose (person-mSv)
1.6		OPG Supervision	PCSS	Exit Door	1.14E-02	8	1	60	480.00	5.45E+00	5.45E+00
		Total							495.69		5.73E+00
1.7	Receive 60 RWC-PT/CTs outside PCSS	Receive, inspect RWC-PT/CTs, confirm dose rates	Outside, South side of PCSS	RWC-PT/CT@1 m	1.00E-01	0.25	1	60	15.00	1.50E+00	1.50E+00
1.8		Remove tie-downs for 60 RWC-PT/CTs	Outside, South side of PCSS	RWC on contact	1.39E-01	0.25	2	60	15.00	2.09E+00	4.17E+00
1.9		Perform contamination scan of forklift and personnel prior to exit from PCSS	Inside South side of PCSS	PCSS	1.14E-02	0.083	2	60	4.98	5.65E-02	1.13E-01
1.10		Align Forklift and remove RWC from flatbed	Outside, South side of PCSS	RWC-PT/CT@1 m	1.00E-01	0.083	2	60	4.98	4.98E-01	9.96E-01
		Total							39.96		6.78E+00
1.11	Emplace 60 RWC-PT/CTs in designated location inside PCSS	Move RWC-PT/CT package to inside PCSS and place in appropriate location/layer.	inside PCSS among RWCs	RWC-PT/CT@1 m	1.00E-01	0.25	2	60	15.00	1.50E+00	3.00E+00
1.12		Record/verify RWC-PT/CT ID, location & dose rates	inside PCSS among RWCs	RWC-PT/CT@1 m	1.00E-01	0.083	2	60	4.98	4.98E-01	9.96E-01
		Total							19.98		3.99E+00

Estimated Doses for Placement of RWCs and SGs in the PCSS											
Activity No.	Activity	Description	Location	Radiation Source and Distance	Dose Rate (mSv/hr)	Duration (h)	Crew Size	Repeated (# of Times)	Total Duration (h)	Individual Dose (mSv)	Collective Dose (person-mSv)
2.1	Preparation for RWC-CTIs	Start-up PCSS ventilation and lighting system, assume after every shift	Outside PCSS	Exit Door	1.14E-02	0.083	1	16	1.33	1.51E-02	1.51E-02
2.2		Walkdown PCSS to confirm/inspect location for RWC placement.	PCSS	RWC-CTI@1 m	1.00E-01	0.25	2	1	0.25	2.50E-02	5.00E-02
2.3		Inspect 40T Forklift	PCSS	Exit Door	1.14E-02	0.5	1	1	0.50	5.68E-03	5.68E-03
2.4		Start-up 40T Forklift, adjust forks, place sleeves on forks and move close to RWC-CTI package. Assume after every shift.	PCSS	Exit Door	1.14E-02	0.083	1	16	1.33	1.51E-02	1.51E-02
2.5		Ingress and egress of workers at start and end of each shift	PCSS	Exit Door	1.14E-02	0.083	2	16	1.33	1.51E-02	3.02E-02
2.6		OPG Supervision	PCSS	Exit Door	1.14E-02	2	1	16	32.00	3.63E-01	3.63E-01
		Total							36.73		4.79E-01
2.7	Receive 16 RWC-CTIs outside PCSS	Receive, inspect RWC-CTIs, confirm dose rates	Outside, South side of PCSS	RWC-CTI@1 m	1.00E-01	0.25	1	16	4.00	4.00E-01	4.00E-01

Estimated Doses for Placement of RWCs and SGs in the PCSS											
Activity No.	Activity	Description	Location	Radiation Source and Distance	Dose Rate (mSv/hr)	Duration (h)	Crew Size	Repeated (# of Times)	Total Duration (h)	Individual Dose (mSv)	Collective Dose (person-mSv)
2.8		Remove tie-downs for 16 RWC-CTIs	Outside, South side of PCSS	RWC on contact	1.78E-01	0.25	2	16	4.00	7.10E-01	1.42E+00
		Perform contamination scan of forklift and personnel prior to exit from PCSS	Inside South side of PCSS	PCSS	1.14E-02	0.083	2	16	1.33	1.51E-02	3.02E-02
2.10		Align Forklift and remove RWC from flatbed	Outside, South side of PCSS	RWC-CTI@1 m	1.00E-01	0.083	2	16	1.33	1.33E-01	2.66E-01
		Total							10.66		2.12E+00
2.11	Emplace 16 RWC-CTIs in designated location inside PCSS	Move RWC-CTI package to inside PCSS and place in appropriate location/layer.	inside PCSS among RWCs	RWC-CTI@1 m	1.00E-01	0.25	2	16	4.00	4.00E-01	8.00E-01
		Record/verify RWC-CTI ID, location & dose rates	inside PCSS among RWCs	RWC-CTI@1 m	1.00E-01	0.083	2	16	1.33	1.33E-01	2.66E-01
		Total							5.33		1.07E+00
Activity No.	Activity	Description	Location	Radiation Source and Distance	Dose Rate (mSv/hr)	Duration (h)	Crew Size	Repeated (# of Times)	Total Duration (h)	Individual Dose (mSv)	Collective Dose (person-mSv)
3.1	Preparation for RWC-EFs	Start-up PCSS ventilation and lighting system, assume after every shift	Outside PCSS	Exit Door	1.14E-02	0.083	1	64	5.31	6.03E-02	6.03E-02

Estimated Doses for Placement of RWCs and SGs in the PCSS												
Activity No.	Activity	Description	Location	Radiation Source and Distance	Dose Rate (mSv/hr)	Duration (h)	Crew Size	Repeated (# of Times)	Total Duration (h)	Individual Dose (mSv)	Collective Dose (person-mSv)	
3.2		Walkdown PCSS to confirm/inspect location for RWC placement.	PCSS	RWC-EF@1 m	1.00E-01	0.25	2	1	0.25	2.50E-02	5.00E-02	
3.3		Inspect 40T Forklift	PCSS	Exit Door	1.14E-02	0.5	1	1	0.50	5.68E-03	5.68E-03	
3.4		Start-up 40T Forklift, adjust forks, place sleeves on forks and move close to RWC-EF package. Assume after every shift.	PCSS	Exit Door	1.14E-02	0.083	1	64	5.31	6.03E-02	6.03E-02	
3.5		Ingress and egress of workers at start and end of each shift	PCSS	Exit Door	1.14E-02	0.083	2	64	5.31	6.03E-02	1.21E-01	
3.6		OPG Supervision	PCSS	Exit Door	1.14E-02	8	1	64	512.00	5.81E+00	5.81E+00	
		Total							528.69		6.11E+00	
3.7		Receive 64 RWC-EFs outside PCSS	Receive, inspect RWC-EFs, confirm dose rates	Outside, South side of PCSS	RWC-EF@1 m	1.00E-01	0.25	1	64	16.00	1.60E+00	1.60E+00
3.8			Remove tie-downs for 64 RWC-EFs	Outside, South side of PCSS	RWC on contact	1.43E-01	0.25	2	64	16.00	2.28E+00	4.57E+00
3.9			Perform contamination scan of forklift and personnel	Inside South side of PCSS	PCSS	1.14E-02	0.083	2	64	5.31	6.03E-02	1.21E-01

Estimated Doses for Placement of RWCs and SGs in the PCSS											
Activity No.	Activity	Description	Location	Radiation Source and Distance	Dose Rate (mSv/hr)	Duration (h)	Crew Size	Repeated (# of Times)	Total Duration (h)	Individual Dose (mSv)	Collective Dose (person-mSv)
		prior to exit from PCSS									
3.10		Align Forklift and remove RWC from flatbed	Outside, South side of PCSS	RWC-EF@1 m	1.00E-01	0.083	2	64	5.31	5.31E-01	1.06E+00
		Total							42.62		7.35E+00
3.11	Emplace 64 RWC-EFs in designated location inside PCSS	Move RWC-EF package to inside PCSS and place in appropriate location/layer.	inside PCSS among RWCs	RWC-EF@1 m	1.00E-01	0.25	2	64	16.00	1.60E+00	3.20E+00
3.12		Record/verify RWC-EF ID, location & dose rates	inside PCSS among RWCs	RWC-EF@1 m	1.00E-01	0.083	2	64	5.31	5.31E-01	1.06E+00
		Total							21.31		4.26E+00
6.1	Preparation for RWC-SGs	Start-up PCSS ventilation and lighting system, assume after every shift	Outside PCSS	Exit Door	1.14E-02	0.083	1	48	3.98	4.52E-02	4.52E-02
6.2		Walkdown PCSS to confirm/inspect location for RWC placement.	PCSS	SG@1 m	1.00E-01	0.25	2	1	0.25	2.50E-02	5.00E-02
6.3		Inspect 40T Forklift	PCSS	Exit Door	1.14E-02	0.5	1	1	0.50	5.68E-03	5.68E-03
6.4		Start-up 40T Forklift, adjust forks, place sleeves on	PCSS	Exit Door	1.14E-02	0.083	1	48	3.98	4.52E-02	4.52E-02

Estimated Doses for Placement of RWCs and SGs in the PCSS											
Activity No.	Activity	Description	Location	Radiation Source and Distance	Dose Rate (mSv/hr)	Duration (h)	Crew Size	Repeated (# of Times)	Total Duration (h)	Individual Dose (mSv)	Collective Dose (person-mSv)
		forks and move close to RWC-SG package. Assume after every shift.									
6.5		Ingress and egress of workers at start and end of each shift	PCSS	Exit Door	1.14E-02	0.083	2	48	3.98	4.52E-02	9.05E-02
6.6		OPG Supervision	PCSS	Exit Door	1.14E-02	15	1	48	720.00	8.18E+00	8.18E+00
		Total							732.70		8.41E+00
6.7	Emplacement of SGs in west bay of PCSS	Set up the rigging required (jack and slide system) (inside building)	PCSS	PCSS S Walls @1m	1.14E-02	2.5	6	1	2.5	2.84E-02	1.70E-01
6.8		Receive, inspect and place SG in the PCSS	PCSS	SG @30cm side	1.61E-01	0.5	3	48	24	3.86E+00	1.16E+01
6.9			PCSS	SG @1m side	1.00E-01	2	3	48	96	9.60E+00	2.88E+01
6.10			PCSS	SG @5m side	2.82E-02	4	3	48	192	5.41E+00	1.62E+01
6.11			PCSS	U5 SG @30cm neck	1.61E-01	2.5	2	12	30	4.83E+00	9.65E+00
6.12			PCSS	U6 SG @30cm neck	1.61E-01	2.5	2	12	30	4.83E+00	9.65E+00
6.13			PCSS	U7 SG @30cm neck	1.61E-01	2.5	2	12	30	4.83E+00	9.65E+00
6.14			PCSS	U8 SG @30cm neck	1.61E-01	2.5	2	12	30	4.83E+00	9.65E+00
6.15	Position SG in the storage location		PCSS	U5 SG @1m neck	1.00E-01	4	3	12	48	4.80E+00	1.44E+01
6.16			PCSS	U6 SG @1m neck	1.00E-01	4	3	12	48	4.80E+00	1.44E+01

Estimated Doses for Placement of RWCs and SGs in the PCSS											
Activity No.	Activity	Description	Location	Radiation Source and Distance	Dose Rate (mSv/hr)	Duration (h)	Crew Size	Repeated (# of Times)	Total Duration (h)	Individual Dose (mSv)	Collective Dose (person-mSv)
6.17			PCSS	U7 SG @1m neck	1.00E-01	4	3	12	48	4.80E+00	1.44E+01
6.18			PCSS	U8 SG @1m neck	1.00E-01	4	3	12	48	4.80E+00	1.44E+01
6.19			PCSS	SG @5m side	2.82E-02	4	3	48	192	5.41E+00	1.62E+01
6.20			PCSS	SG @5m side	2.82E-02	44	4	1	44	1.24E+00	4.96E+00
		Total							862.5		1.74E+02
Total Collective Dose											
Maximum Individual Dose - assumes 1 worker does each task apart from supervision											9.60E+00
2.21E+02											

8.0 Conclusions

This report documents the safety assessments that were performed to support the construction of the PCSS on the PWMF site. These safety assessments included a normal operations safety assessment, malfunction/accident safety assessment, and an ALARA assessment.

In the normal operations safety assessment, doses to workers and the public for normal operation of the PWMF were assessed. It was concluded that doses to the public due to chronic emissions from the PWMF were significantly less than the dose acceptance criterion. However, dose to workers and the public due to direct gamma radiation could potentially exceed the dose limit based on the shielding analysis which was conducted based on the current design.

To aid OPG in evaluating different shielding building design options, three configurations were considered for the analysis of the PCSS. The base case considered a PCSS design based on the DWMF RWSB, which has concrete shielding panels and an industrial roof. Two sensitivity cases were then also considered. The first sensitivity case considered a building with a shielded roof based, similar to the SGSB at the WWMF. The second sensitivity considered the same building design as the base case, but with additional shielding added to the area around the overhead door which serves as the main entry point for waste packages into the building. The base case and second sensitivity case (overhead door shielding) exceeded the dose acceptance criteria at dose points PW24, PW26, and PW10. The first sensitivity case (shielded roof) exceeded the dose criteria at PW26 and PW10. For all cases, the SGs were the main contributors to the calculated dose rates. Therefore, for all of the cases the SG source strengths were scaled to be 10 mrem/h at 1 m (which is more realistic as opposed to the conservative 40 mrem/h at 1 m that was originally assumed), and with this scaling the cases with the shielded roof were below the dose criteria at all dose points. Recommendations were made for any future MCNP analysis and these recommendations included refining source terms based on survey results, crediting decay, re-evaluating fence distances around the PCSS, and re-evaluating the waste layout within the PCSS.

In the malfunction/accident safety assessment, hazards were identified and screened for the construction of the PCSS, on-site transfers, handling and storage of the RWCs and SGs. On this basis, the bounding event was identified to be the drop of a SG or a RWC and the radiological consequences of the event were assessed. It was concluded that the doses to worker and public resulting from the event were less than the dose acceptance criteria. The consequence of the earthquake event was also assessed and the estimated doses for all receptors considered were less than the dose acceptance criterion as well.

The ALARA assessment showed that for the emplacement of 60 RWC-PT/CTs, 16 RWC-CTIs, 64-RWC-EFs and 48 SGs, the overall collective doses are 16.5, 3.7, 17.7, and 182.6 person-mSv, respectively, for a total collective dose of 221 person-mSv.. In order to stay below the OPG ECL for a NEW of 1,000 mrem/yr (10 mSv/yr) the emplacement tasks should be divided among multiple workers. Temporary shielding could also be used to reduce dose rates to workers during emplacement activities.

9.0 References

- [1] Ontario Power Generation, "Pickering Waste Management Facility – Safety Report," 92896-SR-01320-10002 R006, November 2018.
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Appendix A: Hazard Pre-Screening

A.1 Hazard Pre-screening

The pre-screening of hazards associated with PCSS safety analysis as presented below was conducted based on the previous work [A-1] and was updated to take into account the project specific aspects, such as the location and design of the PCSS, and the characteristics of the packages (SG or RWC) to be transferred and stored.

Category	Hazard	Screening Status	Rationale
H-EXT External Hazards – Human Induced			
Mobile Sources			
H-EXT-1	Aircraft Impact	IN	This hazard is expected to cause significant damage to the PCSS and may lead to a radiological release.
H-EXT-2 Rail Transportation Hazards			
H-EXT-2.1	Train Crash	OUT	The screening distance for train derailment is estimated to be 80 m (3-rail-car length) from the crash [A-2]. The CN Rail main line runs north of the PNGS, at approximately 3 km to the PWMF and the CP Rail mainline is located approximately 6 km north of the site [A-3]. Therefore, this hazard can be screened out based on the distance from the PWMF.
H-EXT-2.2	Cold Toxic Gas Release	OUT	The CN Rail mainline runs North of the PNGS, at approximately 3 km to the PWMF and the CP Rail mainline is located approximately 6 km north of the site, [A-3]. Table 3-1 of Reference [A-2] shows the SDV for Cold Toxic Gases. SDV for Ammonia, Hydrochloric Acid and Hydrogen Fluoride releases is 0.9 km and 1.4 km, respectively. This means that these toxic materials can be screened out based on distance.
			SDV for Chlorine, Sulphuric Acid and Sulphur Dioxide is 4.4 km. This hazard can be screened out based on frequency (8.81E-07) (refer to Table 3-9 of Reference [A-3]).
H-EXT-2.3	Hot Toxic Gas Release	OUT	The CN Rail mainline runs North of the PNGS, at approximately 3 km to the PWMF and the CP Rail mainline is located approximately 6 km north of the site [A-3]. Table 3-2 of Reference [A-2] shows that the maximum SDV is 2.3 km (sulphur dioxide) for hot toxic gases. Therefore, this hazard can be screened out based on the distance from the PWMF.

Category	Hazard	Screening Status	Rationale
H-EXT-2.4	BLEVE – Missile Damage	OUT	The CN Rail mainline runs North of the PNGS, at approximately 3 km to the PWMF and the CP Rail mainline is located approximately 6 km north of the site, [A-3]. The BLEVE SDV is estimated to be 1600 m [A-2]. Therefore, the BLEVE hazard from rail derailment can be screened out based on the distance from the PWMF.
H-EXT-2.5	BLEVE – Blast Wave	OUT	The blast waves associated with a BLEVE are localized and not as strong as a Vapour Cloud Explosion (VCE) [A-2]. Since this hazard is bounded by the VCE hazard, it is not included in the screening analysis.
H-EXT-2.6	VCE	OUT	The CN Rail mainline runs North of the PNGS, at approximately 3 km to the PWMF and the CP Rail mainline is located approximately 6 km north of the site [A-3]. The Vapour Cloud Explosion SDV is estimated to be 460 m [A-2]. Therefore, this hazard can be screened out based on the distance from the PWMF.
H-EXT-2.7	Explosions of Rail Car Containing Explosive	OUT	The CN Rail mainline runs North of the PNGS, at approximately 3 km to the PWMF and the CP Rail mainline is located approximately 6 km north of the site [A-3]. The SDV is estimated to be 700 m [A-2]. Therefore, this hazard can be screened out based on the distance from the PWMF.
H-EXT-3 Road Transportation Hazards			
H-EXT-3.1	Cold Toxic Gas Release, such as: ammonia, hydrochloric acid and hydrogen fluoride, hot toxic gases, BLEVEs, VCEs, and Explosions	OUT	As major roads/highways are slightly further away from the plant than the railway, these offsite road transportation accidents can be screened out based on distance [A-2].
H-EXT-3.2	Cold Toxic Gas Release e.g., Chlorine; Sulphuric Acid, Sulphur Dioxide	OUT	Only 10% of these chemicals are transported on Highway 401 compared to the CN rail line traffic [A-2]. This hazard can be screened out based on frequency (8.81E-08), referring to Table 3-11 of Reference [A-3].
H-EXT-4 Ship Accidents			

Category	Hazard	Screening Status	Rationale
H-EXT-4.1	Small Vessels	OUT	Boats/small vessels are not permitted to dock on the shore near the PWMF. The accidents associated with small vessels are not expected to have an impact on the PWMF. Therefore, this hazard can be screened out.
H-EXT-4.2	Large Vessels	OUT	The normal shipping lanes in Lake Ontario are 10 kilometres away from the shoreline in the vicinity of the plant [A-2]. In addition, there are no commercial wharfs around the Pickering area [A-3]. Therefore, this hazard can be screened out based on the distance from the PWMF.
Fixed Sources			
H-EXT-5	Nearby Nuclear Event	OUT	An accident at the Pickering A, Pickering B or Darlington NGS, resulting in significant releases would progress slowly enough to ensure notification to PWMF personnel such that the required actions could be taken. Any anticipated dose from the PWMF as a result of a significant event at either Pickering A or Pickering B, would be bounded by the dose received from the station itself. Therefore, this hazard can be screened out.
H-EXT-6 Toxic Gas Release			
H-EXT-6.1	Toxic Gas Release – Chlorine originated from Ajax Water Treatment Plant	IN	The Ajax Water Treatment Plant is situated near the Ajax Waterfront Park and uses chlorine cylinders for water treatment. The SDV for Chlorine is 4.4 km [A-2]. The Ajax Water Treatment facility is located approximately 4.0 km from the PCSS. This hazard cannot be screened out based on distance, it will be further evaluated.
H-EXT-6.2	Toxic Gas Release - Chlorine originated from the Duffin Creek Water Pollution Control Plant	OUT	The Duffin Creek Water Pollution Control Plant which uses chlorine for pollution control is located in Pickering at 1.0 km from the PCSS. Due to its proximity, it may be able to release sufficient chlorine to impair the SG/RWC transporter operator. Since the SDV for chlorine is 4.4 km, this hazard cannot be screened out based on distance. However, the annual frequency of a chlorine leak from a fixed storage tank is 2.86E-07 (refer to Table 3-12 of Reference [A-3]), which is below the cutoff frequency of 10E-6, this hazard can be screened out based on frequency.
H-EXT-7	BLEVE	OUT	External fixed sources of BLEVEs have been identified within a radius of 5 km of PNGS [A-3] and it was concluded that none of the sites were within the

Category	Hazard	Screening Status	Rationale
			SDV, which is 1600 m for BLEVE [A-2]. Therefore, this hazard can be screened out based on distance.
Other Sources			
H-EXT-8	Missiles from Military Activity	OUT	This is considered a malevolent act; therefore, it is out of scope per Reference [A - 2]
H-EXT-9	Orbital Debris Crashes	OUT	Orbital debris can cause serious damage to the SGs and RWCs. There is no SDV for this hazard type [A-2]. However, based on the annual frequency analysis, this hazard can be screened out for UFDS facilities and DSC on-site transfer due to low frequency [A-5][A-6]. Similarly, this hazard can be screened out for the PCSS based on similar building size and transport route.
N-EXT External Hazards – Natural			
N-EXT-1	Earthquakes	IN	The ground motion associated with this event may exceed the design capacity of the PWMF facility. Earthquake could also affect the RWCs or SGs if they are being transported when the earthquake occurs. This hazard has the potential to lead to a radiological release, and therefore it cannot be screened out.
N-EXT-2 Soil Failures			
N-EXT-2.1	Slope Instability	IN	The PNGS site complies with the specific clauses of the Canadian Foundation Engineering Manual and the National Building Code of Canada (NBCC) ([A - 2] and [A-3]). However, potential slope failures/soil instability will impact the onsite transfer of SGs and RWCs. This hazard will be further evaluated.
N-EXT-2.2	Subsidence	OUT	The PNGS site is not situated in a geographical area where subsidence can occur ([A - 2] and [A-3]). Therefore, this hazard can be screened out.
N-EXT-2.3	Swelling Clay	OUT	The foundations of PNGS are not on clay layers [A - 2]. Therefore, this hazard can be screened out.
N-EXT-2.4	Soil Frost	OUT	This hazard is primarily relevant to the integrity of buried piping [A - 2]. This hazard is not anticipated to impact the transfer or storage of the SGs and RWCs and is therefore not applicable to the present assessment.
N-EXT-3 Flooding			

Category	Hazard	Screening Status	Rationale
N-EXT-3.1	Flooding Due to Runoff	IN	A PMP event has the potential to cause damage to the PWMF SSCs and could result in radiological release. Therefore, flooding has been screened in for transportation and storage.
N-EXT-3.2			Main river courses are located at a distance greater than 2 km from the western (Rouge River and the Petticoat Creek) and eastern (Duffin's Creek) boundary of the PNGS site [A-3]. Based on distance, the potential for these rivers to represent a potential flood hazard to the PWMF site is screened out.
	Flooding Due to River	OUT	Krosno Creek is located immediately to the west of the PNGS and is prone to flooding. Based on Flood Plain Mapping from the Toronto and Region Conservation Authority (TRCA), water surface elevations for Krosno Creek are in the range from 76.26 m (at Liverpool Road) to 77.22 m (at Sandy Beach Road). Ground elevations between the PNGS and the flood zone are approximately 3.6 m and 5.1 m, respectively, above the Regional Flood elevation at these locations, Appendix F of Reference [A-3]. An assessment has been conducted as part of the Fukushima follow-up and it was determined that Krosno Creek would maintain at minimum approximately 2.7 m of freeboard from a potential spill during the flooding due to a PMP event. Based on this, the potential for flooding from this river can be screened out.
N-EXT-3.3	Flooding Due to Waves	OUT	Unlike DSMs which are stored outside, the RWCs and SGs are stored within the PCSS which is away from the shore. As such, flooding due to waves will not directly affect RWCs and SGs. Therefore, this hazard can be screened out.
N-EXT-3.4	Flooding Due to Seiche	OUT	Section 4.4.4 of Reference [A-3] notes that the site requires protection for water surge of up to 0.75 m, as the highest modeled water level at Darlington resulting from surge or seiche is about 0.75 m. The 100-year maximum lake level is 75.6 m [A-3], so the possible maximum level is 76.35m. However, the average shoreline near PNGS is 77 m. This hazard can be screened out.
N-EXT-3.5	Flooding Due to Tsunami	OUT	A tsunami in Lake Ontario is an improbable event, with no associated flood hazard potential [A-2]. Furthermore, the Great Lakes are in a geologically stable, mid-continental region, where the probability of occurrence of earthquakes large enough to generate tsunamis is negligible [A-3]. Therefore, this hazard can be screened out.
N-EXT-3.6	Flooding Due to Sudden	OUT	No large lakes and no man-made water retaining structures creating reservoirs are located within the drainage areas in the vicinity of the PNGS that could influence flooding [A-3]. For this reason, this hazard can be screened out.

Category	Hazard	Screening Status	Rationale
	Releases of Water from Natural or Artificial Storage		
N-EXT-3.7	Flooding Due to Rapid Melting of Snow and Large Blocks of Ice	OUT	Rapid melting of snow and large blocks of ice accumulated on the buildings' rooftop and at site as the temperature rises above the freezing point (late winter/early spring) can cause flooding. However, the event is slow developing [A-3], providing enough time for operational personnel to ensure all PWMF facility are in a safe state. Therefore, this hazard can be screened out.
N-EXT-3.8	Flooding Due to Other Causes	OUT	Other causes of flooding may include underwater landslides and lake ice. Lake Ontario shorelines as a whole are not susceptible to shore slope failure or landslide [A-3]; lake ice can be also screened out as a flood hazard as ice structures are not expected to create or worsen any coastal flood hazard at Pickering [A-3]. Therefore, this hazard has been screened out.
N-EXT-4 Meteorological – Extremes			
N-EXT-4.1	Temperature (extreme high/ extreme low)	OUT	Extreme temperatures are predictable allowing time for operational staff to ensure all PWMF facilities are in a safe state. Procedures are in place to prohibit transfer under poor or slippery road conditions [A-6]. Therefore, this hazard can be screened out.
N-EXT-4.2	Snowpack	OUT	Snowpack and subsequent 48-hour winter PMP would occur gradually, allowing time for the removal of snow for affected structures. The procedures will be developed that waste transfer activities should not be performed during snow-covered conditions and are bounded by a transporter failure incident [A-6]. Therefore, this hazard can be screened out.
N-EXT-4.3	Freezing Rain	OUT	The impact of freezing rain is bounded by the impact of external flood, ice-storms and snowpack. Similar to the current practice, procedures will be developed to prohibit transfer under poor or slippery road conditions. Even if the on-site transfer of SG and RWC takes longer than expected as result of adverse road conditions, the radiological consequence is not expected given the robust design of a RWC or packed SG. Therefore, this hazard can be screened out.
N-EXT-4.4	Extreme Water Temperature	OUT	Operation of the PWMF does not depend on the use of lake water. There is no interaction between the transfer of the RWCs and SGs and the lake water temperature. This event is screened out.

Category	Hazard	Screening Status	Rationale
N-EXT-4.5	Avalanches	OUT	The PNGS is not situated in a mountainous region with large slopes which would lead to an avalanche. This event is screened out.
N-EXT-4.6	Lightning	IN	The effects of a lightning strike will increase the temperature of the affected SG or RWC and might result in an increased release of loose contamination from inside the packages; the packages will be cleaned of surface contamination prior to transport. Therefore, this event is screened in.
N-EXT-4.7	Hurricanes	OUT	Tornadoes are more frequent in the region of concern and the impact of a tornado is considered bounding for high-winds category of hazard. Therefore, the wind speeds from tornadoes are considered a bounding hazard.
N-EXT-4.8	Tornadoes	IN	This hazard is expected to cause significant damage to the PWMF and will impact transport and may lead to radiological release. As per [A-8], the tornado occurrence rate in the Pickering site is 3.13E-06 events per year. This hazard requires further evaluation.
N-EXT-4.9	Sandstorms	OUT	Sandstorms are typically associated with deserts. In the vicinity of the PWMF there are no large sand-bodies, therefore sandstorms are not a credible potential external hazard for Ontario [A-3]
N-EXT-4.10	Ice Storms	OUT	The PCSS conforms to NBCC requirements ([A-2][A-3]) which account for loading due to ice and snow. Waste transfer activities should not be performed under severe weather conditions such as ice storms. Therefore, this hazard can be screened out.
N-EXT-4.11	Frazil Ice	OUT	Operation of the PWMF does not depend on the use of the lake water. There is no interaction between transport and the lake. Therefore, this hazard can be screened out.
N-EXT-4.12	Low Lake Level/Drought	OUT	Operation of the PWMF does not depend on the use of the lake water. Therefore, this hazard can be screened out.
N-EXT-4.13	Meteorites	OUT	Similar to the orbital debris hazard, this hazard cannot be screened out based on qualitative screening. However, based on the annual frequencies of this hazard ([A-5][A-6]), this hazard can be screened out for UFDS facilities and DSC on-site transfer due to low frequency. Similarly, this hazard can be screened out for the PCSS based on similar building size and transport route.
N-EXT-4.14	Geomagnetic storm	OUT	Geomagnetic storm events will impact the power distribution system equipment and may cause loss of off-site power [A-3]. This hazard does not have an impact on the PCSS; therefore, it can be screened out.

Category	Hazard	Screening Status	Rationale
N-EXT-5 Other Hazards			
N-EXT-5.1	Forest Fire	OUT	There is no heavily forested area within 3 km of the site [A-6]. The SDV for this hazard is 1 km [A-2]. Therefore, this hazard can be screened out.
N-EXT-5.2	Corrosion from Salt Water	OUT	This hazard is not applicable in the Great Lakes area [A-2]; therefore, this hazard can be screened out.
N-EXT-5.3	Animals	OUT	This hazard does not have any impact on the PWMF site or on-site transfer [A-6].
H-INT Internal Hazards			
H-INT-1	Turbine Generated Missiles	IN	The SG or RWC transfer route from the Station to the PCSS is in the proximity of the stations' powerhouses. A missile may have an impact on the transfer, handing or storage of the SGs or RWCs.
H-INT-2	Other Mechanically Generated Missile Sources	OUT	PWMF facility: As the Heat Transport pump missiles are assumed incapable of penetrating the RB wall; there is no impact to the PWMF facility. The effects of missiles from other pumps and valves are assumed bounded by turbine missiles. During on-site transfer: Similar to DSC on-site transfer, missile sources originating from hydrogen cylinder/trailers/ stationary tank set, compressed gas bottle storage facility and oil storage tank along the SG or RWC onsite transfer route were screened out based on frequency (Section 5.6.1, 5.6.2, 5.6.3 and 5.6.4 of Reference [A-6]). A transportation accident causing mechanical damage and leading to a pressure vessel burst is bounded by tornado missiles.
H-INT-3	Acetylene Decomposition Explosion Missile	OUT	The effects of this hazard would be bounded by that of tornado generated missiles.
H-INT-4	Missiles Generated by a Hydrogen Explosion at the Tritium Removal Facility	OUT	This hazard is associated with the tritium removal facility at Darlington and not applicable for the Pickering site [A-9].
H-INT-5	Control Rod Ejection Missiles	OUT	This hazard is not applicable due to the design of a CANDU reactor [A-9].

Category	Hazard	Screening Status	Rationale
H-INT-6	Explosions within the PWMF Facility and along the on-site transfer route	IN	No explosive materials will be stored in the PCSS. However, there are potential sources of explosions along the SG/RWC transfer route that may lead to radiological releases.
H-INT-7 Release of Toxic, Radioactive or Corrosive Gases and Liquids from On-Site Storage			
H-INT-7.1	Acute Inhalation Toxicity	Out	It is expected that no acutely toxic materials will be stored in the PCSS. Therefore, this hazard can be screened out.
H-INT-7.2	Corrosion	OUT	It is expected that no corrosive materials will be stored in the processing building. Therefore, this hazard can be screened out.
H-INT-7.3	Oxidizing/Reactive Chemicals	OUT	There is no oxygen gas stored at the PWMF facility. This hazard is screened out.
H-INT-7.4	Asphyxiants	OUT	There will not be any significant quantities of asphyxiating gas (argon and helium) stored in the PCSS. Therefore, this hazard can be screened out.
H-INT-7.5	Release of Stored Energy	OUT	Catastrophic failure of pressure vessels is excluded from consideration. There are no other sources of significant stored energy, such as high-pressure piping, associated with the PWMF.
H-INT-8 Transportation			
H-INT-8.1	Vehicle Impacts – Onsite Vehicle Movements	IN	Vehicle accident during onsite transfer of SGs/RWCs have the potential to lead to radiological release. The accident could consist of a collision resulting in a drop of the RWC or SG, or the transporter leaving the road due to transporter operator health-related emergency. Therefore, this hazard is screened in.
H-INT-8.2	Collision Impacts Within PCSS	IN	Collision with other vehicles/structures within the PCSS has the potential to lead to radiological release. Therefore, this hazard is screened in.
H-INT-8.3	Toxic and/or Dangerous Goods - Onsite Vehicle Movements	OUT	This hazard is bounded by vehicle accidents involving radiological waste.
H-INT-8.4	BLEVE – Blast Wave	IN	The blast waves associated with a BLEVE could occur along the SG/RWC transfer route from PNGS to PCSS. Therefore, this hazard is screened in.
H-INT-8.5	Vapour Cloud Explosion	IN	There are propane storage tanks along the SG/RWC transfer route from PNGS to PCSS, which could result in VCE. Therefore, this hazard is screened in.

Category	Hazard	Screening Status	Rationale
H-INT-8.6	Fire	IN	Fires along the transfer route or originating from combustible materials on the transporter can lead to damage of transporter and packages being transported and potential release of radioactivity.
H-INT-9	Collapsed Structures	OUT	This hazard is bounded by earthquakes.
H-INT-10	Fire – Toxic Effects Only	OUT	The effects of this hazard are bounded by fire.
H-INT-11	Dropped or impacting loads	IN	The dropping of SGs/RWCs during handling can lead to radioactive release. This applies to transport and handling in the PCSS.
H-INT-12	Electromagnetic Interference (EMI) and Radio-Frequency Interference (RFI)	OUT	Proper design ensures that EMI and RFI are not a potential hazard to safety. The Pickering B Hazard Screening report [A-3] states that this hazard was accounted for in the design of the PNGS B. The same design requirements would be expected to be applicable to the PWMF.
H-INT-13	Seal Failure	IN	The failure of lid/seal of the SG or RWC could potentially result in the radiological release.
H-INT-14	Fire within the PCSS	IN	Fire within the PCSS can lead to damage of RWCs and SGs stored and potential release of radioactivity.
H-INT-15	Extended loss of AC power (ELAP)	OUT	An ELAP is a loss of all off-site and on-site AC power sources for an unknown period of time. It could be a significant challenge for the long-term cooling of the reactor core and the spent fuel storage pool. Given that only RWCs and SGs will be stored within the PCSS and that cooling is not specifically required for the safe storage of RWCs and SGs and any operation within the PCSS could be held when an ELAP occurs, the radiological impact of an ELAP on the safe operation of the PCSS is negligible. Therefore, this hazard can be screened out.

A.2 References

- [A-1] Ontario Power Generation, "PWMF Safety Assessment Update", 92896-REP-01320-00015, November 2022.
- [A-2] Ontario Power Generation, "OPG Probabilistic Safety Assessment (PSA) Guide – External Hazards Screening," N-GUID-03611-10001 Vol. 8, R005, November 2018.
- [A-3] Ontario Power Generation, "Hazard Screening Analysis – Pickering B", NK30-REP-03611- 00008 R002, December 2021.
- [A-4] Ontario Power Generation, "Dry Storage Module (DSM) Storage Facility Safety Assessment", 90387, December 1990.
- [A-5] Ontario Power Generation, "Hazard Screening Analysis – Pickering Used Fuel Dry Storage", P-REP-03611-00009, R000, September 2017.
- [A-6] Ontario Power Generation, "Hazards Analysis of the Existing Dry Storage Container Transport Route at Pickering Site", 92896-REP-00120-00005 R000, July 2013.
- [A-7] Ontario Power Generation, "Pickering Waste Management Facility Campus Plan", 92896-REP- 03460-00001 R005, November 2014.
- [A-8] Ontario Power Generation, "Pickering NGS "B" High Wind Probabilistic Safety Assessment", NK30-REP-03611-00020-R002, July 2017.
- [A-9] Ontario Power Generation, "OPG Probabilistic Safety Assessment (PSA) Guide – Internal Hazards Screening", N-GUID-03611-10001, Vol. 9, R003 December 2018.

Appendix B: Aircraft Crash Frequency Calculations

This Appendix presents the aircraft crash frequency calculations for the PWMF site. The calculations were based on the Appendix B of Reference [B-1], including the calculation of the effective area of the target and multiplying that by the aircraft crash rate.

The effective target area A_{eff} is calculated as

$$A_{\text{eff}} = A_f + A_s$$

where

$$A_f = (WS + R) * H * \cot\Phi + (2 * L * W * WS) / R + L * W$$
$$A_s = (WS + R) * S$$

Where

A_f = effective fly-in area;
 A_s = effective ski area;
WS = aircraft wingspan;
R = length of the diagonal of the facility;
H = facility height;
 $\cot\Phi$ = mean of the cotangent of the aircraft impact angle;
L = length of facility;
W = width of facility; and
S = aircraft skid distance

The values for the aircraft wingspan, mean of the cotangent of the aircraft impact angle and aircraft skid distance were taken from Tables B-16, B-17 and B-18 from Reference [B-2], respectively. The aircraft crash rates for the PNGS site were taken from Table 3-2 of Reference [B-3]. Airports located in a radius of about 35 kilometers from the PNGS were considered in the airfield crash rate calculations.

For the SG transfer vehicle (SPMT), the size (L, W, H) is from page 18 of Reference [B-4]. The size of the RWC transfer vehicles was conservatively considered to be the same as the size of the SPMT. For PCSS, the dimensions of the building were based on References [B-5].

The results of aircraft crash frequency calculations for the PWMF site, taking into the results of [B-6] and [B-7], are presented in Table B-1.

Table B-1: Aircraft Crash Frequency Calculations

Parameters	Unit	Category 1	Category 2	Category 3	Category 4	Category 5	Total Crash Frequency/ Facility
		Light Aircraft	Helicopters	Small Transport	Large Transport	Military Combat	
Wingspan	WS, ft	73	50	59	98	110	
Skid distance	S, ft	60	0	1440	1440	447	
Impact angle cotangent	cot ϕ	8.2	0.58	10.2	10.2	10.4	
Crash rate	km ² yr ⁻¹	5.10E-06	3.60E-07	9.30E-07	1.20E-06	6.60E-08	
DSC On-Site Transfer with Lifting Transporter							
Transporter Length	L, ft		27.83	27.83	27.83	27.83	
Transporter Width	W, ft		10.88	10.88	10.88	10.88	
Diagonal of Transporter	R, ft		29.88	29.88	29.88	29.88	
Transporter Height	H, ft		15.52	15.52	15.52	15.52	
Effective fly area	Af, ft ²		2,034.72	15,569.24	22,533.58	25,110.67	
Effective skid area	As, ft ²		0.00	127,990.26	184,150.26	62,527.31	
Total Area	Aeff, ft ²		2,034.72	143,559.50	206,683.84	87,637.98	
	Aeff, km ²		0.00019	0.013	0.019	0.008	
Probability of a loaded transporter on-site	yr ⁻¹		0.017	0.017	0.017	0.017	
Crash Frequency	yr ⁻¹		1.17E-12	2.12E-10	3.95E-10	9.20E-12	6.17E-10
Phase I (processing building and storage buildings SB 1 and SB 2)							
Facility Length	L, ft		342.00	342.00	342.00	342.00	
Facility Width	W, ft		312.00	312.00	312.00	312.00	
Diagonal of Facility	R, ft		462.93	462.93	462.93	462.93	

Parameters	Unit	Category 1	Category 2	Category 3	Category 4	Category 5	Total Crash Frequency/ Facility
		Light Aircraft	Helicopters	Small Transport	Large Transport	Military Combat	
Facility Height	H, ft		45.00	45.00	45.00	45.00	
Effective fly area	Af, ft ²		121,800.28	352,129.37	388,008.98	404,205.27	
Effective skid area	As, ft ²		0.00	751,585.13	807,745.13	256,101.55	
Total Area	Aeff, ft ²		121,800.28	1,103,714.50	1,195,754.11	660,306.82	
	Aeff, km ² ₂		0.011	0.103	0.111	0.061	
Crash Frequency	yr ⁻¹		4.07E-09	9.54E-08	1.33E-07	4.05E-09	2.37E-07
DSM/RCS Area							
Facility Length	L, ft	196.00	196.00	196.00	196.00	196.00	
Facility Width	W, ft	136.80	136.80	136.80	136.80	136.80	
Diagonal of Facility	R, ft	239.02	239.02	239.02	239.02	239.02	
Facility Height	H, ft	16.07	16.07	16.07	16.07	16.07	
Effective fly area	Af, ft ²	84,306.88	40,724.47	88,899.39	104,041.95	109,822.95	
Effective skid area	As, ft ²	18,721.16	0.00	429,147.83	485,307.83	156,011.64	
Total Area	Aeff, ft ²	103,028.04	40,724.47	518,047.22	589,349.78	265,834.59	
	Aeff, km ²	0.010	0.004	0.048	0.055	0.025	
Crash Frequency	yr ⁻¹	4.88E-08	1.36E-09	4.48E-08	6.57E-08	1.63E-09	1.62E-07
Phase II - DSC Storage Buildings SB3, SB4 and SB5							
Facility Length	L, ft		891.08	891.08	891.08	891.08	
Facility Width	W, ft		553.75	553.75	553.75	553.75	
Diagonal of Facility	R, ft		1049.13	1049.13	1049.13	1049.13	
Facility Height	H, ft		33.19	33.19	33.19	33.19	
Effective fly area	Af, ft ²		369,189.50	731,629.83	781,518.39	804,562.77	
Effective skid area	As, ft ²		0.00	1,595,705.38	1,651,865.38	518,130.54	
Total Area	Aeff, ft ²		369,189.50	2,327,335.21	2,433,383.77	1,322,693.32	
	Aeff, km ²		0.034	0.216	0.226	0.123	

Parameters	Unit	Category 1	Category 2	Category 3	Category 4	Category 5	Total Crash Frequency/ Facility
		Light Aircraft	Helicopters	Small Transport	Large Transport	Military Combat	
Crash Frequency	yr ⁻¹		1.23E-08	2.01E-07	2.71E-07	8.11E-09	4.93E-07
PCSS for RWCs							
Facility Length	L, ft	167.00	167.00	167.00	167.00	167.00	
Facility Width	W, ft	157.00	157.00	157.00	157.00	157.00	
Diagonal of Facility	R, ft	229.21	229.21	229.21	229.21	229.21	
Facility Height	H, ft	26.24	26.24	26.24	26.24	26.24	
Effective fly area*	Af, ft ²	51351.05	18331.67	55806.12	65486.37	69355.00	
Effective skid area*	As, ft ²	9066.35	0.00	207512.42	235592.42	75813.81	
Total Area	Aeff, ft ²	60417.40	18331.67	263318.53	301078.79	145168.82	
	Aeff, km ²	0.006	0.002	0.024	0.028	0.013	
Crash Frequency	yr ⁻¹	2.86E-08	6.13E-10	2.28E-08	3.36E-08	8.90E-10	8.64E-08
Cumulative Frequency for Used Fuel Dry Storage Area (Phase I and Phase II), RCS Area and PCSS for RWCs							
							9.78E-07
PCSS for SGs							
Facility Length	L, ft	167.00	167.00	167.00	167.00	167.00	
Facility Width	W, ft	157.00	157.00	157.00	157.00	157.00	
Diagonal of Facility	R, ft	229.21	229.21	229.21	229.21	229.21	
Facility Height	H, ft	26.24	26.24	26.24	26.24	26.24	
Effective fly area*	Af, ft ²	51351.05	18331.67	55806.12	65486.37	69355.00	
Effective skid area*	As, ft ²	9066.35	0.00	207512.42	235592.42	75813.81	
Total Area	Aeff, ft ²	60417.40	18331.67	263318.53	301078.79	145168.82	
	Aeff, km ²	0.006	0.002	0.024	0.028	0.013	
Crash Frequency	yr ⁻¹	2.86E-08	6.13E-10	2.28E-08	3.36E-08	8.90E-10	8.64E-08
RWC/SG On-Site Transfer							
Transporter Length	L, ft	60.27	60.27	60.27	60.27	60.27	

Parameters	Unit	Category 1	Category 2	Category 3	Category 4	Category 5	Total Crash Frequency/ Facility
		Light Aircraft	Helicopters	Small Transport	Large Transport	Military Combat	
Transporter Width	W, ft	13.00	13.00	13.00	13.00	13.00	
Diagonal of Transporter	R, ft	61.66	61.66	61.66	61.66	61.66	
Transporter Height	H, ft	15.75	15.75	15.75	15.75	15.75	
Effective fly area	Af, ft ²	20,029.67	3,074.26	21,666.42	28,922.98	31,696.48	
Effective skid area	As, ft ²	8,079.37	0.00	173,744.76	229,904.76	76,730.27	
Total Area	Aeff, ft ²	28,109.04	3,074.26	195,411.19	258,827.74	108,426.75	
	Aeff, km ²	0.00261	0.00029	0.018	0.024	0.010	
Probability of a loaded transporter on-site	yr ⁻¹	0.004	0.004	0.004	0.004	0.004	
Crash Frequency	yr ⁻¹	5.63E-11	4.34E-13	7.13E-11	1.22E-10	2.81E-12	2.53E-10

Note: *Based on the arrangement of RWCs and SGs in the PCSS, it is conservatively assumed that 50% of the PCSS is occupied by RWCs. Only this portion of the PCSS was taken into account the calculation of cumulative crash frequency for safety containers. The crash frequency for the rest of the building used for the storage of SGs was calculated separately.

B.1 References

- [B-1] US Department of Transportation, "Accident Analysis for Aircraft Crash into Hazardous Facilities", DOE-STD-3014-2006, Reaffirmed May 2006
- [B-2] OPG, Ontario Power Generation Used Fuel Dry Storage Container Design Requirement, 00104-DR-79171-10000 R03, June 2011
- [B-3] OPG, "Hazard Screening Analysis – Pickering B", NK30-REP-03611-00008 R002, December 2021.
- [B-4] Mammoet, "Old Steam Generator Offloading and Laydown Procedure", W -01098-PLAN-79137-00013 R000, 2007.
- [B-5] OPG, Email from Shelaney L. To Eric H. Re PCSS Layout, PV209/RE/0009 R00, July 27, 2023.
- [B-6] OPG, "NSS-P Safety Assessment Update," 92896-REP-01320-00015 R00, November 2022.
- [B-7] OPG, "Radiological Assessment of Lower Aged Fuel in PWMF SB3 including Conceptual SB5", 92896-REP-01320-00013 R00, April 2021.

Appendix C: Photos along the Portion of the Transfer Route

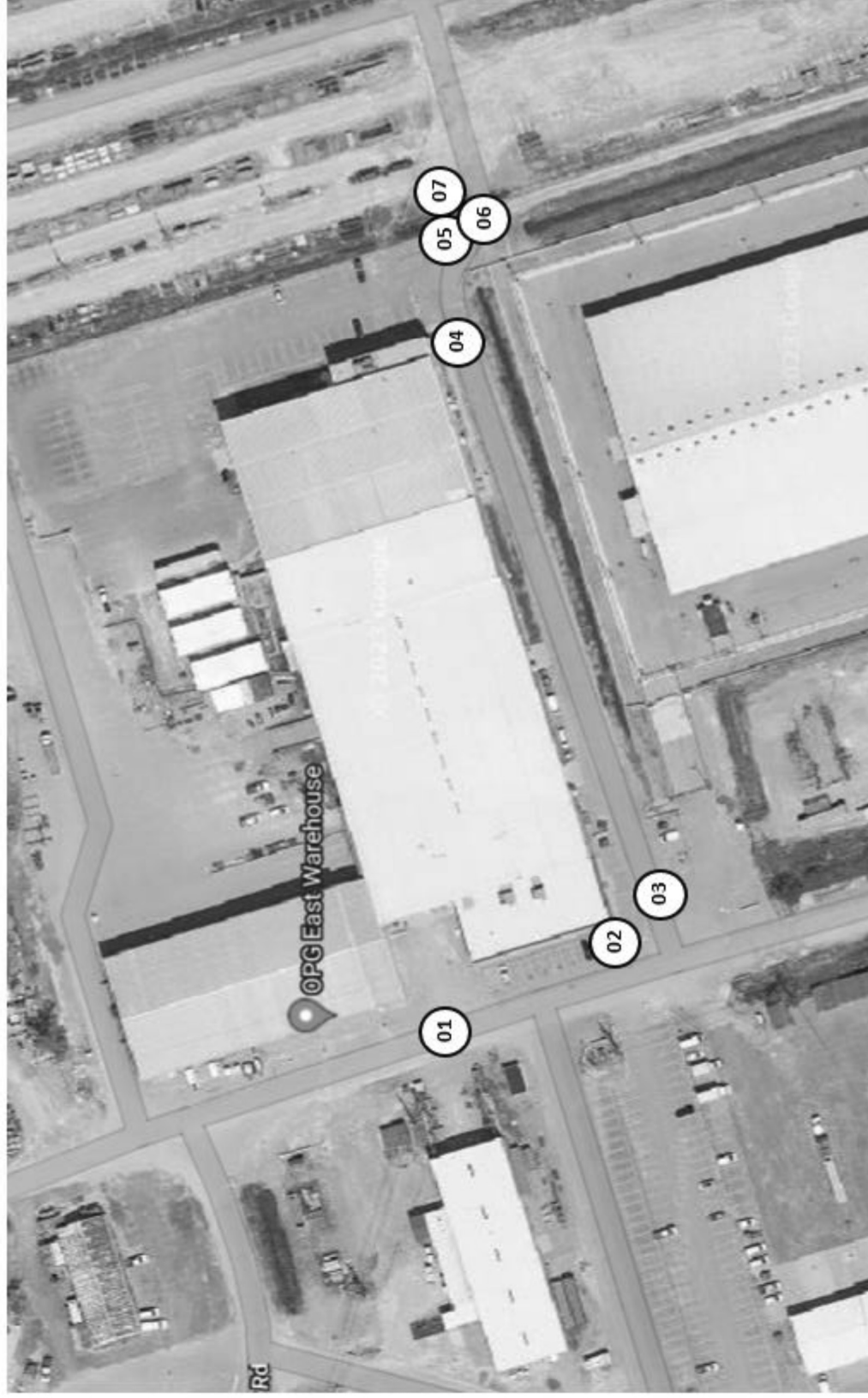


Figure C: Picture Showing the Locations where Photos were Taken along the Transfer Route)



Figure C-1: Photo Taken at East Complex Warehouse Cross-Walk (Approximate 50m North of Intersection).



Figure C-2: Photo Taken At the Southwest Corner of East Complex Warehouse (Looking Southeast towards Entrance to PWMF Building).



Figure C-3: Photo Taken At the Southwest Corner of East Complex Warehouse (Looking East along the Route)



Figure C-4: Photo Taken At the Southeast Corner of East Complex Warehouse (Looking West towards PNGS).



Figure C-5: Photo Taken At the Midpoint of Curved Section of Route (Looking South) .



Figure C-6: Photo Taken At Eastern End of Route (Looking West).



Figure C-7: Photo Taken At Eastern End of Route (Looking Northeast through the Fence)
Note: PCSS will be built in this area.

Appendix D: Materials used in MCNP Modeling

D.1 Single Container MCNP Models

D.1.1 RWC-PT

For the RWC-PT concept, the container material is simply listed as carbon steel [8]. As the type of carbon steel was not specified, a carbon steel used in the previous full building MCNP model of the PWMF site [5], ASTM A516 Grade 70, was used to allow for easy integration of the new containers into the full building model in the Stage 2 calculation. The PT/CT coupons were treated as 100% zirconium, as this is a thick-walled container and photons are being modelled, it is not necessary to include the exact composition of the PT/CTs. The density of the homogenized PT/CT coupons was determined by taking the assumed mass of 3192 kg of coupons per container provided in Reference [8] and dividing it by the container internal volume of 1.78 m³ to get a density of 1.79 g/cm³. The composition of the materials used in the RWC-PT model is shown in Table D-1.

Table D-1: Material Composition of RWC-PT Components

Material	Density (g/cm ³)	Composition (wgt %)
Carbon Steel (ASTM A516 Grade 70)	7.85	C: 0.27% Si: 0.4% P: 0.025% S: 0.025% Mn: 1.2% Fe: 98.08%
Homogenized PT Coupons	1.79	Zr: 100%

D.1.2 RWC-EF

The material specification for the RWC-EF model was left unchanged from those used in the previous shielding analysis for the conceptual design of the RWC-EF [6]. The composition of the container and the End Fitting assemblies is shown in Table D-2 and Table D-3.

Table D-2: Material Composition of RWC-EF Container [6]

RWC-EF Component	Material Specification
External Bolt	ASTM A352 LC3
Fork Lift Pocket Support	A36 Carbon Steel
Internal Shield Plates and Plenum	A36 Carbon Steel
Lid	ASTM A516 Gr. 60
Body	ASTM A516 Gr.60

Table D-3: Material Composition of End Fitting Assemblies [6]

IEFs component	Material Specification
EF body	SS Type 403
Liner Tube	SA268 TP410
Fuel Adapter, Flow Tube, Shield Plug Body	SS Type 410
Wear Ring, Casing, Spider/Safety Stem and Latch	ASTM A564 SS630
Inboard Journal Ring	UNS T30102 AISI Type D2
Outboard Bearing Sleeve	UNS T30102 AISI Type A2
EF Shielding Sleeve	ASTM A519 Gr. 1025 Carbon Steel

D.1.3 Steam Generators

For the Steam Generator models, the materials were taken from the drawing of the SG [10] to the extent possible.

Table D-4: Material Composition of SG Components

Component	Material	Density (g/cm³)	Composition (wgt %)
Outer Shell	Carbon Steel – ASTM A516 Grade 70	7.85	C: 0.27% Si: 0.4% P: 0.025% S: 0.025% Mn: 1.2% Fe: 98.08%
Homogenized u-tube bundle	Nickel-Copper – ASTM B163 [63]	Material: 8.8 g/cm ³ Component ⁷ : 1.0399 g/cm ³	C: 0.3% S: 0.024% Si: 0.5%

⁷ Homogenized u-tube bundle density was set to 11.82% of the material density to account for the hollow tubes in the bundle. This ratio is consistent with the previous modelling of the WWMF SGs in Reference [8].

			Mn: 2% Fe: 2.5% Ni: 66.676% Cu: 28%
Tubesheet ⁸	Carbon Steel Forgings for Piping – ASTM SA105 [64]	Material: 7.86 g/cm ³ Component ⁹ : 0.929 g/cm ³	C: 0.35% Mn: 0.60% P: 0.035% S: 0.04% Cu: 0.40% Ni: 0.40% Cr: 0.30% Mo: 0.12% V: 0.08% Fe: 97.675%

D.2 Full Building PCSS MCNP Model

The materials used were largely the same as the previously developed model for the PWMF in Reference [5]. A new material was added to represent the rockwool insulation of the industrial roof of the PCSS. This material definition was taken from the shielding analysis of the RWSB at the DWMF [12].

The materials for the RWCs and SGs were incorporated into the model, using the same definitions as described above. The only exception is that the air inside the RWC-EF used when creating the surface source used a slightly different density and definition of air, which was replaced with the same air definition as the rest of the model. The assumed composition of the materials used in the modelling of the PCSS are shown in Table D-5.

⁸ Carbon Steel Forgings for Piping - ASTM SA105 from reference [62] contains 0.1 to 0.33% of silicon. However, for a gamma calculation, the omission of a very small amount of silicon in the Tubesheet, which is not part of the source material, is acceptable and hence the composition was not corrected.

⁹ The tubesheet density was set to 11.82% of the material density to account for the hollow tubes. This ratio is consistent with the previous modelling of the WWMF SGs in Reference [8].

Table D-5: Composition of PCSS Materials

Material	Density (g/cm ³)	Element	Weight %	Reference
Concrete (shielding panels, floor)	2.35	H	0.56	Same as existing model in [5], first described in [16]
		O	49.83	
		Na	1.71	
		Mg	0.24	
		Al	4.56	
		Si	31.58	
		S	0.12	
		K	1.92	
		Ca	8.26	
		Fe	1.22	
Steel (A516 Grade 70, industrial roof cladding)	7.85	C	0.27	Same as existing model in [5], first described in [16]
		Si	0.4	
		P	0.025	
		S	0.025	
		Mn	1.2	
		Fe	98.08	
Rockwool Insulation (industrial roof insulation)	0.1	O	41.72	[12]
		Na	1.699	
		Al	3.45	
		Si	24.74	
		P	0.0655	
		K	1.303	
		Ca	21.64	
		Ti	0.306	
		Mn	0.0465	
		Fe	1.82	

ENCLOSURE 2

OPG letter, K. Aggarwal to C. Salmon, "Pickering Waste Management Facility - Application for Waste Facility Operating Licence WFOL-W4-350.00/2028 Amendment to Construct and Operate the Pickering Component Storage Structure"

CD# 92896-CORR-00531-01544 P

Predictive Environmental Risk Assessment for Pickering Component Storage Structure

92896-REP-07701-00019 R001

(64 total pages)

Proprietary	
Document Number: 92896-REP-07701-00019	
Sheet Number: n/a	Revision: R001
Title: Predictive Environmental Risk Assessment for Pickering Component Storage Structure	

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Predictive Environmental Risk Assessment for Pickering Component Storage Structure

92896-REP-07701-00019 R001 (LOF)

2023-11-30

Proprietary

Accepted by:

Cammie Cheng

Nov 30, 2023

Cammie Cheng
Senior Manager, Environment,
Health and Safety Nuclear

PREDICTIVE ENVIRONMENTAL RISK ASSESSMENT FOR PICKERING COMPONENT STORAGE STRUCTURE

92896-REP-07701-00019 R001 (LOF)

REPORT PREPARED FOR:

Ontario Power Generation
889 Brock Road
Pickering, ON L1W 3J2

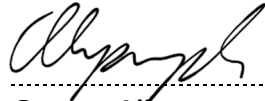
REPORT PREPARED BY:

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Mississauga, ON

Ref. 23-3251, R001
15 November 2023

PREDICTIVE ENVIRONMENTAL RISK ASSESSMENT FOR PICKERING COMPONENT STORAGE STRUCTURE

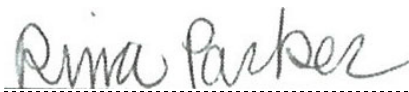
92896-REP-07701-00019 R001 (LOF)



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Author



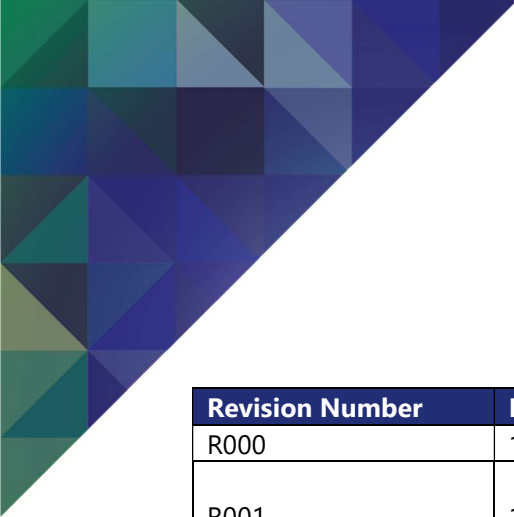
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Don Hart, Ph.D.
Project Principal and Reviewer



Revision Number	Date	Comments
R000	19-Oct-2023	Initial Issue of report.
R001	15-Nov-2023	Revision of Section 6.1.4.1 and Section 6.1.4.2 to remove text referring to a 1% increase in vehicle traffic.

LAND ACKNOWLEDGMENT

The lands and waters on which the Pickering Nuclear Generating Station (PNGS) is situated are the treaty and traditional territory of the Michi Saagiig and Chippewa Nations, collectively known as the Williams Treaties First Nations.

PNGS is within the territory of the Gunshot Treaty and the Williams Treaties of 1923. These Treaty Rights were reaffirmed in 2018 in a settlement with Canada and the Province of Ontario.

To acknowledge the treaty and traditional territory, is to recognize the rights of the First Nations. It is to recognize the history of the land, predating the establishment of the earliest European colonies. It is also to acknowledge the significance for the Indigenous peoples who lived and continue to live upon it, to acknowledge the people whose practices and spiritualities are tied to the land and water and continue to develop in relation to the territory and its other inhabitants today.



EXECUTIVE SUMMARY

Ontario Power Generation (OPG), plans to construct the Pickering Component Storage Structure (PCSS) for the storage of low and intermediate level waste, including components such as steam generators, pressure and calandria tubes, calandria tube inserts as well as end fittings.

Since this would be a new activity for the Nuclear Sustainability Services – Pickering Waste Management Facility (NSS-PWMF) within Pickering Nuclear (PN) site, not covered under the current NSS-PWMF operating licence, a licence amendment to the existing NSS-PWMF operating licence will be required. A predictive environmental risk assessment (PERA) is prepared to be a supporting document to the licence amendment application. The PERA presented in this document meets the requirements outlined in CSA N288.6-22 (CSA, 2022) and REGDOC 2.9.1 (CNSC, 2020).

The PERA will supplement the existing PN environmental risk assessment (ERA) (Ecometrix, 2023a) which has so far not considered the potential for effects from the PCSS.

The potential interactions of the PCSS Project with various environmental components during all phases of the Project were evaluated qualitatively. Based on the qualitative assessment of Project-Environment interactions, the following assessment areas were identified as the focus of the quantitative assessment in the PERA.

- Emissions of dust (total suspended particulates) and particulate matter (PM₁₀, PM_{2.5}) to air during site preparation and construction.
- Elevated noise levels during site preparation and construction.
- Gamma radiation from the PCSS during operation.

Human Health Risk Assessment

The screening assessment of air quality and noise indicated that all predicted air concentrations and noise levels are expected to be below their limits; therefore, no further quantitative assessment is required.

The human health risk assessment evaluated the impact on human health of gamma radiation from the PCSS. For exposure of human receptors to gamma radiation from the PCSS, the potential dose to the Sport Fisher, located at the outfall, was evaluated. The estimated dose for the Sport Fisher is 4.38 µSv/a. Considering the existing facilities on the PN site, the dose to the Sport Fisher could be up to 4.94 µSv/a. This estimate represents less than 1% of the regulatory public dose limit of 1000 µSv/a.

Overall, since the dose estimates are a small fraction of the public dose limit and natural background exposure, no discernable health effects are anticipated due to exposure of potential groups to gamma radiation from the PCSS.

Ecological Risk Assessment

The screening assessment of air quality indicated that all predicted air concentrations are expected to be below their limits; therefore, no further quantitative assessment is required. While no specific noise level thresholds exist for ecological receptors, noise levels are expected to be elevated temporarily only during site preparation and construction. Most wildlife in the area are already accustomed to noise levels associated with an urban environment (i.e., noise from traffic on local roads and highway 401 and from other nearby industrial and commercial activities). Therefore, no further quantitative assessment is required.

The ecological risk assessment evaluated the impact on ecological health of gamma radiation from the PCSS. For exposure of ecological terrestrial receptors to gamma radiation from the PCSS, the maximum dose rate to any ecological receptors residing in close proximity to the PCSS could be up to 0.012 mGy/d, and up to 2.74E-04 mGy/d for off-site ecological receptors residing at the fenceline. All predicted doses are lower than the 2.4 mGy/d radiation benchmark for terrestrial biota. Therefore, it was concluded that there are likely no adverse radiological effects to the ecological receptors.

The dose also remains well below the radiation benchmark (1% or less) if the maximum dose from the PCSS is combined with the dose to ecological receptors from being exposed to radionuclides through other existing PN operations.

Mitigation Measures and Environmental Monitoring Program

OPG will obtain all required environmental approvals and permits for the Project and will follow typical construction best practices including implementation of an Environmental Management Plan and a Stormwater Management Plan.

OPG's Environmental Policy requires that OPG maintain an Environmental Management System (EMS) consistent with the ISO 14001 Environmental Management System Standard. During site preparation, construction and operation of the PCSS, OPG's EMS will continue to require the assessment of environmental risks associated with the facility's activities, and to ensure that these activities are conducted such that any adverse impact on the natural environment is as low as reasonably achievable (ALARA).

Thermoluminescent dosimeters (TLDs) will be installed around the PCSS to monitor ambient dose rates during operation, and confirm that gamma dose rates remain below the dose rate target of 0.5 µGy/hr. TLD measurements will be summarized in the quarterly reports for the NSS-PWMF.

Based on the results of the PERA, no need for additional mitigation as a result of the PCSS was identified.

Overall, the PCSS will not result in any unacceptable risks to human and ecological receptors residing in the vicinity of the PN site. OPG maintains a comprehensive Environmental Monitoring

Program that provides data to confirm that all facilities on the PN site, including the future PCSS, operate in a manner that is protective of human and ecological receptors residing in the surrounding area.

LIST OF ACRONYMS

Acronym	Definition
AAQC	Ambient Air Quality Criteria
ALARA	As Low As Reasonably Achievable
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CNSC	Canadian Nuclear Safety Commission
CO	Carbon Monoxide
COPC	Contaminant of Potential Concern
CSA	Canadian Standards Association
EMP	Environmental Monitoring Program
ERA	Environmental Risk Assessment
HHRA	Human Health Risk Assessment
ISO	International Organization for Standardization
L&ILW	Low and Intermediate Level Waste
MECP	Ontario Ministry of Environment, Conservation and Parks
NOx	Nitrogen Oxides
NSS-DWMF	Nuclear Sustainability Services – Darlington Waste Management Facility
NSS-PWMF	Nuclear Sustainability Services – Pickering Waste Management Facility
OPG	Ontario Power Generation
PCSS	Pickering Component Storage Structure
PERA	Predictive Environmental Risk Assessment
PM	Particulate Matter
PN	Pickering Nuclear
PNGS	Pickering Nuclear Generating Station
QA	Quality Assurance
RWSB	Retube Waste Storage Building
SO ₂	Sulfur Dioxide
TLD	Thermoluminescent Dosimeters
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UCLM	Upper Confidence Limit on the Mean
WSP	Water Supply Plant

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1.0 Introduction

Ontario Power Generation (OPG) plans to construct and operate the Pickering Component Storage Structure (PCSS) for the storage of low and intermediate level waste, including components such as steam generators, pressure and calandria tubes, calandria tube inserts as well as end fittings.

Since this would be a new activity for the Nuclear Sustainability Services – Pickering Waste Management Facility (NSS-PWMF) within Pickering Nuclear (PN), not covered under the current NSS-PWMF operating licence, a licence amendment to the existing NSS-PWMF operating licence will be required. In order to obtain the licence amendment, it will be necessary to demonstrate to the Canadian Nuclear Safety Commission (CNSC) that construction and operation of the PCSS will have no adverse significant environmental impact.

Accordingly, a predictive environmental risk assessment (PERA) has been prepared to be a supporting document to the licence amendment application. The PERA presented in this document meets the requirements outlined in CSA N288.6-22 (CSA, 2022) and REGDOC 2.9.1 (CNSC, 2020). Clause 11.1 of CSA N288.6-22 and Section 4.1.1 of REGDOC 2.9.1 version 1.2 identify the need for a revised predictive environmental risk assessment when there is a proposed major facility change. From OPG's perspective, construction and operation of the PCSS is considered a proposed major facility change that would trigger a predictive environmental risk assessment. The PERA is intended to supplement the existing PN environmental risk assessment (ERA) (Ecometrix, 2023a) and to support any future ERAs and/or PERAs that will be completed for PN, as applicable.

1.1 Indigenous Engagement

OPG recognizes that while the assessment of effects from the PCSS project has been satisfied from the Western scientific perspective, it may not fully address the impact on Indigenous inherent and treaty rights as they are understood today. OPG endeavors to continue to work with Indigenous nations and communities to develop more fulsome and ongoing engagement. OPG plans to share this PERA report with Indigenous nations and communities for feedback.

2.0 Objectives and Scope

The objective of this assessment is to predict any potential adverse environmental effects (alternatively referred to as “effects”) associated with the construction and operation of the PCSS.

The scope of the assessment will include consideration of project activities and their interactions with the environment, screening level identification of activities with potential for environmental effects, and prediction of effects from those activities.

The construction activities associated with building the structure will be considered at a screening level, but as further discussed below under project-environment interactions (**Section 5.0**), no environmental impacts from construction are expected. Accordingly, the scope of this assessment will be focused thereafter on the facility operation. Consistent with CSA N288.6:22 (CSA, 2022), the scope of this assessment only considers normal operation of the PCSS and does not assess potential effects associated with accidents.

Decommissioning of the PCSS is out of scope for this assessment. The existing Preliminary Decommissioning Plan for the NSS-PWMF will be updated to include decommissioning planning for the PCSS.

The predicted effects from the PCSS will be compared to existing effects related to the current PN operations as described in the existing PN ERA (Ecometrix, 2023a).

The need for mitigation measures, or for environmental monitoring related to operation of the PCSS, will be considered based on the predicted effects of the operation.

Cumulative effects due to the operation of the PCSS will be evaluated, along with a comparison against baseline conditions in the existing PN ERA (Ecometrix, 2023a).

3.0 Structure of the Assessment

The PERA is carried out in accordance with ERA guidance as per CSA N288.6-22 (CSA, 2022) and CNSC REGDOC 2.9.1 (CNSC, 2020). The steps in the assessment are illustrated at a high level in **Figure 3-1**.

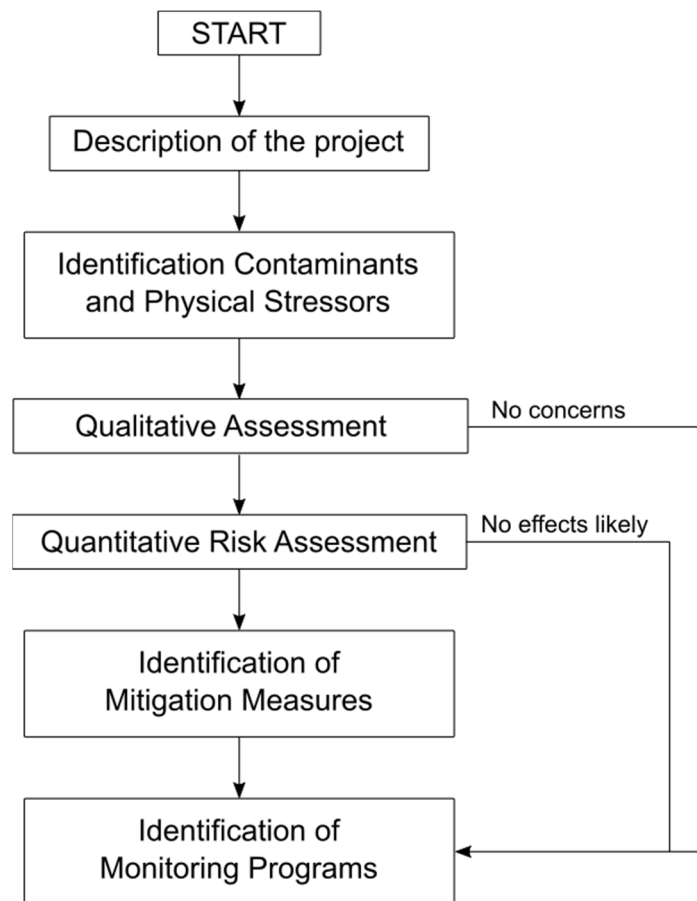


Figure 3-1: Steps in the Predictive Environmental Risk Assessment

A qualitative assessment of potential for environmental effects related to project activities (i.e. of potential project-environment interactions) identifies activities that require a quantitative predictive assessment.

The quantitative risk assessment in **Figure 3-1** includes consideration of risk to both human receptors (HHRA) and ecological receptors (EcoRA). These are two components of ERA as described by CSA N288.6-22 (CSA, 2022).

The mitigation measures mentioned in **Figure 3-1** refer to environmental protection measures associated with the project, which include measures to monitor and/or control emissions, as described in CNSC REGDOC 2.9.1 on Environmental Protection (CNSC, 2020).

The monitoring programs mentioned in **Figure 3-1** refer to the environmental monitoring programs (EMP). Any additions to the existing EMP that may be needed in relation to the operation of the PCSS will be described.

The following sections of this report address the structure outlined in **Figure 3-1**, including:

- Section 4.0 Description of the Project (including contaminants of potential concern)
- Section 5.0 Potential Project-Environment Interactions, Qualitative Assessment, and Plan for Quantitative Assessment
- Section 6.0 Predictive Human Health Risk Assessment
- Section 7.0 Predictive Ecological Risk Assessment
- Section 8.0 Cumulative Effects Assessment
- Section 9.0 Environmental Management
- Section 10.0 Quality Assurance
- Section 11.0 Conclusions and Recommendations

4.0 Description of the Project

4.1 Project Overview

The Nuclear Sustainability Services – Pickering Waste Management Facility (NSS-PWMF), formerly the Pickering Waste Management Facility (PWMF), sits within the Pickering Nuclear (PN) site to the east of the Pickering Nuclear Generating Station (PNGS). The PN site is located in the Province of Ontario, in the Regional Municipality of Durham, in the City of Pickering, on the north shore of Lake Ontario at Moore Point, about 32 km east of downtown Toronto and 21 km west of Oshawa at latitude 43° 49' N and longitude 79° 04' W. The site location and vicinity are shown in **Figure 4-1**. The PN site is owned and operated by Ontario Power Generation (OPG).

The NSS-PWMF has been in service since 1994 and is comprised of two (2) sites. The NSS-PWMF Phase I site is located southeast of PN Unit 8, adjacent to the east side of the station security fence, and contains two used fuel dry storage buildings and a Retube Component Storage area. The NSS-PWMF Phase II site is located approximately 500 m north-east of the power generating facilities in the East Complex, with its own distinct “protected area” (OPG, 2018).

The proposed PCSS will be located adjacent to the northern boundary of the NSS-PWMF Phase II site within the Pickering Site East Complex as shown in **Figure 4-2**. However, ownership and operation of the PCSS will fall under the NSS-PWMF. The PCSS will be used for the storage of low and intermediate level waste from potential refurbishment and/or decommissioning storage requirements, including components such as steam generators, pressure and calandria tubes, calandria tube inserts, and end fittings. Based on the expected waste streams that will be produced, the PCSS is expected to have an area of approximately 26,000 ft². The structure will be shielded with concrete walls and enclosed with a roof.

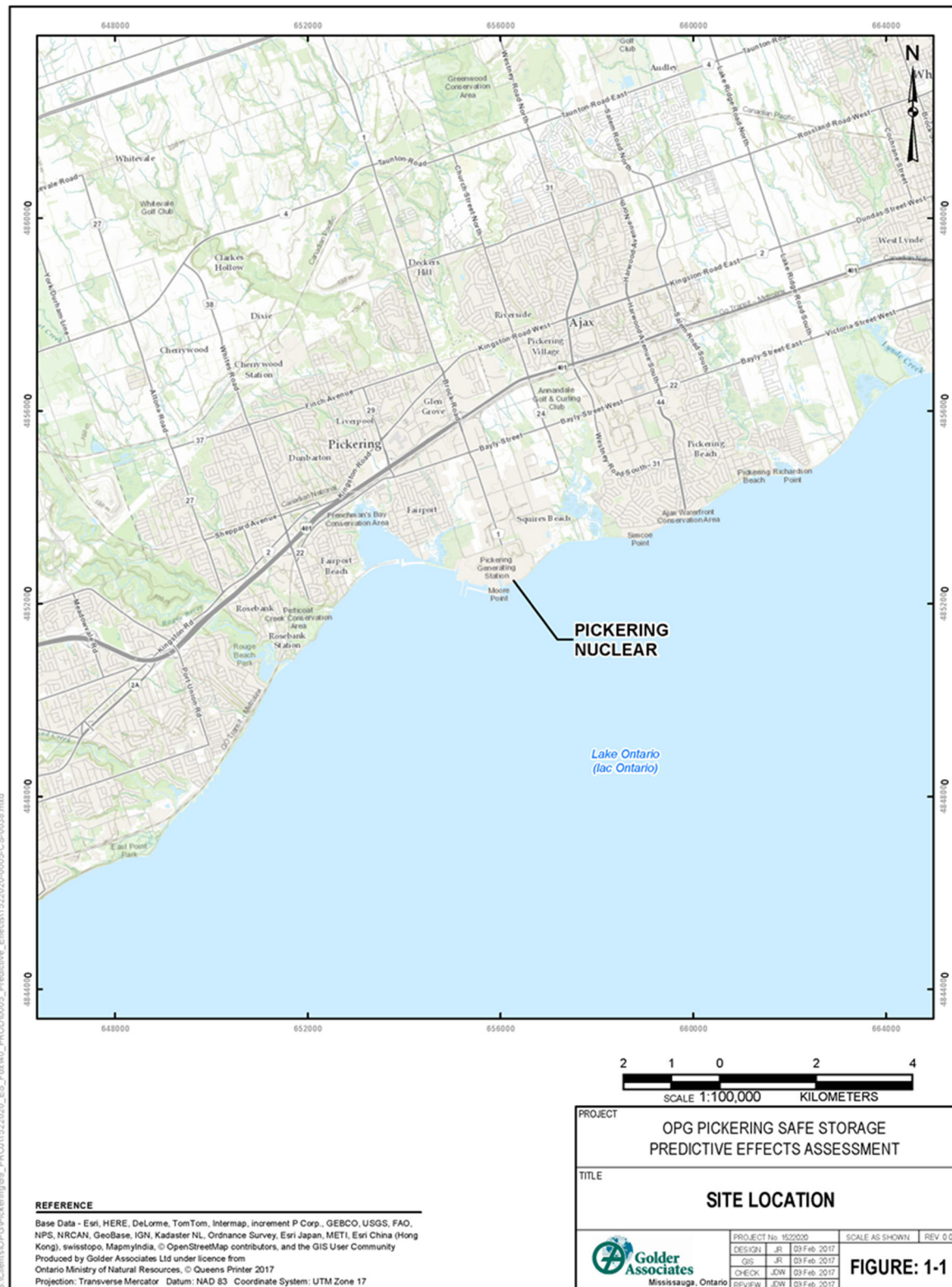


Figure 4-1: PN Site Location and Vicinity

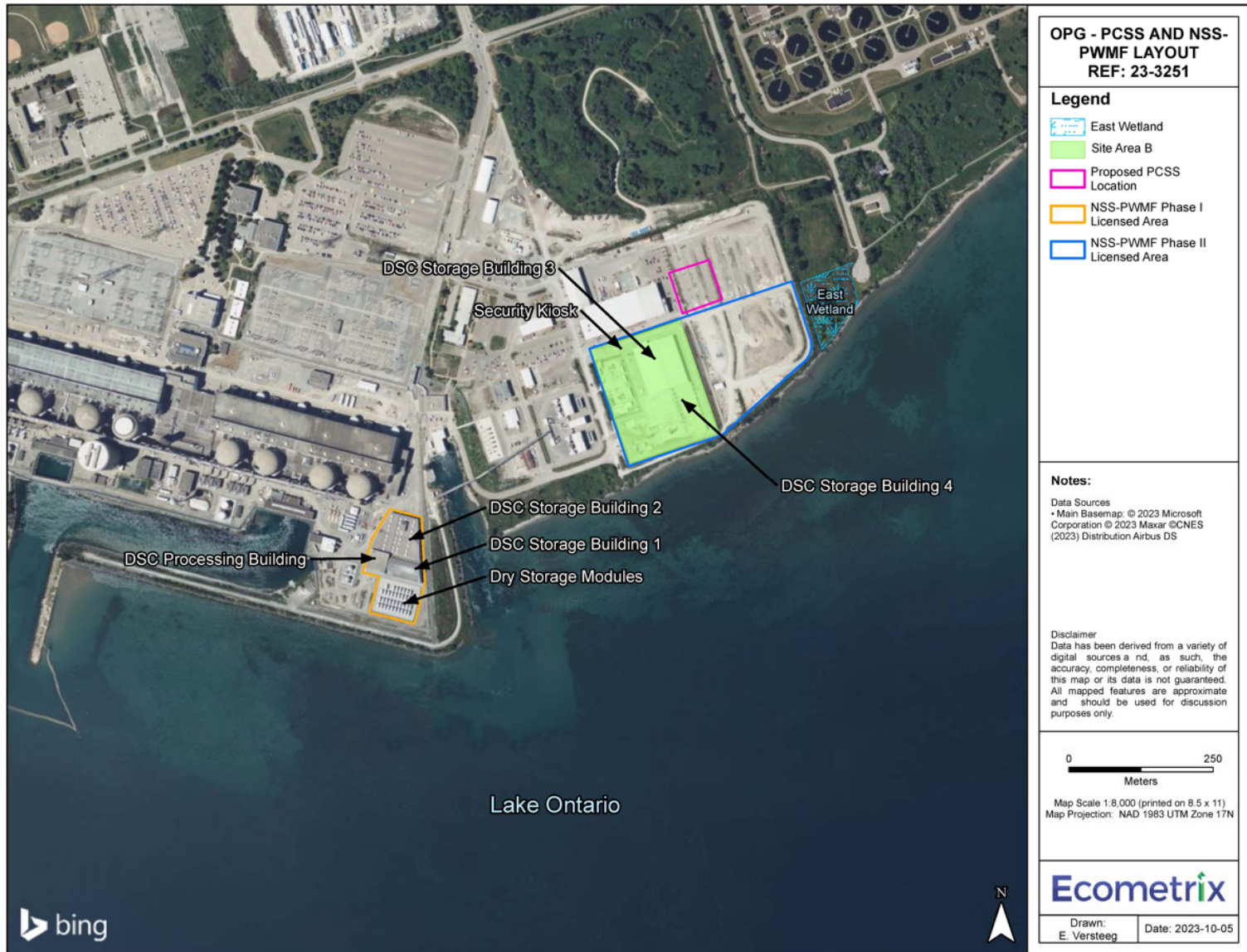


Figure 4-2: PCSS and NSS-PWMF Layout

4.2 Project Activities

Three main phases are associated with the Project and include:

- **Site Preparation:** This phase includes all activities associated with preparing the Project area for construction of the PCSS. Activities may include clearing the site, excavation, grading, and installation of utilities.
- **Construction:** This phase includes all activities associated with constructing the PCSS immediately following site preparation and up to the transfer of wastes to the new structure.
- **Operation and Maintenance:** This phase includes all activities associated with normal operation of the PCSS, and includes accepting and storing wastes and performing regular inspections and maintenance activities.

4.2.1 Site Preparation Phase Works and Activities

Site preparation involves preparation of the site for future construction activities. All site preparation activities are assumed to be completed at approximately the same time before construction of the PCSS begins. For the purposes of this PERA, the following site preparation activities are assumed to occur during pre-construction.

4.2.1.1 Site Clearing and Maintenance of Cleared Areas

Currently, the area of the proposed PCSS (shown on **Figure 4-2**) is being used as a laydown area where tools, materials and other equipment are being temporarily stored. The area is sparsely vegetated, but small patches of shrubbery and plants may need to be removed using conventional equipment including shovels, chainsaws or excavators. Cleared vegetation may be transported off-site for disposal or may remain on the PN site. Following clearing, the area will be maintained to ensure new vegetation does not repopulate the area and that the area remains clear of debris.

4.2.1.2 Excavation

During site preparation, the area will be excavated and levelled as required to establish appropriate grading for future construction of the PCSS. Excavation will take place using conventional equipment such as excavators and bulldozers. Where possible, excavated soil may be used as fill material. Otherwise, soil and other excavated materials may either be stored for future use at the PN site or be disposed of off-site in accordance with applicable regulations.

4.2.1.3 Grading and Compaction

Grading and compaction will be required on the overall site and in the area where backfilling of the structure's foundation has occurred. Conventional construction equipment such as graders and vibratory rollers will be used. Where possible, site grading will direct surface runoff to the

existing drainage infrastructure using industry best management practices for erosion and sediment control.

4.2.1.4 Installation of Utilities

Utilities connected to the new PCSS will include electricity, communication services, and fire water supply. The structure will not have any personal services (i.e. washrooms, office, lunch room, etc.)

4.2.1.5 Transportation and Storage of Construction Materials, Equipment, Trailers and Personnel

During the site preparation phase, construction materials, equipment and trailers will be transported and stored within the PCSS area. This will increase the amount of vehicle traffic (passenger vehicles, heavy construction machinery) moving to and within the Project area. A spill management plan will be in place within the construction island as a result of these activities.

4.2.1.6 Vehicle and Equipment Operation, Maintenance and Refueling

Refuelling by a refuelling truck and maintenance of construction equipment and vehicles will occur on an as-needed basis within the PCSS construction island. A spill management plan will be in place within the construction island as a result of these activities.

4.2.1.7 Stormwater Management and Drainage

The stormwater management system collects, transports, and discharges precipitation that falls onto the NSS-PWMF site. During site preparation, measures will be put in place to minimize the impact of site runoff. These temporary measures may include ditching, sediment basins, berms and hay bales to reduce sediment loadings in runoff. As noted, site grading should direct surface runoff to the existing drainage infrastructure where possible. OPG will employ best practices for stormwater management that would meet Ontario Ministry of Environment, Conservation and Parks (MECP) requirements and industrial sewage works rules.

4.2.2 Construction Phase Works and Activities

The construction phase involves the construction of the new PCSS. For the purposes of this PERA, the following activities are assumed to occur during construction.

4.2.2.1 PCSS Construction

Construction activities and materials will be similar to those used for conventional industrial buildings. Once the PCSS is constructed, the area surrounding the structure will be paved over.

4.2.2.2 Construction Waste Management

Construction activities are expected to produce negligible quantities of conventional construction waste and no radioactive waste. Potential waste streams include gravel, wood, domestic refuse, and potentially small quantities of metal and concrete. On-site waste

management and off-site disposal will be the responsibility of the construction contractor selected by OPG.

4.2.2.3 Transportation and Storage of Construction Materials, Equipment, Trailers and Personnel

During the construction phase, construction materials, equipment, and trailers will continue to be transported and stored within the PCSS area. This will increase the amount of vehicle traffic (passenger vehicles, heavy construction machinery) moving in, out and within the PCSS area.

4.2.2.4 Vehicle and Equipment Operation, Maintenance and Refueling

Refuelling by a refuelling truck and maintenance of construction equipment and vehicles will occur on an as-needed basis within the PCSS area in areas designated for such activities.

4.2.2.5 Stormwater Management and Drainage

Stormwater management during construction will be the same as during site preparation. OPG will employ best practices for stormwater management that would meet Ontario MECP requirements and industrial sewage works rules.

4.2.3 Operation and Maintenance Phase Works and Activities

The operation and maintenance phase is assumed to commence once construction is complete. The operation of the NSS-PWMF is governed by the Waste Facility Operating Licence (CNSC, 2018) and OPG policies and procedures covering all aspects of the waste management systems and structures. The PCSS will be incorporated into the existing NSS-PWMF operating policies and procedures.

4.2.3.1 Transfer of Waste to the PCSS

The PCSS is proposed to store L&ILW associated with the possible PNGS refurbishment project and possibly future PNGS decommissioning activities. The waste streams that would require storage at the PCSS include intact steam generators (SGs), pressure tubes and calandria tubes, calandria tube inserts and end fittings. These materials will be processed (e.g. volume reduced, packaged, etc.) within the PNGS before transfer to the PCSS for secure storage.

4.2.3.2 Operation of the PCSS

Storage of wastes at the PCSS will occur in accordance with approved OPG policies and practices. Radiological monitoring consistent with existing OPG procedures and protocols for other waste buildings within the NSS-PWMF will occur at the PCSS once radiological wastes are received.

The PCSS will require regular inspection and maintenance; maintenance is anticipated to consist largely of lamp replacement for overhead lights, roof inspections and routine scheduled maintenance of mechanical components (e.g., fans, service doors, fire protection systems).

Radioactive contamination is not expected in the PCSS under normal operation. Waste packages must be surveyed and be free of loose external contamination before leaving the Protected Area boundary of the PNGS. Based on knowledge of existing waste buildings, it is expected that negligible quantities of LLW, such as contaminated wipes, floor sweepings, rags and cleaning materials may be produced in the PCSS during operation and maintenance. These wastes will be managed according to approved OPG policies and practices.

Operation and maintenance of the PCSS will require minimal use of potentially hazardous substances. Small quantities of non-radioactive domestic waste typical of a commercial/industrial facility (e.g., cleaning solutions) may be produced during operation and maintenance of the facility.

4.2.3.3 Stormwater Management and Drainage

The infiltration capacity of the NSS-PWMF area may be decreased by the PCSS due to vegetation clearing, grading and compaction, and the paving of surfaces. This may result in an increase in peak flows. To the extent possible, grading will be designed to direct surface runoff towards existing drainage infrastructure. All site grading and other stormwater management activities will be undertaken during the site preparation phase. OPG will employ best practices for stormwater management that would meet Ontario MECP requirements and industrial sewage works rules.

5.0 Potential Project-Environment Interactions, Qualitative Assessment

5.1 Potential Project Environment Interactions

The PCSS has the potential to affect various components of the environment, including the surface water environment, atmospheric environment (air quality and noise), the soil and shallow groundwater (by transfer from air to soil porewater), the terrestrial environment (plants and animals) and human health (workers and members of the public). Based on the description of Project activities (**Section 4.2**) the potential for impact on components of the environment is evaluated qualitatively in this section at a screening level, to identify interactions that warrant further quantitative assessment (see **Table 5-1**).

Workers during site preparation, construction, and operations and maintenance will be working under the existing OPG Radiation Protection Program, and the existing Health and Safety Management Systems. Normal work planning procedures will be followed, and worker doses will be monitored as usual. As such, worker health from the PCSS is not considered further in the PERA.

Table 5-1: Identification of Project-Environment Interactions

Project Activities	Atmospheric Environment (air and noise)	Surface Water Environment (quality and quantity)	Groundwater (quality and quantity)	Geology (Soils)	Radiation and Radioactivity	Terrestrial Environment	Aquatic Environment	Human Health (public)
Site Preparation								
Site Clearing and Maintenance of Cleared Areas	✓	O	O	O	-	✓	O	✓
Excavation (and Storage)	✓	O	O	O	-	✓	O	✓
Grading and Compaction	✓	O	O	O	-	✓	O	✓
Installation of Utilities	✓	-	O	O	-	✓	-	✓
Transportation and Storage of Construction Materials, Equipment, Trailers and Personnel	✓	O	O	O	-	✓	O	✓
Vehicle and Equipment Operation, Maintenance and Refueling	✓	O	O	O	-	✓	O	✓
Stormwater Management and Drainage	-	O	O	O	-	O	O	O
Construction								
PCSS Construction	✓	O	O	O	-	✓	O	✓
Construction Waste Management	✓	O	O	O	-	✓	O	✓
Transportation and Storage of Construction Materials, Equipment, Trailers and Personnel	✓	O	O	O	-	✓	O	✓
Vehicle and Equipment Operation, Maintenance and Fueling	✓	O	O	O	-	✓	O	✓

Project Activities	Atmospheric Environment (air and noise)	Surface Water Environment (quality and quantity)	Groundwater (quality and quantity)	Geology (Soils)	Radiation and Radioactivity	Terrestrial Environment	Aquatic Environment	Human Health (public)
Stormwater Management and Drainage	-	O	O	O	-	O	O	O
Operation and Maintenance								
Transfer of Waste to the PCSS	O	O	O	O	✓	✓	O	✓
Operation of the PCSS	-	-	-	-	✓	✓	-	✓
Stormwater Management and Drainage	-	O	O	-	-	-	O	O

Note:

✓ Indicates direct interaction with the environmental component. Further quantitative assessment required.

O Indicates negligible interaction with the environmental component. No further quantitative assessment required.

- Indicates no interaction with the environmental component. No assessment required.

5.2 Qualitative Assessment of Project-Environment Interactions

Table 5-1 summarizes the potential interactions of the Project with various environmental components either as direct or negligible interactions. The following section details these interactions and assesses the risk qualitatively or identifies that the interaction is assessed further quantitatively in **Sections 6.0, 7.0 and 8.0**.

5.2.1 Atmospheric Environment (Air Quality and Noise)

The atmospheric environment consists of the air surrounding the Project area within which air pollutants and elevated noise levels may be experienced by on-site and off-Site humans or ecological receptors. All phases of the Project are expected to interact with the atmospheric environment.

5.2.1.1 Air Quality

5.2.1.1.1 Radiological Emissions

No radiological air emissions are expected during any phase of the Project. No radiological materials are associated with site preparation and construction. During operation and maintenance of the PCSS, radiological wastes will be contained and stored in the PCSS, and as a result, no radiological emissions are expected during normal operations. Thus, radiological emissions to the atmosphere are considered negligible and are not assessed further in the PERA. Gamma radiation from the PCSS is discussed in **Section 5.2.5**.

5.2.1.1.2 Non-Radiological Emissions

Site preparation and construction are expected to involve the use of both light equipment (e.g., chainsaws) and heavy equipment (e.g., bulldozers, dump trucks, pick-up trucks) that could release non-radiological air emissions (e.g., exhaust emissions) into the atmosphere. Excavation, grading, installation of buried utilities and other sub-surface activities that disrupt the soil surface may contribute to particulate matter (PM) and dust in the air.

OPG will follow typical construction best practices including implementation of an Environmental Management Plan. The construction Environmental Management Plan will include protocols for dust suppression during site preparation and construction to reduce the release of particulates and dust into the atmosphere. The on-site storage of excess soils may also contribute to particulate and dust emissions and may also be subject to dust suppression protocols as required. During construction, building and construction waste materials (e.g., concrete) may also contribute particulates and dust to the atmosphere. Other chemicals including fuel (gasoline or diesel), oils, paints, solvents and cleaners may release volatile compounds into the atmosphere during use or accidental spills. However, the quantity and frequency of these releases is considered negligible as these chemicals will be securely stored, and spills would be managed following site-specific procedures and existing OPG spill management protocol.

Once operation of the PCSS begins, there would be exhaust emissions from vehicles during the transfer of waste materials. Vehicle traffic associated with PCSS operation may be similar to or slightly higher than that associated with current NSS-PWMF operations, but the increased vehicle emissions due to the slightly increased traffic volumes would overall be considered negligible.

Considering the above interactions, non-radiological air pollutants (e.g., particulate matter, dust, exhaust emissions) may impact the atmospheric environment during site preparation and construction, and will be quantitatively assessed in the PERA.

5.2.1.2 Noise

During site preparation and construction, elevated levels of noise may be produced. Both light equipment (e.g., chainsaws, power tools) and heavy equipment (e.g., bulldozers, dump trucks, pick-up trucks) produce loud sounds and vibrations during their operation. In addition, loud banging sounds typical of an active construction site are expected during site preparation and construction.

During operation and maintenance, noise may be produced by trucks transferring waste materials to the PCSS. Vehicle traffic associated with PCSS operation may be similar to or slightly higher than that associated with current NSS-PWMF operations but would overall be considered negligible.

OPG will follow typical construction best practices including implementation of an Environmental Management Plan.

Considering the above interactions, elevated levels of noise during site preparation and construction only may impact the atmospheric environment and will be quantitatively assessed in the PERA.

5.2.2 Surface Water Environment and Aquatic Environment

The surface water environment at PN with respect to the PCSS is described as surface runoff and drainage features on the property, which ultimately drain into Lake Ontario. The aquatic environment at PN with respect to the PCSS is Lake Ontario. A construction Environmental Management Plan will be in place with mitigation measures to minimize adverse impacts to the environment. For example, excavations are expected to be shored or sloped until stable to ensure that any surface water runoff is directed to a sump pit where it will be collected and removed by a sump pump and will subsequently be properly managed and controlled to meet the regulatory requirements. Excavations, stockpiling or backfilling activities will also be rescheduled or suspended to limit work completed during days of heavy rainfall or adverse weather conditions that could impact soil or surface water quality.

Any impacts from the transportation and storage of various components as well as vehicle and equipment operations involved in site preparation, construction and operations may indirectly impact surface water. However, surface water quality entering the surface drainage features will

not likely be impacted, due to the implementation of OPG's existing spill management protocols, which outlines the framework to manage spills, ensuring the implementation of spill prevention, preparedness, clean-up and remediation processes. Potential impacts due to a spill event investigation and associated corrective actions are not considered in this document.

During all Project phases there is no source of contaminants (radiological or non-radiological) that would result in impacts to surface water or sediment. Water would be managed and monitored according to the approved Environmental Compliance Approval for the PN site.

During site preparation and construction surface runoff and drainage will be directed towards surface drainage infrastructure (i.e., new ditches and sewers that connect to the existing stormwater infrastructure).

Sediment may have the potential to impact the surface drainage infrastructure, drainage to Lake Ontario and therefore the aquatic environment. A Stormwater Management Plan will be developed to provide the plans for mitigating erosion and sediment transport during site preparation and construction. Additionally, it is expected that the PCSS Project will utilize construction best practices to mitigate the amount of sedimentation created within the Project area and apply the appropriate control measures to achieve the required contaminant removal efficiency for total suspended solids (TSS) prior to the release of water into the surface water environment. Additional control measures such as diversion ditching, silt fencing, and straw bale barriers will also be used in areas where existing systems or typical control measures do not fully address potential sedimentation issues related to this Project.

A separate Stormwater Management Plan will be developed for the operation and maintenance phase post construction. The assessment of modifications to existing stormwater infrastructure (e.g., the development of a new stormwater outfall, or the installation of new drainage ditches and storm sewers) needed to support the Project will be completed by a civil engineer. It is assumed that any modifications or expansions to the stormwater management system will meet water quality protection criteria as per MECP requirements. As such, no change to existing channel forming flows, flood risk, or erosion potential will be expected during operation and maintenance of the PCSS. Additionally, any shoreline work for potential outfalls, if needed, would be done as per Toronto and Region Conservation Authority approvals. The stormwater management system itself will not represent an adverse effect to surface water quantity.

Considering the above commitments and mitigation measures, no further quantitative assessment is included as part of this PERA. Further detail on mitigations will be developed through the design of the stormwater management system. Therefore, impacts to the surface water environment (through surface water quality) and to the aquatic environment as a result of surface water runoff from the PCSS Project are considered to be adequately managed and will not be assessed further in the PERA.

5.2.3 Groundwater (Quality and Quantity)

Overall, during site preparation, construction, operation and maintenance, any exposed soil can result in constituents in soil, surface water and precipitation infiltrating downwards towards the groundwater table instead of being diverted to surface drainage. Soils interacting with surface water (site drainage) can infiltrate into the water table and impact groundwater quality. However, groundwater quality is not expected to be impacted as a result of these activities as any potential spills will be managed following site-specific procedures and existing OPG spill management protocol. Potential impacts due to a spill event investigation and associated corrective actions are not considered in this document.

Dewatering of groundwater is not expected during excavation activities, however this will be confirmed via a hydrogeological or geotechnical investigation. If dewatering is needed, it will only be done with necessary permissions, intended to be protective against the discharge or re-infiltration of collected groundwater.

Therefore, based on the current understanding that dewatering will not occur, impacts to the groundwater quality and quantity as a result of the PCSS Project will be negligible, and will not be assessed further in the PERA.

5.2.4 Geology (Soils)

Overall, during site preparation, construction, operation and maintenance, any exposed soil can be impacted due to excavations, or the storage, transportation or handling and maintenance of various components related to different phases of the PCSS. Soil and other excavated materials may either be stored for future use at the PN site or be removed off-site in accordance with applicable regulations.

Soil quality is not expected to be impacted as a result of these activities as any potential spills will be managed following site-specific procedures and existing OPG spill management protocol. Potential impacts due to a spill event investigation and associated corrective actions are not considered in this document.

A construction Environmental Management Plan will also be in place with some mitigation measures. For example, excavations are expected to be shored or sloped until stable to ensure any surface water runoff is directed to a sump pit where it will be collected and removed by a sump pump where it will subsequently be properly managed and controlled to meet the regulatory requirements. Also, excavations, stockpiling or backfilling activities will also be rescheduled or suspended to limit work completed during days of heavy rainfall or adverse weather conditions that could impact soil or groundwater quality.

Therefore, impacts to the soil quality as a result of the PCSS Project will be negligible, and will not be assessed further in the PERA.

5.2.5 Radiation and Radioactivity

Increased radiation or radioactivity levels in the environment are not expected during site preparation and construction as these phases do not involve the use of radioactive materials or the modification of facilities that use radioactive materials.

During the operation and maintenance phase, no radioactivity will be released to air or water as all radionuclides are expected to be contained in waste storage containers within the PCSS (**Section 5.2.1.1.1**).

There will be gamma radiation fields emitted during the transfer of waste storage containers and once waste is stored in the PCSS during operation. The design of the PCSS will provide some shielding in the walls, which will be verified upon the completion of the structure design. The effects of direct gamma radiation from operation of the PCSS are assessed conservatively by assuming the full complement of loaded waste storage containers and minimal shielding.

Therefore, gamma radiation fields from the transfer and storage of waste containers at the PCSS during the operation and maintenance phase can impact humans and terrestrial organisms and is therefore considered further for the quantitative assessment.

5.2.6 Terrestrial Environment

The terrestrial environment considers the various terrestrial habitats within and immediately surrounding the PCSS site and the diverse groups of plants and animals that rely on those habitats for survival, including federally and provincially-protected Species at Risk (SAR). Although the PCSS site is highly disturbed and is not considered to contain significant terrestrial habitat, some plant and animal species adapted to urban and disturbed environments may reside within the PCSS site. Interactions between the Project and the terrestrial environment are expected to occur as a result of either direct disturbance of the ground (e.g., excavation) or through the release of air pollutants and noise/vibration from the atmospheric environment.

The PCSS will be constructed within the existing PN site, which consists of numerous buildings, parking lots, paved and gravel areas, and outdoor laydown areas where equipment and materials are stored. There is no significant vegetation within the proposed PCSS site. Vegetation that does exist is sparse and is consistent with rugged vegetation typical of a highly-disrupted, developed environment (e.g., weeds, grasses, small shrubs). These small pockets of vegetation will be removed during site preparation to clear the area for paving and the PCSS structure itself. Denser vegetation consisting of cultural meadows containing species tolerant of poor soil conditions exist to the north and east of the site. Pockets of mineral cultural woodlands containing younger treed communities and mineral cultural thickets are interspersed within the surrounding meadows. Small mineral shallow marshes exist dotted around the PN site to the north, east and west of the proposed PCSS location (Beacon, 2023). To the south, along Lake Ontario, there also exist pockets of meadows, thickets and open shoreline where vegetation is generally sparse. Off-site vegetated areas surrounding the PN site are fragmented by roads, public trails and other infrastructure (Beacon, 2023). Soil organisms that live within the subsurface may be impacted during site preparation as the landscape is drastically altered and

disturbed by excavation and grading. Small mammals and birds are likely present in the proposed PCSS area, and may use the area for shelter or to hunt and scavenge for prey and food. These mammals and birds will be disrupted during site preparation and construction, but are expected to return during normal operations when construction has ceased.

During all phases of the Project, there is the potential for vehicle collisions with wildlife that may result in injuries or road mortalities. Wildlife surrounding the PCSS may be impacted by air emissions (e.g., vehicle exhausts, dust) and loud noises and vibrations during site preparation and construction. During operation and maintenance, wildlife may be exposed to direct gamma radiation fields from the PCSS where waste materials are stored.

During site preparation and construction, various measures outlined in the construction Environmental Management Plan will be followed to minimize impacts to the terrestrial environment and local wildlife. The Environmental Management Plan identifies best practices relating to air and water management, noise control, contaminated and excess soil management, and general wildlife management. Safe driving best practices will be used to avoid vehicle collisions with wildlife.

Since direct interactions between Project activities and the atmospheric environment were identified for the site preparation and construction phases, the subsequent effects on the terrestrial environment will be quantitatively assessed for these phases. In addition, a quantitative assessment of radiation exposures near the PCSS during the operation and management phase will be completed for terrestrial wildlife.

5.2.7 Human Health (Public)

During site preparation and construction, OPG staff will be working under the existing OPG Health and Safety Management Systems. Similarly, on-site contractors are expected to work in accordance with their own health and safety programs and procedures. Once operation of the PCSS begins, OPG staff will be working under the existing OPG Radiation Protection Program. For these reasons, the assessment of potential Project effects to on-site workers are not considered part of this PERA.

Members of the general public will not have direct access to the PCSS as the entire PN site is enclosed by perimeter fencing and is continuously protected by security personnel. However, off-site human receptors at the perimeter of the PN site may be impacted by Project activities. This is primarily expected to be due to loud noises and vibrations associated with site preparation and construction. Human receptors may come into contact with airborne dust at the PN perimeter. As noted in **Section 5.2.1.1.2**, dust suppression techniques used during site preparation and construction is expected to reduce the amount of dust emissions released to the atmosphere. Human receptors at the PN site boundary may be exposed to air constituents associated with engine emissions during site preparation and construction. During operation and maintenance, the general public in close proximity to the eastern boundary of the PN site may be exposed to direct gamma radiation fields emitted from the PCSS.

Since direct interactions between Project activities and the atmospheric environment were identified, the subsequent effects on human health (e.g., dust, engine emissions, noise) will also be quantitatively assessed for the site preparation and construction phases. In addition, a quantitative assessment of direct gamma radiation exposures to the general public at the PN site boundary from the PCSS during the operation and maintenance phase will be completed.

5.2.8 Identification of Contaminants of Potential Concern and Physical Stressors

The environmental stressors investigated further in this PERA include air emissions, noise and radiation.

It is expected that air emissions are released during the site preparation and construction phase that are largely related to engine emissions from construction activities involving both light and heavy equipment. It is expected that the contaminants of potential concern (COPCs) include sulfur dioxide (SO₂), nitrogen oxide compounds (NO_x), carbon monoxide (CO), dust (i.e., total suspended particulates) and particulate matter at 2.5 µm and 10 µm (PM_{2.5} and PM₁₀). Noise is also a potential stressor to human and terrestrial biota associated with the use of light and heavy equipment operations during site preparation and construction of the PCSS.

Finally, gamma radiation fields associated with the storage of radiological wastes can act as a potential stressor to both human and terrestrial biota from the PCSS.

5.3 Quantitative Assessment of Project-Environment Interactions

As previously noted, **Table 5-1** summarizes the potential interactions of the Project with various environmental components either as direct, indirect or negligible interactions. Direct interactions identified in **Table 5-1** and further characterized in **Section 5.2** will be assessed quantitatively in **Sections 6.0** and **7.0**. Additionally, **Section 8.0** will quantitatively assess potential cumulative effects between the PCSS and the existing PN site.

Section 6.0 will quantitatively assess potential risks to human health from air pollutants, dust and noise emissions produced during site preparation and construction of the PCSS, and from gamma radiation released from the PCSS during operation and maintenance.

Similarly, **Section 7.0** will quantitatively assess potential risks to ecological (terrestrial) receptors from air pollutants, dust and noise emissions produced during site preparation and construction of the PCSS, and from gamma radiation fields from the PCSS during operation and maintenance.

5.4 Climate Change Considerations

There is uncertainty related to interactions of climate change with this Project. Changes in climate have the potential to affect meteorological parameters that influence dispersion over the long term (i.e., the life of the Project). This may influence deposition rates and subsequent environmental media concentrations. Considering site preparation and construction activities are anticipated to last for a short duration (less than one to two years), the impact of climate change on meteorological conditions is minimal.

Likely increased frequency and severity of extreme weather events over the coming decades due to climate change may affect the Project. Changes in climate during the lifetime of the Project may result in increased precipitation which would result in additional runoff. Additionally, extreme precipitation events are expected to increase over time. The design of the water management infrastructure would include additional capacity to accommodate climate change, as applicable. Additionally, the Project will be designed using engineering best practices which will account for considerations of extreme weather events. OPG's existing Emergency Management Program addresses actions to be taken to respond to emergencies which would include extreme weather events.

Overall, considering the limited interactions of the Project with the environment, and the existing measures (e.g., Emergency Management Program, consideration of extreme weather events in infrastructure design) to mitigate interactions between the environment and the Project, the impacts of climate change on the Project are considered negligible.

6.0 Predictive Human Health Risk Assessment

6.1 Problem Formulation

The problem formulation provides the objectives, goals, framework and methodology for the risk assessment and consists of identifying the relevant components for the HHRA. These components include the human receptors that may be potentially present in or around the PN Site; the chemical and radiological contaminants in or around the PN Site; and the exposure pathways by which receptors could be exposed to contaminants in the environment. A conceptual site model illustrates all of these relationships, based on the results of the problem formulation.

6.1.1 Health and Safety of On-site Workers

On-site workers, contractors, and visitors are potentially exposed to environmental contaminants, both chemical and radiological, but these exposures are considered and controlled through OPG's Health and Safety Management System and the Radiation Protection Program, and are not considered in this HHRA, as discussed below.

The Health and Safety Management System Program is designed to ensure the protection of employees, contractors and visiting members of the public. The program outlines a systems approach used to manage risks associated with activities, products and services of OPG Nuclear operations. Contractors are required to maintain a level of safety equivalent to OPG staff while working at an OPG workplace. Work at OPG is subject to safe work planning requirements where safety hazards are identified and mitigating measures are communicated through Pre-Job Briefings. Routine or planned work is governed by approved procedures and operating instructions.

During operation and maintenance of the PCSS, OPG's Radiation Protection Program will be applied. The Radiation Protection Program is designed to ensure that doses for employees, contractors and visiting members of the public are below regulatory limits, and As Low As Reasonably Achievable (ALARA), social and economic factors being taken into account. Employee radiation doses are monitored to ensure they do not exceed exposure control levels that are below regulatory limits. Doses to visitors and contractors are also monitored. Only workers classified as Nuclear Energy Workers (NEWs) may perform radioactive work. Visitors are limited to non-radioactive work and escorted by a qualified NEW. Personal information is collected for the purposes of dose reporting.

As human exposures on the site are kept within safe levels through the Health and Safety Management System Program and Radiation Protection Program, on-site receptors are not addressed further in the HHRA. The focus of the HHRA is on off-site members of the public.

6.1.2 Receptor Selection and Characterization

The focus of the HHRA is on potential risk to off-site members of the public. Off-site members of the public are potentially exposed to low levels of airborne or waterborne contaminants. The

most-affected off-site members of the public are defined as the "critical group". Potential critical groups are defined through site specific surveys and their doses are calculated in the OPG Annual Environmental Monitoring Program (EMP) Reports.

Consistent with the potential critical groups identified in the EMP (OPG, 2023) and in the PN ERA (Ecometrix, 2023a), the six potential critical groups are:

- The **C2** potential critical group consists of inhabitants at a correctional institute located approximately 3 km NNE of the PN Site. The C2 group obtains drinking water from the Ajax Water Supply Plant (WSP) and does not consume locally grown fruits or vegetables. The C2 resident is conservatively assumed to be at this location 100 percent of the time over the full year
- The **Industrial/Commercial** potential critical group consists of adult workers whose work location is close to the nuclear site. Members of this group are typically at this location about 23% of the time. They consume water from the Ajax WSP. The closest location for this group is about 1 km NNE of the site.
- The **Urban Residents** potential critical group consists of Pickering and Ajax area residents which surround the PN Site (e.g., Fairport, Fairport Beach, Rosebank, Liverpool, Pickering Village, etc.). The members of this group mostly consume water from the Ajax WSP and also consume a diet composed in part of locally grown produce and some locally caught fish. Members of this potential critical group are also externally exposed to beach sand at local beaches (Beachpoint Promenade, Beachfront Park, or Squires Beach).
- The **Farm** potential critical group consists of residents of agricultural farms (but not dairy farms) within a 10 km radius of the PN Site. Members of this group obtain most of their water supply from wells but also a portion from the Ajax WSP. Members of this potential critical group consume locally grown produce and animal products, as well as locally caught fish. They are also externally exposed to beach sand at local beaches (Beachpoint Promenade, Beachfront Park, or Squires Beach).
- The **Dairy Farm** potential critical group consists of residents of dairy farms within a 20 km radius of the PN Site. This group obtains most of their water supply from local wells. They also consume locally grown fruit and vegetables and locally produced animal products, including fresh cow's milk. Members of this potential critical group are also externally exposed to beach sand at local beaches (Beachpoint Promenade, Beachfront Park, or Squires Beach).
- The **Sport Fisher** potential critical group is comprised of non-commercial individuals fishing near the PN site outfalls, 0.5 km south of the PN site. Members of this group were conservatively assumed to obtain their entire amount of fish for consumption from the vicinity of the PN site and spend 1% of their time at the outfall location where atmospheric exposure occurs.

Indigenous communities were considered in the selection of receptors for the HHRA. Information from engagement with Indigenous communities, councils and organizations gathered during preparation of the PN U5-8 Refurbishment Environmental Assessment (EA) (SENES, 2007) did not indicate their use of lands, water or resources for traditional purposes within the Local Study Area (defined for the PN U5-8 Refurbishment EA as extending approximately 10 km from PN). However, it is possible that individuals may carry out these activities in a limited fashion as these activities would be restricted by the urbanization, population density, and preponderance of private land in the area. Through engagement with Indigenous communities, OPG continues to seek to learn about how the lands and waters in the area around PN are being used. Based on OPG's current understanding, it was judged that any influence from PN on the health of Indigenous communities was likely to be bounded by the assessment for potential critical groups located much closer to PN who consume foods local to PN as part of their diet. For example, the farm receptors obtain a large fraction of their fruits, vegetables and animal produce locally, with the nearest location at 6 km from PN. While there may be dietary differences such as more wild game in the Indigenous diet, and more farm produce in the farm diet, both groups will have high local food intake fractions, and overall dietary intakes will be similar. Likewise, the Sport Fishers are assumed to obtain their entire fish diet from the PN outfall. It is expected that Indigenous communities would receive doses that are equal to or lower than those received by these potential critical groups.

Since the majority of the potential critical groups are located greater than 1 km from the PN Site, their exposure to releases from the PCSS site during all Project phases is limited. Of the six potential critical groups, the Sport Fisher is expected to conservatively represent interactions with the PCSS due to their proximity to the site, approximately 0.5 km south of the PN Site at the outfall. The exposure location of this critical receptor group is shown in **Figure 6-1**.

In summary, the Sport Fisher (representative of receptors that are in close proximity to the site boundary) is the human receptor group assessed in this HHRA.

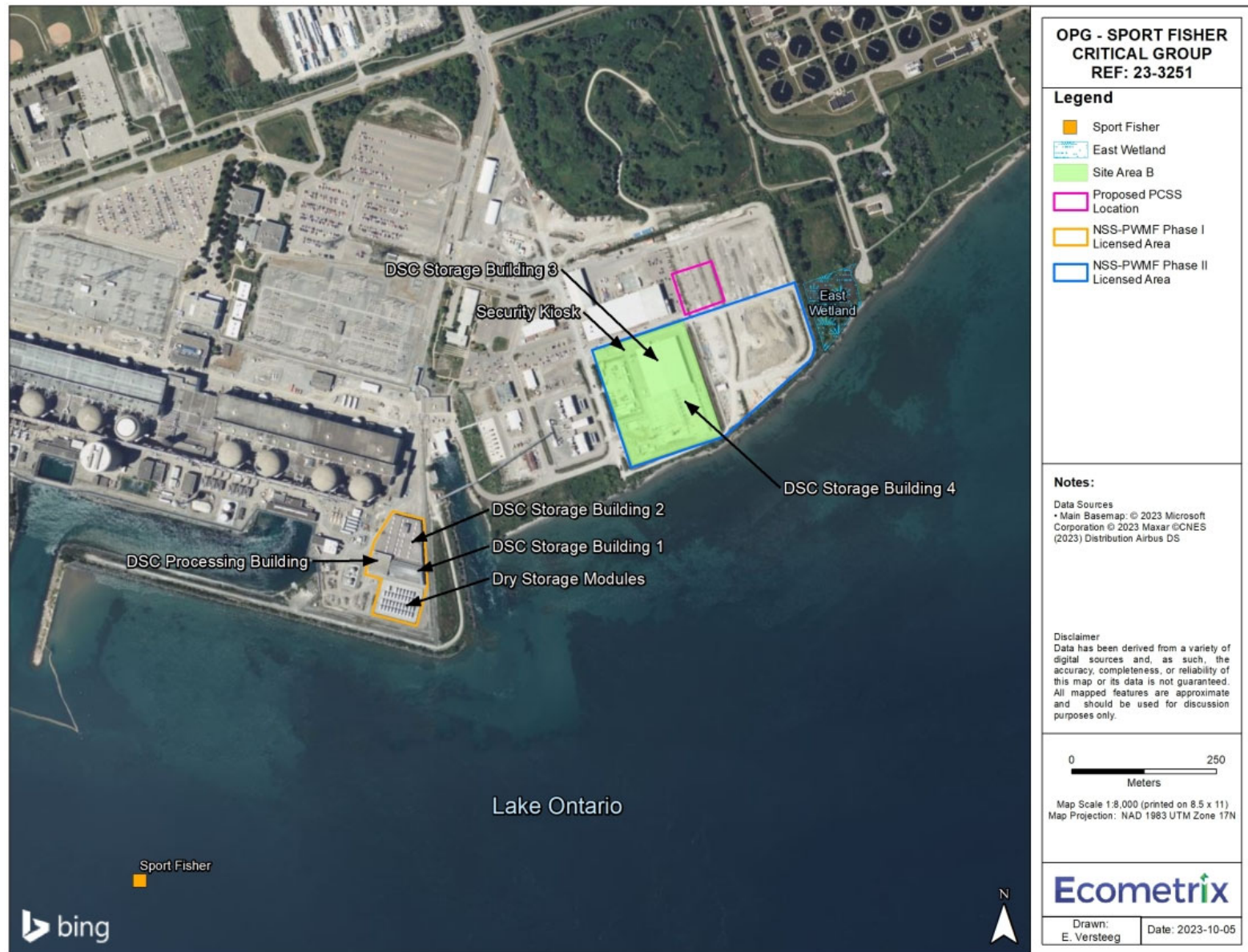


Figure 6-1: Location of Human Receptor – Sport Fisher

6.1.3 Human Health Exposure Pathways and Conceptual Model

As discussed in **Section 5.2**, direct interactions of PCSS with the atmospheric environment were identified. Additionally, human receptors will be exposed to direct gamma radiation from the PCSS. **Table 6-1** summarizes the human health exposure pathways from the PCSS for the human receptors identified for the site.

Table 6-1: Human Health Exposure Pathways

Receptor Group	Environmental Media	Exposure Pathway
Sport Fisher	Air	Radiation immersion (external exposure)
		Noise – noise levels
		Inhalation of particulates and contaminants

6.1.4 Screening Assessment

6.1.4.1 Atmospheric Environment (Air Quality and Emissions)

Air quality around the PN site is dominated by emissions released throughout the Greater Toronto Area and the United States and is typical of the general air quality in Southern Ontario along the Windsor-Quebec corridor. Substances that can produce smog or acid rain dominate air quality impacts and include carbon monoxide, nitrogen oxides, sulfur dioxide, total suspended particulates (TSP), inhalable particulates (PM₁₀) and respirable particulates (PM_{2.5}). Ontario's MECP measures air quality at several locations between Toronto and Oshawa. The PN site itself does not significantly contribute to chemical air quality emissions at a regional level (OPG, 2003).

Air quality at the proposed PCSS is expected to be comparable to the current and historic air quality of the local region (i.e., City of Pickering), except for a brief period during site preparation and construction where project activities are expected to contribute higher levels of dust (TSP) and particulates (PM₁₀ and PM_{2.5}) to the atmosphere.

The screening of air quality COPCs against ambient air quality criteria/standards in this PERA report is consistent with the methodology used in the 2003 PWMF Phase II EA. The PWMF Phase II project involved the construction of a new storage building to increase storage capacity at the PWMF (now the NSS-PWMF) as the PWMF Phase I storage capacity became insufficient over time (OPG, 2003). Air quality modelling conducted as part of the PWMF Phase II expansion is considered bounding of the PCSS project, as the PWMF Phase II project was greater in scope and involved the site preparation of a larger area and the construction of multiple storage buildings.

The concentration of COPCs in air were compared against Ontario MECP's Ambient Air Quality Criteria (AAQCs) and Canadian Ambient Air Quality Standards (CAAQS) from the Canadian Council of Ministers of the Environment (CCME) to determine whether measured and modelled concentrations of atmospheric COPCs could pose a risk to human receptors over the lifetime of the PCSS project. Concentrations were directly compared to guidelines with the same averaging periods. The AAQCs with averaging times of 24 hours or longer are considered protective of chronic health effects and have been selected for use in this PERA. The air quality guidelines used are shown in **Table 6-2**.

Table 6-2: Air Quality Guidelines

Parameter	AAQC	Averaging Time	CAAQS	Averaging Time
Carbon monoxide	13 ppm	8-Hour	NA	NA
Nitrogen dioxide	100 ppb	24-Hour	17 ppb ^{a, b}	Annual
Sulfur dioxide	4 ppb	Annual	5 ppb ^{a, b}	Annual
PM _{2.5}	27 µg/m ³ ^(a)	24-Hour	27 µg/m ³ ^a	24-Hour
PM ₁₀	50 µg/m ³	24-Hour	NA	NA
Total suspended particulates (TSP)	120 µg/m ³	24-Hour	NA	NA

Notes:^a 2020 target^b Represents the average over a single calendar year of all 1-hour average concentrations

AAQC – Ontario MECP Ambient Air Quality Criteria (MECP, 2020)

CAAQS – Canadian Ambient Air Quality Standard (MECP, 2019)

Averaging Time - Averaging times for ambient air quality criteria protective against chronic effects are generally 24 hours or longer

µg/m³ – micrograms per cubic metre of air

ppm - parts per million

ppb – parts per billion

NA – Not available

Consistent with the 2003 PWSF Phase II EA, the overall PN site, inclusive of the NSS-PWSF, is not considered to significantly contribute nitrogen oxides (NO_x) or sulfur dioxide (SO₂) to the atmosphere (OPG, 2003). Thus, local air quality measurements of these specific parameters are considered bounding of any air concentrations arising from site preparation, construction and operation of the PCSS. Local air quality measurements were obtained for the last three (3) available years (2018 to 2020) from the Ontario MECP's "Air Quality in Ontario" reports (MECP, 2022, 2023a, 2023b). Air quality data was assessed from the Toronto East and Toronto West monitoring stations (west of the PN site) and the Oshawa station (east of the PN site). The annual average and annual 90th-percentiles for air concentrations of NO₂, SO₂ and CO are shown in **Table 6-3**.

Average annual 1-hour concentrations of NO₂ ranged from 3.50 – 3.79 ppb in Oshawa and 8.41 – 10.55 ppb in Toronto East between 2018 to 2020. Annual 90th-percentile 1-hour concentrations ranged between 7.7 – 8.3 ppb in Oshawa and 17.8 – 21.8 ppb in Toronto East. No exceedances of the annual CAAQS were recorded at the Toronto East and Oshawa stations based on the annual average 1-hour concentrations.

SO₂ and CO are not monitored at every station – the closest station to the PN site where these parameters are measured is the Toronto North monitoring station, approximately 32 km west of the PN site. Between 2018 to 2020, average annual 1-hour concentrations of SO₂ ranged between 0.15 – 0.26 ppb at the Toronto North station, while annual 90th-percentile 1-hour concentrations ranged between 0.3 – 0.5 ppb. The annual average 1-hour concentrations of SO₂ met the CAAQS of 5 ppb (annual averaging period) and the AAQC of 4 ppb (annual averaging period). During the same sampling period, maximum 8-hour annual concentrations of CO ranged between 0.62 – 0.84 ppm, meeting the 8-hour CO AAQC of 13 ppm.

Table 6-3: Select Monitored Concentrations of NO₂, SO₂ and CO at the Toronto East, Toronto North, and Oshawa Monitoring Stations, 2018 – 2020

Parameter	Units	Station	Year	Annual Average 1-hour Concentration	Annual 90th-percentile 1-hour Concentration	AAQC	CAAQS
NO ₂	ppb	Toronto East	2018	10.55	21.8	NA	17
		Toronto East	2019	10.24	21.6	NA	17
		Toronto East	2020	8.41	17.8	NA	17
		Oshawa	2018	3.79	8.3	NA	17
		Oshawa	2019	3.50	8.0	NA	17
		Oshawa	2020	3.61	7.7	NA	17
SO ₂	ppb	Toronto North	2018	0.26	0.5	4	5
		Toronto North	2019	0.15	0.3	4	5
		Toronto North	2020	0.15	0.4	4	5
CO ^a	ppm	Toronto North	2018	0.62 (8-hour max)	NA	13	NA
		Toronto North	2019	0.71 (8-hour max)	NA	13	NA
		Toronto North	2020	0.84 (8-hour max)	NA	13	NA

Notes:^a Carbon monoxide data are 8-hour maximums

AAQC – Ambient Air Quality Criteria

CAAQS – Canadian Ambient Air Quality Standards

Based on expected release of dust and particulates during site preparation and construction activities, the 2003 PWMF Phase II environmental assessment predicted incremental 24-hour air concentrations at two locations (Site Area B and East Wetland) of the PWMF Phase II site (refer to **Figure 4-2** in **Section 4.1** for the locations of Site Area B, the East Wetland and the PCSS). Predicted incremental 24-hour concentrations were added to background 24-hour concentrations of TSP, PM₁₀ and PM_{2.5} and compared against 24-hour ambient air quality criteria (**Table 6-4**).

Site Area B is considered representative of the PCSS due to the close proximity of the two sites, and the East Wetland is similarly representative of a receptor at the boundary of the PN site.

Table 6-4: Estimated Total Airborne Dust and Particulates at the Site Area B and East Wetland Boundary During Site Preparation and Construction Compared with AAQC Guidelines

Parameter	Background 24-Hour Concentration (µg/m³) ^a		Predicted Incremental 24-Hour Concentration (µg/m³)	Incremental + Background (90th-Percentile) 24-Hour Concentration (µg/m³)	24-Hour Air Quality Criteria (AAQC)
	Average	90th-Percentile			
Site Area B					
Total Suspended Particulates (TSP)	42	75	7.4	82.4	120
PM ₁₀	18	35	2.1	37.1	50
PM _{2.5}	11.5	23	0.44	23.4	27
East Wetland					
Total Suspended Particulates (TSP)	42	75	5.3	80.3	120
PM ₁₀	18	35	1.3	36.3	50
PM _{2.5}	11.5	23	0.41	23.4	27

Notes:

^a Background concentrations for TSP, PM₁₀ and PM_{2.5} were taken from the 2003 PWMF Phase II environmental assessment. These values represent average and 90th-percentile 24-hour concentrations.

Results presented in **Table 6-4** demonstrate that maximum predicted incremental TSP, PM₁₀ and PM_{2.5} 24-hour concentrations could reach 7.4 µg/m³, 2.1 µg/m³ and 0.44 µg/m³ at Site Area B, respectively. At the East Wetland, the maximum predicted incremental TSP, PM₁₀ and PM_{2.5} 24-hour concentrations were modelled to reach 5.3 µg/m³, 1.3 µg/m³ and 0.41 µg/m³, respectively. These predicted incremental increases assume reasonable dust suppression measures are used on dry days (i.e., road and surface watering).

The total 24-hour concentrations for TSP, PM₁₀ and PM_{2.5} (incremental increases plus 90th-percentile background) are all below the applicable ambient air quality criteria at both modelled locations. Any increases in dust and particulate emissions are expected to be short-term and below the applicable AAQC/CAAQS limits.

The modelling is conservative as it assumed that site preparation and construction activities expected to generate the most intense amounts of dust and particulates would all occur at the same time over a three-month period. It is more likely that site preparation and construction activities would occur more infrequently over a phased construction schedule. Furthermore, the modelled predictions assumed that these project activities would occur at the same time as the worst-case meteorological conditions, which is similarly unlikely to occur over the modelled three-month construction schedule.

Construction traffic was not considered in the air quality modelling as it is expected that the increase in traffic and vehicle emissions would be negligible. (OPG, 2003). The emissions released by a small number of construction vehicles (e.g., backhoes, graders, dump trucks) would be negligible compared to the number of vehicles that currently service the thousands of employees working at the PN site. Relatedly, no off-site impacts to air quality are expected from the negligible increase in construction-related traffic emissions.

Based on the assessment above, no impacts to human health are expected from air emissions of dusts, particulates, or other air pollutants associated with vehicle exhausts including NO_x, SO₂ or CO. Thus, project-related atmospheric emissions as they relate to human health are not assessed further in this PERA report.

6.1.4.2 Atmospheric Environment (Noise)

Site preparation and construction activities are expected to result in increased noise levels. Consistent with **Section 6.1.4.1**, the 2003 PWMF Phase II environmental assessment was considered applicable for the PCSS project. The 2003 PWMF Phase II environmental assessment assumed that equipment and vehicles would utilize noise control devices, be maintained in proper working condition, and that noise emissions from such equipment would be compliant with regulatory noise guidelines. These assumptions are similarly applicable to the PCSS project.

Background noise at the PCSS is assumed to be similar to the overall PN site. The 2022 PN ERA reported an L_{Aeq} (1-hr) of 54 dBA and L_{A90} (1-hr) of 50 dBA at noise monitoring station NM-2 during daytime hours (07:00 – 19:00). The L_{Aeq} (1-hr) represents the average sound energy in A-weighted decibels (dBA) measured over a 1-hour period; the L_{A90} (1-hr) represents the sound

energy (in dBA) exceeded for 90% of the measurement period (i.e., 54 minutes of the 1-hour measurement period). As the L_{A90} describes the noise level exceeded for 90% of the measurement period, it is a more representative measure of background sound levels. This monitoring station is considered representative of daytime background noise levels experienced by a receptor adjacent to the walking trail at the eastern boundary of the PN site.

Similar to the air quality assessment, the 2003 PWMF Phase II environmental assessment predicted noise levels at Site Area B and the East Wetland. The maximum sound level experienced by a receptor at Site Area B exposed to worst-case construction activities was modelled to be 55 dBA. Maximum predicted noise levels at the East Wetland due to construction activities was modelled to be 64 dBA.

The MECP does not have prescribed noise and vibration limits from construction activity. Health Canada recommends that project-related noises do not exceed 75 dBA; above this level, noise is likely to cause sleep disturbance or disturb vulnerable populations (HC, 2017). Both PN baseline and modelled noise levels associated with PCSS construction do not exceed this 75 dBA threshold.

Site preparation and construction activities are expected to be relatively short in duration, and will occur in phases over the course of the overall construction schedule. Work will also be limited to daytime hours when background sound levels are generally higher. As previously noted, the increase in vehicle traffic associated with site preparation and construction is expected to be negligible compared to baseline traffic levels. Therefore, noise effects from a small incremental increase in construction traffic is considered negligible compared to the overall PN site.

Based on the assessment above, no human health effects are expected to occur as a result of sound emissions associated with site preparation and construction of the PCSS. No further assessment of project-related noise as it relates to human health is required in this PERA report.

6.1.4.3 Radiation

The Sport Fisher is the only potential critical group where gamma radiation fields from the NSS-PWMF would likely be measurable. This was confirmed in the 2022 PN ERA (Ecometrix, 2023a) based on a 2017 study. At a distance of 400 m from the NSS-PWMF, the measured air kerma rate was below the detection limit of 0.33 nGy/h. At a distance of 1 km from the PWMF, the air kerma rate was estimated to be negligible. Therefore, the Sport Fisher is expected to experience external exposure to gamma radiation due to the proximity to the PCSS.

The dose rates outside of the PCSS are estimated based on the administrative dose targets for the NSS-PWMF. It is expected that the dose rate outside of the PCSS will be below the target of 0.5 μ Sv/h and below 100 μ Sv/a at the PN site boundary. The radiation dose to the Sport Fisher is quantified and considered further in the exposure assessment below.

6.1.5 Summary

The screening assessment of air quality and noise indicated that all predicted air concentrations and noise levels are expected to be below their limits; therefore, no further quantitative assessment is required.

Therefore, based on the Problem Formulation, the focus of the exposure assessment is on exposure of the Sport Fisher to gamma radiation from the PCSS.

6.2 Exposure Assessment

In the exposure assessment, the exposure of human receptors to radiological COPCs is quantified in terms of radiation dose.

The assumed dose rate at the eastern site boundary at the walking trail is 100 $\mu\text{Sv/a}$, equivalent to the administrative dose target for the NSS-PWMF. Based on exposure of 2,000 hours at the site boundary, the maximum dose rate at the eastern site boundary is 0.05 $\mu\text{Sv/h}$. The Sport Fisher is assumed to reside at the outfall (0.5 km south of the PN site) 1% of the time or 87.6 hours per year, which is consistent with the assumptions for the Sport Fisher in the PN ERA (Ecometrix, 2023a). Assuming the Sport Fisher is exposed to the maximum dose rate of 0.05 $\mu\text{Sv/h}$ for 87.6 hours (1% occupancy), the predicted total annual dose to the Sport Fisher from the PCSS is 4.38 $\mu\text{Sv/a}$. The dose estimate for the Sport Fisher is conservative, as the Sport Fisher is located farther away than the eastern site boundary, yet is conservatively assumed to have the same maximum dose rate as the eastern site boundary. The dose rates are summarized in **Table 6-5**.

Table 6-5: Predicted Dose Rate for Human Receptors from the PCSS

Receptor	Predicted Annual Dose from PCSS ($\mu\text{Sv/a}$)
Eastern Site Boundary ^(a)	100
Sport Fisher ^(b)	4.38

Notes:

- (a) The dose at the Eastern Site Boundary is equivalent to the administrative dose target for the public at the Pickering site boundary and is 10% of the regulatory public dose limit of 1 mSv/a for members of the public.
- (b) The dose to the Sport Fisher is based on an occupancy at the Outfall of 1% or 87.6 hours per year, and is consistent with assumptions in OPG's EMP.

6.3 Hazard Assessment

6.3.1 Radiation Public Dose Limit

The public dose limit for radiation protection is 1 mSv/a, as described in the Radiation Protection Regulations under the Nuclear Safety and Control Act (Nuclear Safety and Control Act, 1997). This limit is defined as an incremental dose. It is set at a fraction of natural

background exposure to radiation. Public doses arising from licensed facilities are compared to the public dose limit and higher doses are considered unacceptable.

6.4 Risk Characterization

6.4.1 Radiation

The public dose estimate for the Sport Fisher is 4.38 $\mu\text{Sv/a}$. This dose estimate represents 0.4% of the regulatory public dose limit (1000 $\mu\text{Sv/a}$) for the Sport Fisher. Since the Sport Fisher is expected to receive the highest dose from PCSS, the demonstration that the Sport Fisher is protected implies that other potential critical groups near the PN site are also protected.

Since the dose estimates are a small fraction of the public dose limit and natural background exposure, no discernable health effects are anticipated due to exposure of potential critical groups to gamma radiation from the PCSS.

7.0 Predictive Ecological Risk Assessment

7.1 Problem Formulation

7.1.1 Receptor Selection and Characterization

As discussed in **Section 5.2**, the environmental stressors investigated further in this PERA include air emissions, noise and radiation.

The terrestrial ecological receptors outlined below represent receptors considered in this predictive ecological risk assessment. As it is impractical to assess potential effects on all species of biota at the PN site, a select group of representative species are chosen. These organisms are selected because they are known to exist on the site, represent major taxonomic/ecological groups, represent major pathways of exposure, have ecological significance, or have important intrinsic or economic value. These potential receptors were also considered in the 2022 PN ERA for the PN site (Ecometrix, 2023a). The rationale for receptor selection is described in detail in the PN ERA. The protection of the selected receptors should provide reasonable assurance that all species within the ecosystem are protected.

- Terrestrial Plants:
 - Chokecherry
 - New England Aster
 - Eastern Hemlock
 - Red Ash
 - Sandbar Willow
 - Pine/Grass
- Terrestrial Invertebrates:
 - Earthworms
- Terrestrial Birds:
 - Red-winged Blackbird
 - Red-tailed Hawk
- Terrestrial Mammals:
 - Red Fox
 - Meadow Vole
 - White-tailed Deer

7.1.2 Ecological Receptor Exposure Pathways and Conceptual Site Model

As discussed in **Section 5.2**, direct interactions of the PCSS with the atmospheric environment were identified. Additionally, ecological receptors will be exposed to gamma radiation from the PCSS. **Table 7-1** summarizes the ecological exposure pathways and conceptual site model from interactions with the PCSS for the ecological receptors identified for the site.

Exposure pathways consider the various routes by which radionuclides and/or chemicals may enter the body of the receptor, or for radionuclides, may exert effects from outside the body.

Exposures to environmental media may be primary (i.e., by contact) or secondary (i.e., via constituent transport through the food chain).

Considering the sources of COPCs to the environment are from the air pathway, the main exposure pathway is through inhalation of dust and particulate matter and exposure to noise during the site preparation and construction phase as well as exposure to external gamma radiation from operation of the PCSS. As such, only terrestrial receptors from the PN ERA are assessed.

Table 7-1: Ecological Conceptual Site Model

Category	Ecological Receptor	Exposure Pathway
Terrestrial Plants	Chokecherry	Uptake of COPCs sourced from Air Radiation Immersion
	New England Aster	
	Eastern Hemlock	
	Red Ash	
	Sandbar Willow	
	Pine/Grass	
Terrestrial Invertebrates	Earthworms	No complete pathways ^(a)
Terrestrial Birds	Red-winged Blackbird	Noise
	Red-tailed Hawk	Inhalation Radiation Immersion
Terrestrial Mammals	Red Fox	Noise
	Meadow Vole	Inhalation
	White-tailed Deer	Radiation Immersion

Note:

(a) As earthworms live in the soil, they would have limited exposure to air, noise and gamma radiation fields.

7.1.3 Screening Assessment

7.1.3.1 Atmospheric Environment (Air Quality and Emissions)

Ecological receptors can be exposed to air emissions as a result of site preparation and construction activities for the PCSS. Terrestrial birds and mammals can come into direct contact with COPCs released into the air through inhalation.

Air quality at the proposed PCSS is expected to be comparable to the current and historic air quality of the local region (i.e., City of Pickering), except for a brief period during site preparation and construction where project activities are expected to contribute marginally higher levels of dust (TSP) and particulates (PM₁₀ and PM_{2.5}) to the atmosphere.

Similar to **Section 6.1.4.1**, the screening of air quality COPCs against ambient air quality criteria/standards in this PERA report is consistent with the methodology used in the 2003 PWMF Phase II EA. Air quality modelling conducted as part of the PWMF Phase II expansion is considered bounding of the PCSS project, as the PWMF Phase II project was greater in scope and involved the site preparation of a larger area and the construction of multiple storage buildings.

Air quality parameters were compared against Ontario MECP's Ambient Air Quality Criteria (AAQCs) as AAQCs are developed to be protective of health and the environment, and are therefore appropriate screening guidelines for ecological receptors (MECP, 2020). The list of ambient air quality guidelines is available in **Table 6-2**. The annual air quality data and the comparison with air quality guidelines can be found in **Table 6-3**, both in **Section 6.1.4.1**.

Based on expected releases of dust and particulates during site preparation and construction activities, the 2003 PWMF Phase II environmental assessment predicted air concentrations at two locations (Site Area B and East Wetland) of the PWMF Phase II site (**Figure 4-2**). Predicted incremental concentrations were added to background concentrations of TSP, PM₁₀ and PM_{2.5} and compared against AAQCs.

Site Area B is considered representative of on-site terrestrial receptors at the PCSS due to the close proximity of the two sites. The East Wetland is considered representative of off-site terrestrial receptors at the boundary of the PN site.

Results presented in **Table 6-4** in **Section 6.1.4.1** demonstrate that maximum predicted incremental TSP, PM₁₀ and PM_{2.5} concentrations could reach 7.4 µg/m³, 2.1 µg/m³ and 0.44 µg/m³ at Site Area B, respectively. At the East Wetland, the maximum predicted incremental TSP, PM₁₀ and PM_{2.5} concentrations were modelled to reach 5.3 µg/m³, 1.3 µg/m³ and 0.41 µg/m³, respectively. These predicted incremental increases assume reasonable dust suppression measures are used on dry days (i.e., road and surface watering).

The total concentrations for TSP, PM₁₀ and PM_{2.5} (incremental increases plus 90th-percentile background) are all below the applicable AAQCs at both modelled locations. Any increases in dust and particulate emissions are expected to be short-term and below the applicable AAQCs.

The modelling assumed that site preparation and construction activities expected to generate the most intense amounts of dust and particulates would all occur at the same time over a three-month period. It is more likely that site preparation and construction activities would occur more infrequently over a phased construction schedule. Furthermore, the modelled predictions assumed that these project activities would occur at the same time as the worst-case

meteorological conditions, which is similarly unlikely to occur over the assumed three-month construction schedule.

Construction traffic was not considered in the air quality modelling as it is expected that the increase in traffic and vehicle emissions would be negligible (OPG, 2003). The emissions released by a small number of construction vehicles (e.g., backhoes, graders, dump trucks) would be negligible compared to the number of vehicles that currently service the thousands of employees working at the PN site. Relatedly, no impacts to off-site receptors are expected from the negligible increase in construction-related traffic emissions.

Based on the assessment above, no impacts to terrestrial receptors are expected from air emissions of dust, particulates, or other air pollutants associated with vehicle exhausts including NO_x, SO₂ or CO. Thus, project-related atmospheric emissions and the potential impact to ecological receptors are not assessed further in this PERA report.

7.1.3.2 Atmospheric Environment (Noise)

Noise levels due to site preparation and construction of the PCSS may potentially cause disturbance to wildlife. Consistent with **Section 6.1.4.2**, noise modelling conducted for the 2003 PWMF Phase II environmental assessment was considered applicable for the PCSS project.

In the 2003 PWMF Phase II environmental assessment, the maximum sound level experienced by a receptor at Site Area B exposed to worst-case construction activities was modelled to be 55 dBA over an assumed three-month construction period. Maximum predicted noise levels at the East Wetland (representative of off-site terrestrial receptors) due to construction activities was modelled to be 64 dBA.

There are no specific noise level thresholds for ecological receptors within regulatory documents. However, considering that noise levels are expected to be temporarily elevated for a maximum of three (3) months during site preparation and construction, it is expected that some wildlife (e.g., small mammals, birds) may be occasionally disturbed due to elevated noise levels; however, most wildlife in the area are likely already accustomed to noise levels associated with an urban environment. This is consistent with assumptions made for the Pickering B Environmental Assessment Terrestrial Environment Technical scope document (Golder, 2007). Noise levels from the PCSS during operations and maintenance are expected to be negligible compared to the noise levels from the rest of the PN site.

Assuming site preparation and construction equipment are adequately maintained and are compliant with regulatory noise limits, construction activities are not expected to result in long-term effects on terrestrial receptors. Site preparation and construction activities are expected to be relatively short in duration, and will occur in phases over the course of the overall construction schedule. Work will also be limited to daytime hours when sound levels are higher than nighttime hours to prevent the disruption of nocturnal wildlife. As previously noted, the increase in vehicle traffic associated with site preparation and construction is expected to be

negligible compared to baseline traffic levels. Therefore, noise effects from a small incremental increase in construction traffic is considered negligible compared to the overall PN site.

Based on the assessment above, given the mitigation measures in place and the temporary nature of the elevated noise levels due to site preparation and construction, noise is not expected to result in adverse risks to terrestrial receptors and is not assessed further in this PERA.

7.1.3.3 Radiation

Ecological receptors in proximity to the PCSS will experience external exposure to direct gamma radiation due to the proximity to the PCSS. The radiation dose to the terrestrial plant, bird and mammal receptors is quantified and considered further in the exposure assessment below.

7.1.4 Summary

The screening assessment of air quality indicated that all predicted air concentrations are expected to be below their limits; therefore, no further quantitative assessment is required. While no specific noise level thresholds exist for ecological receptors, noise levels are expected to be elevated temporarily during site preparation and construction, although most wildlife in the area are likely already accustomed to noise levels associated with an urban environment.

Therefore, based on the Problem Formulation, the focus of the exposure assessment is on exposure of the terrestrial receptors to gamma radiation from the PCSS.

7.2 Exposure Assessment

7.2.1.1 Radiation Dose – Terrestrial Receptors

The assessment of external exposure of terrestrial receptors to gamma radiation from the PCSS is based on the estimated administrative dose targets for the NSS-PWMF.

The estimated dose rates outside the PCSS could be up to the administrative dose target of 0.5 $\mu\text{Sv/h}$. It is difficult to translate the human effective dose to a whole body absorbed dose for various wildlife species with different geometries; however, it has been assumed that the whole-body effective dose for humans ($\mu\text{Sv/h}$) is equivalent to the whole body absorbed dose for wildlife ($\mu\text{Gy/h}$).

The dose rate for ecological receptors in close proximity (directly adjacent) to the PCSS could be up to 0.5 $\mu\text{Gy/h}$ (0.012 mGy/d). The dose rate to any ecological receptor at the closest PN property boundary would be much lower than 0.5 $\mu\text{Gy/h}$ (0.012 mGy/d). Using the assumed dose target for a member of the public at the eastern site boundary of 100 $\mu\text{Sv/a}$ (see **Section 6.2**), terrestrial receptors at the PN property boundary exposed for 8760 hours per year may receive a dose of approximately 1.14E-02 $\mu\text{Gy/h}$ (2.74E-04 mGy/d).

The above assessment is conservative as it assumes the ecological receptor is always located at the PCSS (24 hours per day, 365 days per year) and does not incorporate an occupancy factor based on the fraction of time a receptor is likely to be in close proximity to the PCSS.

7.3 Effects Assessment

7.3.1 Radiation Dose Benchmarks

Radiation dose benchmarks of 400 $\mu\text{Gy/h}$ (9.6 mGy/d) and 100 $\mu\text{Gy/h}$ (2.4 mGy/d) (UNSCEAR, 2008) were selected for the PCSS assessment of effects on aquatic biota and terrestrial biota, respectively, as recommended in the CSA N288.6-22 standard. This is a total dose benchmark, therefore the dose to biota due to each radionuclide of concern is summed to compare against this benchmark. The terrestrial benchmark of 2.4 mGy/d was used to assess radiation dose to terrestrial receptors at the PCSS. Aquatic receptors were not assessed as no Project-related interactions with the aquatic environment are expected (**Section 5.2.2**).

7.4 Risk Characterization

7.4.1 Radiation

The maximum dose rate to any ecological receptors residing in close proximity to the PCSS could be up to 0.012 mGy/d , lower than the 2.4 mGy/d radiation benchmark for terrestrial biota. The maximum dose rate to any off-site ecological receptors residing at the closest boundary of the PN site could be up to 2.74E-04 mGy/d , also lower than the 2.4 mGy/d radiation benchmark for terrestrial biota.

Since the dose estimates are a small fraction of the terrestrial dose benchmark, no discernable health effects to terrestrial biota are anticipated due to exposure to radiation from the PCSS.

Additionally, with respect to species at risk, since there were no exceedances of any dose benchmarks for the ecological receptors evaluated, individual species at risk would also be considered protected.

8.0 Cumulative Effects Assessment

In order to ensure radiation releases from the PN site meet radiation safety limits for humans and ecological radiation benchmarks for wildlife, the combined radiation dose from current PN operations (PNGS and NSS-PWMF) must be considered together with the potential radiation release from the future operation of the PCSS.

The Predictive Effects Assessment (PEA) for PN Safe Storage (Ecometrix, 2023b; Golder and Ecometrix, 2017) was not considered in the cumulative effects assessment as the maximum dose from existing conditions on the PN Site would be bounding of the receptors exposed to the PCSS during PN Safe Storage. Emissions from PNGS are not expected to occur at the same time as the predicted doses during PN Safe Storage.

8.1 Human Health

The 2021 PN ERA calculated total doses received by the Sport Fisher from PN and NSS-PWMF operations. As indicated in **Section 6.1.4.3**, based on distance from the facility, the Sport Fisher is the only human receptor likely to receive measurable dose from the PCSS.

The combined radiation dose for the Sport Fisher is presented in **Table 8-1** below. The total dose received by the Sport Fisher from current PN operations (PNGS and NSS-PWMF) and the PCSS was estimated to be 4.94 $\mu\text{Sv/a}$. This is a conservative assessment, as the cumulative dose assumes exposure to the administrative dose target for the NSS-PWMF. The cumulative dose is well below the public dose limit for radiation protection of 1 mSv/a. As the total cumulative dose is only a small fraction (0.5%) of the public dose limit and natural background radiation exposure, no health effects are expected within the general public.

Table 8-1: Cumulative Radiation Dose to the Sport Fisher from PN and PCSS

Receptor	Units	Max Dose from PNGS ^a	Max Dose from NSS-PWMF ^a	Predicted Max Dose from PCSS ^b	Total Max Dose
Sport Fisher	$\mu\text{Sv/a}$	0.5	0.063	4.38	4.94

Notes:

^a Total radiation dose estimates for the Sport Fisher receptor from the PNGS (Ecometrix, 2023a)

^b Predicted max dose from PCSS is based on the conservative assumption of exposure to the administrative dose target for the NSS-PWMF. Actual exposure to gamma radiation from the PCSS is expected to be lower.

$\mu\text{Sv/a}$ – microSievert per year

8.2 Ecological Health

The 2022 PN ERA also calculated total maximum and UCLM doses received by various terrestrial and aquatic receptors from PN operations. No cumulative effects assessment was done for aquatic receptors in the Outfall and Frenchman's Bay, as radiation releases from the PCSS to the aquatic environment are considered negligible. The combined radiation doses received by ecological receptors are presented in **Table 8-2** below. The maximum combined radiation dose in the terrestrial environment would be 2.75E-02 mGy/d for the red fox. All total maximum and UCLM doses received by terrestrial receptors from both PN and the PCSS were well below (1% or less) the terrestrial radiation benchmark of 2.4 mGy/d. No discernable health effects to terrestrial biota are anticipated due to radiation from PN and the PCSS.

Table 8-2: Cumulative Radiation Dose to Ecological Receptors from PN and PCSS

Location	Receptor	Units	Max Dose from PNGS ^a	UCLM Dose from PN ^a	Max Dose from NSS-PWMF ^a	Max Dose from PCSS	Total Max Dose ^b	Total UCLM Dose ^c	Dose Benchmark	% of Dose Benchmark (Max)	% of Dose Benchmark (UCLM)
Outfall (Aquatic and Riparian)	Benthic Fish	mGy/d	2.38E-02	1.49E-03	NA	NA	2.38E-02	1.49E-03	9.6	0.2%	0.02%
	Pelagic Fish	mGy/d	1.56E-02	9.76E-04	NA	NA	1.56E-02	9.76E-04	9.6	0.2%	0.01%
	Benthic Invertebrate	mGy/d	3.82E-02	2.38E-03	NA	NA	3.82E-02	2.38E-03	9.6	0.4%	0.02%
	Ring-Billed Gull	mGy/d	2.79E-02	3.76E-03	NA	NA	2.79E-02	3.76E-03	2.4	1.2%	0.2%
PN Site (Terrestrial)	Earthworm	mGy/d	9.07E-04	3.52E-04	NA	NA	9.07E-04	3.52E-04	2.4	0.04%	0.01%
	Grass/Shrub	mGy/d	1.08E-03	5.07E-04	1.2E-02	1.2E-02	2.51E-02	2.45E-02	2.4	1.0%	1.0%
	Pine	mGy/d	9.26E-04	3.55E-04	1.2E-02	1.2E-02	2.49E-02	2.44E-02	2.4	1.0%	1.0%
	Red-winged Blackbird	mGy/d	8.56E-04	3.08E-04	1.2E-02	1.2E-02	2.49E-02	2.43E-02	2.4	1.0%	1.0%
	Red-tailed Hawk	mGy/d	8.30E-04	2.73E-04	1.2E-02	1.2E-02	2.48E-02	2.43E-02	2.4	1.0%	1.0%
	Red Fox	mGy/d	3.46E-03	1.58E-03	1.2E-02	1.2E-02	2.75E-02	2.56E-02	2.4	1.1%	1.1%
	Meadow Vole	mGy/d	8.48E-04	2.94E-04	1.2E-02	1.2E-02	2.48E-02	2.43E-02	2.4	1.0%	1.0%
	White-tailed Deer	mGy/d	8.42E-04	2.62E-04	1.2E-02	1.2E-02	2.48E-02	2.43E-02	2.4	1.0%	1.0%
Frenchman's Bay (Aquatic and Riparian)	White Sucker	mGy/d	5.05E-03	4.21E-03	NA	NA	5.05E-03	4.21E-03	9.6	0.1%	0.04%
	Lake Trout	mGy/d	5.03E-03	4.21E-03	NA	NA	5.03E-03	4.21E-03	9.6	0.1%	0.04%
	Frog	mGy/d	3.70E-03	2.87E-03	NA	NA	3.70E-03	2.87E-03	9.6	0.04%	0.03%
	Aquatic Plant	mGy/d	2.13E-03	1.26E-03	NA	NA	2.13E-03	1.26E-03	9.6	0.02%	0.01%
	Benthic Invertebrate	mGy/d	1.85E-03	9.88E-04	NA	NA	1.85E-03	9.88E-04	9.6	0.02%	0.01%
	Bufflehead	mGy/d	7.54E-03	4.06E-03	NA	NA	7.54E-03	4.06E-03	2.4	0.3%	0.2%
	Common Tern	mGy/d	7.58E-03	5.90E-03	NA	NA	7.58E-03	5.90E-03	2.4	0.3%	0.2%
	Trumpeter Swan	mGy/d	3.94E-03	2.26E-03	NA	NA	3.94E-03	2.26E-03	2.4	0.2%	0.1%
	Ring-Billed Gull	mGy/d	1.31E-02	8.09E-03	NA	NA	1.31E-02	8.09E-03	2.4	0.5%	0.3%
	Muskrat	mGy/d	3.09E-03	1.70E-03	NA	NA	3.09E-03	1.70E-03	2.4	0.1%	0.1%

Notes:

Project-related effects from the PCSS and effects from the existing NSS-PWMF are considered negligible for aquatic ecological receptors in the Outfall or Frenchman's Bay, thus no cumulative effects assessment is required.

^a Total radiation dose estimates for ecological biota at the PNGS (Ecometrix, 2023a)

^b For terrestrial ecological receptors, total max dose is the sum of the max PN dose, the max NSS-PWMF dose (terrestrial and aquatic/riparian) and max PCSS dose (terrestrial only)

^c For terrestrial ecological receptors, total UCLM dose is the sum of the PN UCLM dose, the max NSS-PWMF dose (terrestrial and aquatic/riparian) and max PCSS dose (terrestrial only)

UCLM – Upper confidence limit on the mean

mGy/d – milligray per day

NA – Radiation dose to the aquatic/riparian environment is considered negligible

9.0 Environmental Management

9.1 Environmental Management System

OPG's Environmental Policy requires that OPG maintain an Environmental Management System (EMS) consistent with the ISO 14001 Environmental Management System Standard. The EMS provides the structure and processes to ensure implementation and follow-up on the environmental programs needed to comply with the Environmental Policy. As part of OPG's EMS, environmental performance targets, including reportable spills and environmental compliance, are reviewed annually to ensure that opportunities for continuous improvement are identified and implemented. The programs include OPG's approach to ensure compliance with applicable statutory and regulatory requirements.

During construction and operation of the PCSS, OPG's EMS will continue to require the assessment of environmental risks associated with the facility's activities, and to ensure that these activities are conducted such that any adverse impact on the natural environment is as low as reasonably achievable. Additionally, OPG will obtain all required environmental approvals and permits for the Project.

The specific mitigation and emission monitoring measures implemented as part of the PCSS operation are discussed in **Section 9.2**.

9.2 Emission Monitoring and Control

During site preparation and construction OPG will follow the Environmental Management Plan for construction of the PCSS. The Environmental Management Plan will outline the site-specific measures that will be followed to ensure compliance with federal, provincial and municipal legislations, mitigation of potential environmental impacts, and pollution prevention. OPG and its contractors will employ best practices for environmental management which will be outlined in the Environmental Management Plan.

Once the PCSS is operational, additional thermoluminescent dosimeters (TLDs) will be installed around the PCSS to monitor ambient dose rates. The purpose is to ensure that gamma dose rates adjacent to the PCSS remain below the dose rate target of 0.5 µGy/hr. TLD measurements will be summarized in the quarterly reports for the NSS-PWMF.

9.3 Environmental Monitoring Programs

Environmental monitoring at the PN site has been conducted for many years and the environmental performance is reported to the CNSC on a regular basis.

The existing 2022 PN ERA (Ecometrix, 2023a) was developed in accordance with CSA N288.6 to assess the potential risk posed by the existing operation on human and non-human biota. This PERA for the PCSS, estimated the effects of contaminants on the existing environment resulting from the proposed PCSS to be constructed at the NSS-PWMF. The outcome of the ERA, whether baseline or predictive, is to provide risk-based recommendations, either for the EMP or for

environmental control measures. The EMP, in turn provides environmental data for the ERA, and may confirm the effectiveness of control measures. Emission controls for the PCSS are identified in **Section 9.2**, Emission Monitoring and Control.

Project activities during site preparation may result in excess soil that will then need to be managed according to MECP's Management of Excess Soil Guideline. A soil sampling program prior to site preparation activities to characterize soil quality in the PCSS area is recommended prior to site preparation.

Based on the results of the PERA, no additional environmental monitoring as a result of the PCSS has been identified.

10.0 Quality Assurance

All data utilized in this PERA provided by OPG were previously verified by OPG or other contract personnel and provided to Ecometrix for use in the assessment.

All EMP data used in the assessment has been verified by OPG, as described in the Quality Assurance (QA) and Quality Control section of the 2022 PN ERA (Ecometrix, 2023a). The EMP has its own QA program that encompasses activities such as sample collection, laboratory analysis, laboratory quality control, and external laboratory comparison. The station chemistry laboratory also has its own QA program and samples sent to be analyzed externally utilize accredited laboratories.

Throughout the planning and preparation of the PERA, all Ecometrix staff worked under an ISO 9001:2015 certified Quality Management System. All work was internally reviewed and verified. Reviews included verification of data and calculations, transcription in the report, as well as review of report content and formatting. Comments have been dispositioned and addressed as appropriate by report revisions. The review process has been documented through a paper trail of review comments and dispositions.

11.0 Conclusions and Recommendations

The potential interactions of the PCSS Project with various environmental components during all phases of the Project were evaluated qualitatively. Based on the qualitative assessment of Project-Environment interactions, the following assessment areas were identified as the focus of the quantitative assessment in the PERA.

- Emissions of dust (TSP) and particulate matter (PM₁₀, PM_{2.5}) to air during site preparation and construction.
- Elevated noise levels during site preparation and construction.
- Gamma radiation from the PCSS during operation.

11.1 HHRA

The screening assessment of air quality and noise indicated that all predicted air concentrations and noise levels are expected to be below their regulatory limits; therefore, no further quantitative assessment is required.

For exposure of human receptors to gamma radiation from the PCSS, the potential dose to the Sport Fisher was evaluated. The estimated dose for the Sport Fisher is 4.38 µSv/a. Considering the existing facilities on the PN site, the dose to the Sport Fisher could be up to 4.94 µSv/a. This represents less than 1% of the regulatory public dose limit of 1000 µSv/a.

Overall, since the dose estimates are a small fraction of the public dose limit and natural background exposure, no discernable health effects are anticipated due to exposure of potential critical groups to gamma radiation from the PCSS.

11.2 EcoRA

The screening assessment of air quality indicated that all predicted air concentrations are expected to be below their limits; therefore, no further quantitative assessment is required. While no specific noise level thresholds exist for ecological receptors noise levels are expected to be elevated temporarily during site preparation and construction, and most wildlife in the area are likely already accustomed to noise levels associated with an urban environment. Therefore, no further quantitative assessment is required.

For exposure of ecological terrestrial receptors to gamma radiation from the PCSS, the maximum dose rate to any ecological receptors residing in close proximity to the PCSS could be up to 0.012 mGy/d, and up to 2.74E-04 mGy/d for off-site ecological receptors residing at the fenceline. All predicted doses are lower than the 2.4 mGy/d radiation benchmark for terrestrial biota; therefore, no adverse effects are anticipated.

The dose also remains well below (1% or less) the radiation benchmark if the maximum dose from the PCSS is combined with the dose to ecological receptors from being exposed to radionuclides through other existing PN operations.

11.3 Recommendations

Implementation of an Environmental Management Plan during site preparation and construction activities will help mitigate any potential environmental impacts. The Environmental Management Plan will outline procedures relating to air (dust) and water management, noise control, contaminated and excess soil management, and general wildlife management. OPG and its contractors will employ best practices for environmental management which will be outlined in the Environmental Management Plan.

In addition to the Environmental Management Plan, the following plans or documents are recommended to describe mitigations that will prevent or manage impacts to human health and/or terrestrial/aquatic environments:

- A stormwater management plan for site preparation and construction (to provide the plans for mitigating erosion and sediment transport to the surface water environment, and impacts to groundwater from the stormwater management system);
- A stormwater management plan for post development including design requirements;
- Spill management protocol;
- Geotechnical or Hydrogeological Investigation to confirm dewatering requirements;
- Health and Safety Management Systems for protection of on-site workers and contractors; and
- Radiation Protection Program (during operation).

As indicated in Section 9.2, to quantify ambient dose rates, during the operation phase, TLD monitoring should be performed at the PCSS. Results would be reported quarterly as part of the NSS-PWMF reporting requirements.

No other additional monitoring is considered to be warranted.

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**Summary of Regulatory Commitments, Regulatory Obligations and Regulatory
Management Actions Made/Concurrence Requested**

CD# 92896-CORR-00531-01544 P

Submission Title: **Pickering Waste Management Facility - Application for Waste Facility
Operating Licence WFOL-W4-350.00/2028 Amendment to Construct and
Operate the Pickering Component Storage Structure**

Regulatory Commitments (REGC):

No.	Description	Date to be Completed
	None	

Regulatory Management Action (REGM): 4 REGMs

No.	Description	Date to be Completed
1.	Submit the design requirements, environmental management plan, and construction verification plan for the PCSS to CNSC staff. (REGM # 28267121)	Prior to the commencement of construction activities.
2.	Submit the updated safety analysis for the final design of the PCSS to CNSC staff. (REGM # 28267123)	Prior to the commencement of construction activities.
3.	Submit the PCSS final commissioning report for CNSC staff acceptance. (REGM # 28267122)	Prior to operation of PCSS.
4.	Prior notification to CNSC staff on the updated PWMF Operating Policies and Principles for the PCSS. (REGM # 28267257)	Prior to operation of PCSS.

Regulatory Obligation Action (REGO):

No.	Description	Date to be Completed
	None	

**Concurrence
Requested:**

OPG is requesting the Canadian Nuclear Safety Commission to amend the PWMF, WFOL-W4-350.00/2028, to construct and operate the PCSS for interim storage of L&ILW from Pickering NGS by February 2025.

Reference 2

**Attachments 1 to 4 in OPG Letter, P. Seguin to R. Richardson, “Pickering NGS, Units 1 to 4 – Submission of the Detailed Decommissioning Plan and Storage with Surveillance Plan”,
December 9, 2024, e-Doc 7423802, CD# NA44-CORR-00531-37304.**

ATTACHMENT 1

OPG Letter, P. Seguin to R. Richardson, "Pickering NGS, Units 1 to 4 – Submission of the Detailed Decommissioning Plan and Storage with Surveillance Plan".

CD# NA44-CORR-00531-37304

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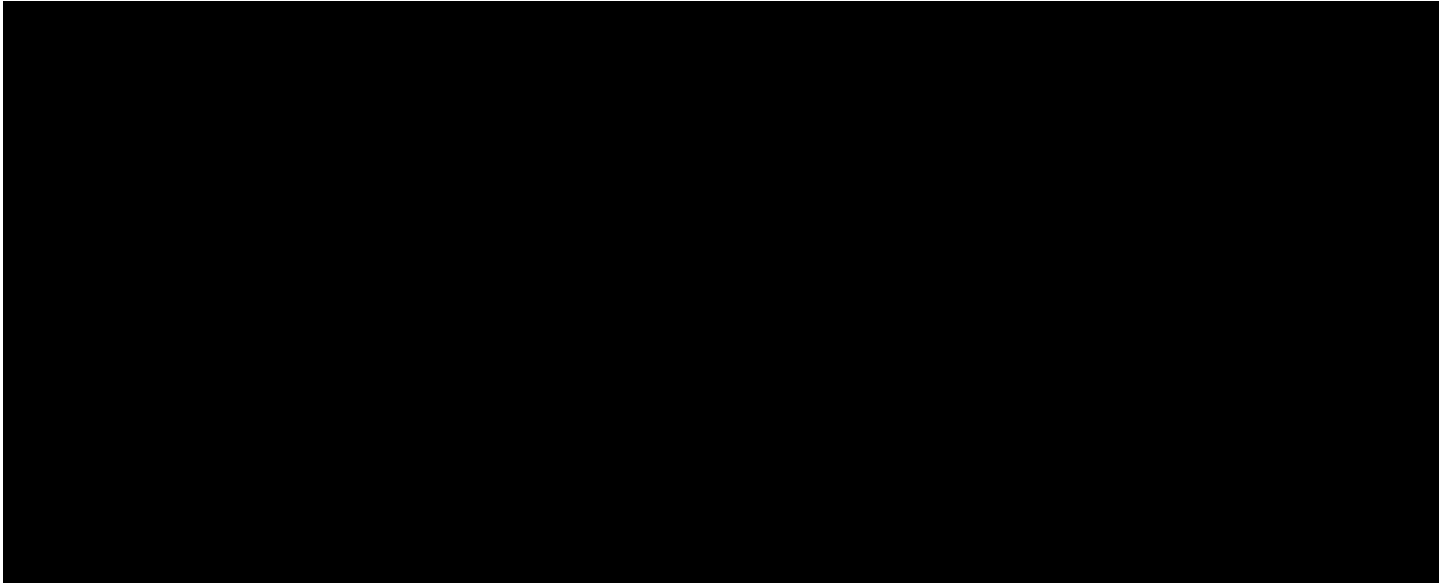
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1.0 INTRODUCTION

The Pickering Nuclear Generating Station (PNGS) consists of PNGS-A, U1 - U4 and PNGS-B, U5 - U8. Within PNGS-A:

- U2 and U3 have been in Storage with Surveillance (SWS), part of the Execution of Decommissioning Stage, since 2010 [R-1], and
- In 2024, U1 was shut down and U4 is planned to be shut down and undergo transition activities from operations to Storage with Surveillance (SWS).

PNGS-B is planned for refurbishment, pending regulatory approval, to enable extended operations and remains in the planning for decommissioning phase [R-2].

The decommissioning planning framework for the Pickering site is supported by multiple regulatory documents:

- This Detailed Decommissioning Plan (DDP) specifically addresses the decommissioning scope for PNGS-A (U1 - U4) and supersedes the previous site-wide Preliminary Decommissioning Plan (PDP) [R-3] prepared in 2022,
- The Preliminary Decommissioning Plan (PDP) for PNGS-B [R-2] covers U5 - U8,
- The Pickering Waste Management Facility (NSS-PWMF) has its own PDP [R-4], and
- The Pickering Site Overarching Document [R-5] defines the interfaces between the PNGS-A DDP (this document), PNGS-B PDP [R-2], and NSS-PWMF PDP [R-4], reflecting the current documentation hierarchy, as illustrated in Figure 1.

1.1 Land Acknowledgement

The lands and waters on which the PNGS is situated are the traditional territory of the Michi Saagiig and Chippewa Nations of the Williams Treaties First Nations. The Johnson-Butler Purchase (also known as the Gunshot Treaty 1877-88), covers the PNGS lands.

Alderville First Nation, Curve Lake First Nation, Hiawatha First Nation, Mississaugas of Scugog Island First Nation, known as the Michi Saagiig, and Chippewas of Georgina Island First Nation, Beausoleil Island First Nation and Rama First Nation are all signatories to the Williams Treaties (1923) and to the Williams Treaties First Nations Settlement Agreement of 2018.

1.2 Phased Approach to Decommissioning Planning

The full PNGS-A decommissioning scope is covered in eight different volumes to facilitate comprehensive planning and execution.

Volume 0, this document, provides the overall framework for PNGS-A Decommissioning and the SWS Plan [R-6]. It outlines the programmatic planning considerations and offers a broad perspective on the entire decommissioning process to be implemented for PNGS-A.

Volume 1 through 7 cover Planning Envelopes (PE) A through G, respectively. The PEs encompass the entire decommissioning scope for PNGS-A and have been defined based on logical groupings of work based on physical location within the station and common characteristics. The PEs can also be executed in parallel or sequentially as required.

Within 5 years of submission, the DDP (Volume 0 and any active volume) will be reviewed and updated as required, per REGDOC-2.11.2 [R-8]. It will be revised, as needed, to incorporate: Any incidents or events with relevant consequences for decommissioning, changes to regulatory requirements, operational experience and lessons learned, technological advances in decommissioning technology.

Table 1 provides a comprehensive breakdown of each volume's content and scope, illustrating the structured approach that has been taken to break down the PNGS-A Decommissioning scope.

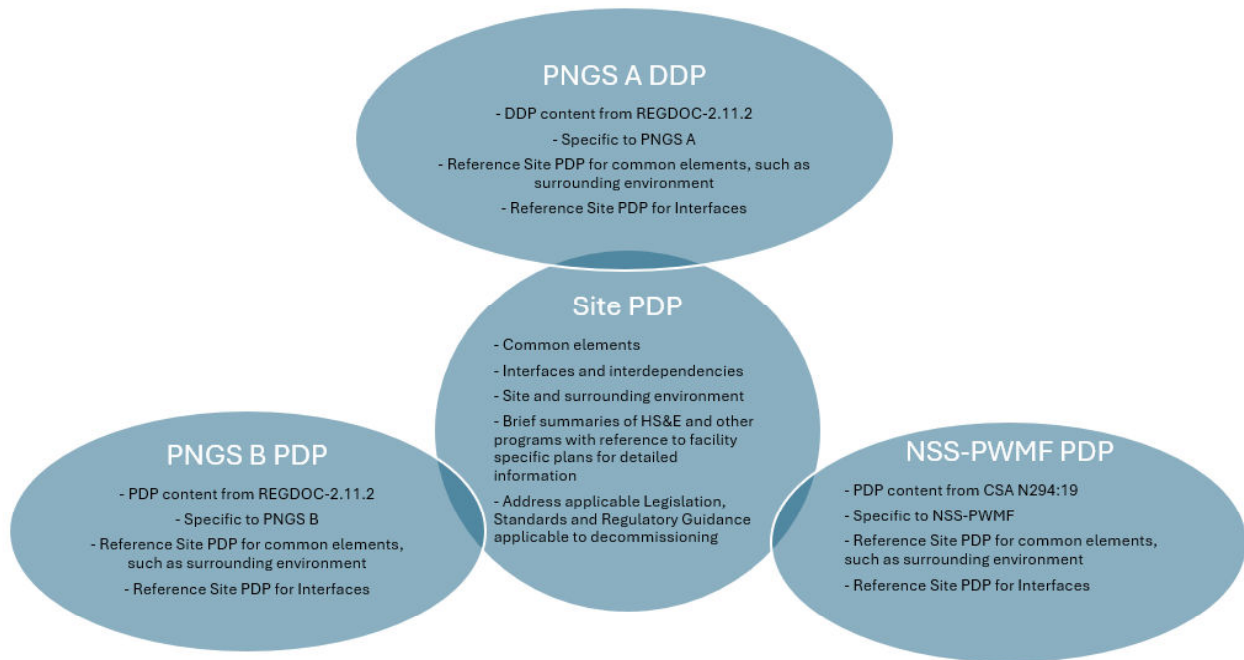


Figure 1 Pickering Decommissioning Plans Interface

1.2.1 PE Volumes Details

Each PE volume captures the specific scope of the PNGS-A decommissioning program dismantling activities associated with the corresponding Planning Envelope. The PE volume will be prepared and submitted to the CNSC for approval prior to the execution of that work scope and will be reviewed and revised every 5 years, as required. This is to align with a graded approach to decommissioning, where a greater level of detail is to be provided for the upfront dismantling activities. Each volume will capture the following items for a specific PE:

- Scope details and separation of the work into work packages,

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- High level dismantling information, including any decontamination requirements,
- Waste management planning, including waste streams (identified as pathways in this document), waste volumes, transportation, storage, and disposal,
- Safety and hazard assessments, and
- Potential environmental risks.

Planning Envelope	Focus Area	Scope	DDP Volume	Submission Strategy
Program Overview	PNGS-A, U1 through U4	Decommissioning program description which covers all aspects of the decommissioning scope (this document)	Volume 0	1 st Submission
PE-A	Out Buildings Removal	Includes structures and systems within the protected area that are not part of the main Powerhouse.	Volume 1	1 st Submission
PE-B	Non-Nuclear Component Removal	Removal of components and systems not considered a nuclear system.	Volume 2	1 st Submission
PE-C	Nuclear Component Removal	Removal of component and systems that are considered part of a nuclear system (including IFB-A and AIFB).	Volume 3	Included in a future submission.
PE-D	Reactor Segmentation	Disassembly and removal of the reactor and internals.	Volume 4	Included in a future submission.
PE-E	Powerhouse Structure	Removal of the Turbine Hall, Turbine Auxiliary and Reactor Auxiliary Bays structures, which make up part of the Powerhouse. This envelope also includes the IFB-A and AIFB.	Volume 5	Included in a future submission.
PE-F	Reactor Building Structural Demolition	Removal of the Reactor Building structures that make up part of the Powerhouse.	Volume 6	Included in a future submission.
PE-G	Site Remediation	Remediation of the site within the protected area, including environmental clean-up and restoration.	Volume 7	Included in a future submission.

Table 1 Decommissioning Planning Envelopes

1.3 Planning Assumptions

The assumed station shutdown dates and decommissioning timelines are in accordance with the latest information available. Planning for decommissioning of the PNGS-A is based on the following fundamental assumptions:

- (a) Individual reactor units at PNGS-A will or have been shut down based on following sequence:

At PNGS-A, end of operating life/shut down dates:

- Unit 1 - October 2024; (in SWS at the end of Stabilization activities in or before 2028 [R-9]).
- Unit 2 - 1997; (in SWS since 2010).
- Unit 3 - 1997; (in SWS since 2010).
- Unit 4 - December 2024 (in SWS at the end of Stabilization activities in or before 2028 [R-9], [R-9]).

- (b) The following major milestones are identified for PNGS-A:

- 2024 to 2028: Stabilization Activities for U1 and U4.
- 2025 to 2034: SWS and Risk Reduction Strategy execution.

NOTE

U2 and U3 have been in SWS since 2010 [R-1].

- 2030s: Separation of PNGS-A and PNGS-B (post planned PNGS-B refurbishment) complete.
- 2034: PNGS-A Irradiated Fuel Bay (IFB-A) fuel removal discussed in section 3.2, complete.
- 2034 to 2058: Major Decontamination, Dismantling and Demolition of all Systems, Structures or Components (SSCs) except Reactor Buildings.
- 2039: Fuel removed from Auxiliary Irradiated Fuel Bay (AIFB) discussed in section 3.2.
- Post 2070: Reactor Building Structure removal and Site Restoration.

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- (c) U1 – U4 will begin Dismantling & Demolition in 2034 [R-7].

NOTE

All dates are nominal. Any modifications associated with shutdown dates may impact these dates.

- (d) U2 and U3 are currently in SWS. U1 and U4 will be in SWS once Stabilization is complete which is currently planned for 2028 or before. SWS activities will change as risk and hazards are removed from the station.
- (e) Dismantling of the units will be staggered over a nominal 20-year period and risk reduction activities may occur during SWS phase in accordance with CNSC Section 8.1 of REGDOC [R-8]. Reactor Buildings for U1 through U4 will be dismantled after PNGS-B has reached the end of its commercial operations.
- (f) Common SSCs needed to support PNGS-B extended operations will be separated as a pre-requisite activity before identified PNGS-A dismantling begins. Separation of SSCs will separate the decommissioning PNGS-A from the operating PNGS-B. Any part of a common system not required for PNGS-A SWS and extended PNGS-B operations will be end stated/abandoned.
- (g) OPG will retain the license and ownership of the PNGS-A site throughout the course of the decommissioning and restoration program.
- (h) OPG, as the owner, will retain responsibility for all work during the shutdown of the units, the Preparation for Safe Storage or Stabilization period, SWS, and decommissioning. OPG may retain one or more contractor/agent to conduct/oversee all or part of the planning or execution of the decommissioning.
- (i) OPG will engage with the vendor community to support in major decontamination, dismantling and demolition. A company or consortium selected based on experience, safety record, overall approach, and cost, will perform all work during the Decontamination, Dismantling & Demolition, and Site Restoration phases. A contracting and commercial strategy will be evaluated and determined prior to execution.
- (j) Heating will be available while PNGS-A is in SWS, during preparation for Dismantling & Demolition, during selected Dismantling & Demolition, and up to the start of major structure removal.
- (k) Low-and Intermediate-Level Waste (L&ILW) arising from decommissioning activities will be disposed of in long-term disposal facilities in accordance with the waste management plan in the DDP. Non-radioactive hazardous waste will be disposed of at approved conventional disposal facilities. Any low-level waste (LLW)/intermediate level waste (ILW) waste generated before a disposal facility is available will be temporarily stored.

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- (l) Any decommissioning activities, such as dismantling, will be coordinated at all four PNGS-A units to optimize the project schedule and maintain continuity in the overall process.
- (m) 'Clearance Levels' based on guidance provided in CSA Standard N292.5 [R-10] will be developed prior to decommissioning (Dismantling & Demolition). These criteria will standardize the approach for segregation of the decommissioning wastes into those requiring long-term management and those that can be recycled, left on site (e.g. clearable concrete rubble), or disposed of in conventional waste facilities.
- (n) For the purpose of the CNSC financial guarantee, no salvage credit is assigned to equipment and components removed during decommissioning; these are considered waste for costing purposes. However, consistent with the principles of the waste management hierarchy [R-11], recycling of clean materials will be pursued.
- (o) Above ground structures will be end Restated as per OPG's planned End States
- (p) Underground metal and concrete piping will be excavated for survey and removed, if necessary. Non-contaminated materials beyond one meter will be left in place, while contaminated materials that exceed the clearance level criteria will be removed and disposed of appropriately.
- (q) Sub-surface structures will be surveyed for contamination. Where technically feasible, these structures will be decontaminated. In cases where decontamination is not practical, the materials will be categorized as LLW and disposed of through appropriate waste management streams. Consistent with international practices [R-64], structures will be dismantled to a nominal depth of one meter below grade, backfilled with concrete rubble and/or soil and graded over. If contamination is present beyond one meter depth, OPG will be responsible to remediate until the respective screening levels are met. Additionally, the one-meter depth allows for the placement of both gravel for drainage and topsoil for erosion control through the establishment of vegetation. At-grade foundation slabs exceeding one meter in thickness will be abandoned in place and as required, be covered with a one-meter-thick layer of backfill.

NOTE

Site restoration is also referred to as 'clean-up' per CNSC REGDOC-2.11.2 [R-8] and can be used interchangeably throughout this DDP.

- (r) The site will be graded and made available for other OPG uses after it has reached its defined Final-End State objectives, obtained a licence to abandon from the CNSC, and been released from regulatory control.

1.4 Applicable Legislation, Standards and Regulatory Guidance

A detailed discussion of the applicable legislation, standards, and regulatory guidance is provided in the Site Preliminary Decommissioning Plan (PDP) [R-3]. All decommissioning

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activities will be performed in accordance with the relevant legislation, regulations, codes, and standards.

1.5 Applicable Programs

OPG is committed to maintaining the highest standards of safety, reliability, and efficiency in its nuclear operations. Central to this commitment is OPG's comprehensive Nuclear Management System (NMS), which encompasses a suite of integrated programs designed to ensure excellence across all aspects of the company's nuclear activities.

1.5.1 Management System

The OPG NMS is implemented at PNGS and is a key input to the Pickering Nuclear Generation Station Licence Conditions Handbook [R-27]. It describes the business framework and processes established by OPG Nuclear and Interfacing Organizations to demonstrate effective implementation and compliance with the requirements set out in CSA N286-12, Management System Requirements for Nuclear Facilities [R-30].

This Management System ensures that:

- Management system principles of CSA N286-12 [R-30] are consistently and effectively applied using a risk-based graded approach to all activities defined in the NMS.
- Program Owners and Authorization Authorities understand their role in maintaining an effective management system.
- Nuclear Management System processes and their supporting technologies are standardized to the greatest extent possible.
- Nuclear Management System review is performed.

The NMS governing document framework is represented in the following diagram:

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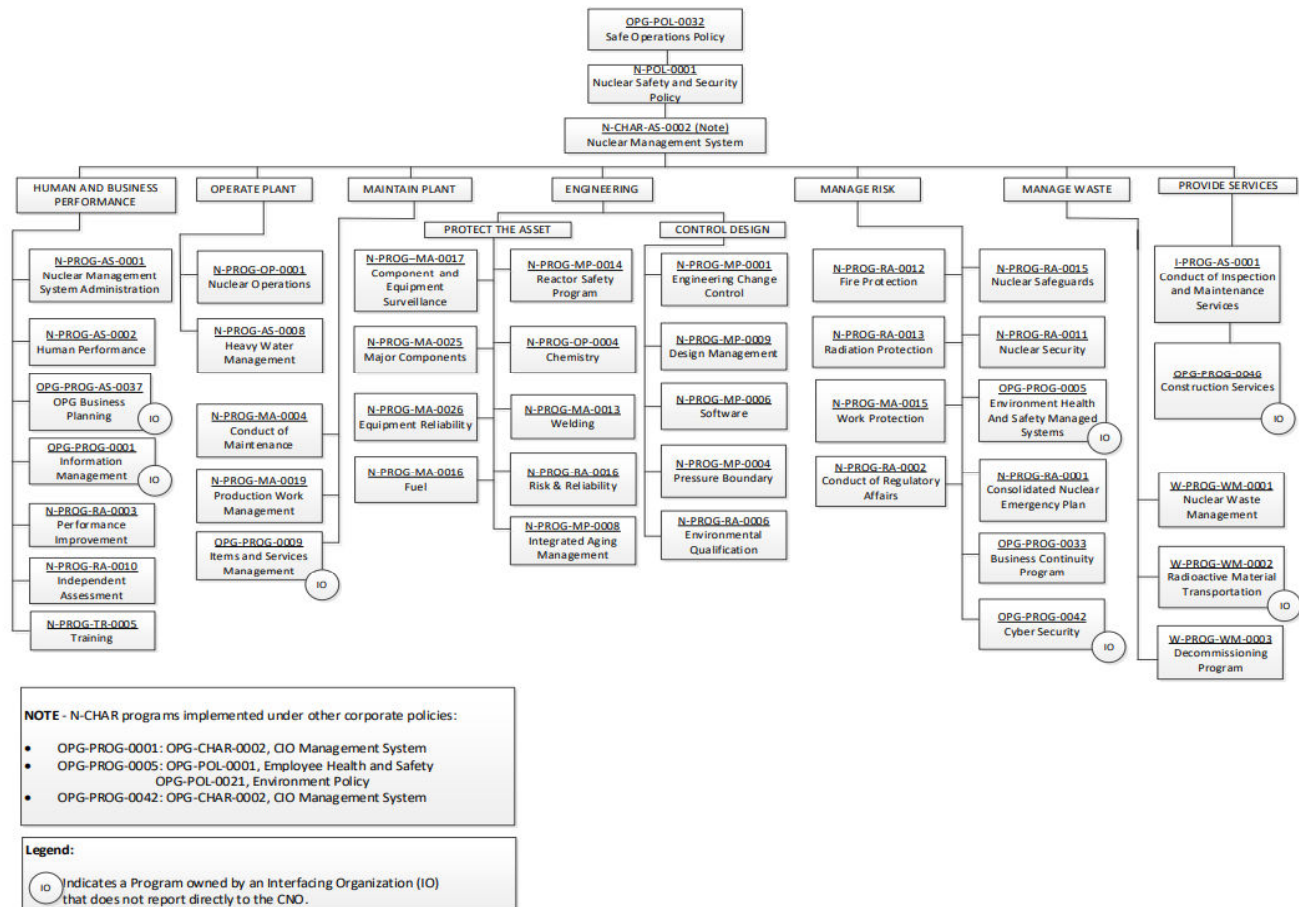


Figure 2 Management System Framework

1.5.2 Emergency Response

The Emergency Management Program [R-74] implements and maintains nuclear emergency response capability to protect the public, employees, and environment in the event of a nuclear emergency. Appropriate planning measures are established to adequately respond to postulated abnormal situations, including preparation of emergency operating procedures, event classification, notification requirements, event mitigation, personnel protective actions (on-site and off-site), designation of emergency facilities, and public information requirements.

1.5.3 Site Security

Physical plant security is provided to minimize risk to the public, employees, environment, and business, from sabotage, theft, or other criminal acts. This program [R-75] supports the need to protect nuclear assets by:

- Establishing an enhanced state of security readiness as a result of potential terrorism and commitments to the CNSC.

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- (b) Maximizing the response capability to contain, mitigate, and terminate a security event that has either occurred or is in progress.
- (c) Minimizing the adverse impact on legitimate plant staff or operations.

This program establishes proactive “best-in-business” security processes and conforms to the goals and objectives of the corporation, and to legislative requirements such as Security Regulations.

1.5.4 Cyber Security

The Cyber Security program [R-76] establishes a framework identifying the processes and overall requirements for an effective Cyber Security program that supports the protection of cyber assets at OPG from cyber-attacks. This program also ensures protection of Nuclear cyber essential assets in compliance with CSA N290.7-14, Cyber Security for Nuclear Power Plants and Small Reactor Facilities.

1.5.5 Safeguards and Nuclear Accountancy

The Safeguards and Nuclear Accountancy program [R-77] puts special controls in place to ensure OPG's Nuclear operations comply with Canada's commitment to the Nuclear Non-proliferation Treaty consistent with International Atomic Energy Agency (IAEA) requirements for storage and handling of nuclear fuel throughout its life cycle. The program includes the following:

- (a) Communication protocol between the IAEA, CNSC, and Nuclear.
- (b) Obligations to meet applicable regulatory requirements and requirements of associated safeguards procedures.
- (c) Reporting to meet applicable regulatory requirements and requirements of safeguards agreements.

This program is governed by the IAEA and is made applicable by way of CNSC's specific licence conditions. The requirements of the program apply to all nuclear material and safeguards management activities performed at all OPG facilities with no exclusions. It covers procurement receipt, disposition, transfer, accounting, safeguards management, storage, and inventory management of nuclear materials. All routine and non-routine work, including decommissioning activities meet the Safeguards and Nuclear Accountancy program requirements.

1.5.6 Radiation Protection

The Radiation Protection (RP) program [R-16] implements a series of standards and procedures for the conduct of activities within nuclear sites and with radioactive materials intended to achieve and maintain high standards of RP including the achievement of the following objectives:

- (a) Controlling occupational and public exposure.

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- Keeping individual doses below regulatory limits.
 - Avoiding unplanned exposures.
 - Keeping individual risk from lifetime radiation exposure to an acceptable level.
 - Keeping collective doses As Low As Reasonably Achievable (ALARA), social and economic factors taken into account.
- (b) Preventing the uncontrolled release of contamination or radioactive materials from the nuclear sites through the movement of people and materials.
- (c) Demonstrating the achievement of (a) and (b) through monitoring.

The RP program is consistent with the Radiation Protection Regulations, the requirements of the license and complies with the CNSC requirement for all licensees to implement an RP program that meets CSA N286-12 requirements for radioactive contamination control and radiation safety.[R-27]

1.5.7 Environmental Protection and Monitoring

OPG maintains registration of an Environmental Management System (EMS) [R-15] to the International Organization for Standardization (ISO) 14001 Standard. The scope of OPG's EMS includes the management of activities related to decommissioning of electricity generating stations, and associated properties, auxiliary buildings, and structures solely owned and/or operated by OPG, or sites operated by OPG on behalf of OPG's partner owners.

The EMS uses a risk-based approach to identify areas of concern with respect to environmental management. The EMS not only addresses the potential for OPG to impact the environment through its operations, but also the potential for the environment to affect OPG's ability to achieve its purpose.

1.5.8 Fire Protection

The Fire Protection Program [R-81] establishes provisions to prevent, mitigate, and respond to fires such that fire risk to nuclear workers, public, environment, Nuclear physical assets, and facility operation, is acceptably low and controlled. The Power Reactor Operating Licences (PROLs) require Nuclear to comply with the requirements of CSA N293-12, Fire Protection for Nuclear Power Plants. Additionally, the Waste Facility Operating Licenses (WFOLs) as well as the PROLs include codes and standards such as the National Fire Code of Canada, the fire protection requirements of the National Building Code of Canada, and applicable National Fire Protection Standards.

1.5.9 Personnel Training

The Training Program [R-79] provides the structure, processes, and tools for defining, developing, implementing, documenting, assessing, and improving the training required to ensure nuclear staff have the appropriate knowledge, skill, and qualifications for safe and efficient facility operations.

Personnel training employs the Systematic Approach to Training methodology, where the extent of application is based on the importance of the task to health, safety, environment, security, significance, and complexity of the task. Procedural and equipment changes, changes in job descriptions, and operating experience feedback are screened to identify changes to tasks and assess potential training implications leading to training modifications.

1.5.10 Decommissioning

As the owner of nuclear facilities, OPG is responsible for planning, preparing for, executing, completing, and funding decommissioning. The Decommissioning Program [R-78] describes the organizational responsibilities, interfaces, and key program elements, requirements, and processes to safely and cost effectively decommission OPG's nuclear facilities.

Decommissioning is performed using a graded approach to achieve a progressive and systematic reduction in hazards. This Program ensures that the protection of health, safety, security, and the environment is planned and optimized during decommissioning.

1.5.11 Radioactive Material Transport, Waste Management and Decommissioning

The Radioactive Material Transport Program [R-18] describes controls that ensure safe, compliant, and efficient radioactive material transportation. In addition, it includes verification that the Transportation Emergency Response Plan is appropriately established to provide corporate emergency response for radioactive material transportation incidents.

It applies to off-site shipping of dangerous goods by all modes of transport, and to anyone who performs an activity associated with the transport of such materials. Transport activities include all operations associated with the movement of dangerous goods such as classification, documentation, packaging, safety marks, security, emergency response, training, and regulatory permits and licences. All off-site transport of dangerous goods, including radioactive materials and waste follows the Radioactive Material Transport program requirements which provide compliance with licences.

1.5.12 Waste Management

OPG ensures that activities involving the Waste Management lifecycle are performed in a manner that protects the workers, the public, and the environment through its Waste Management Program [R-11]. All waste generated during the life cycle of the facility will be monitored, segregated, packaged, or contained, shipped for processing/storage or disposal. All waste material will be adequately characterized, to meet requirements including waste acceptance criteria for clean/likely clean waste and solid radioactive waste. Waste materials will be properly packaged for transportation and storage, or disposal. Any contaminated waste above the normal background level, will be volume reduced to the extent possible and packaged in low specific activity containers for shipment to a suitable waste management facility which is approved for receiving such waste.

1.6 Regulatory Compliance with Applicable Standards

This DDP was developed in adherence to the requirements outlined in CNSC REGDOC 2.11.2 [R-3] and the Canadian Standards Association's (CSA) N294:19 Standard [R-13]. Refer to the DDP Verification Matrix which demonstrates compliance to the specific

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requirements of CSA N294:19 Standard [R-13] and CNSC REGDOC-2.11.2 [R-8] requirements, identifying the respective sections that address each requirement in detail.

1.7 Operational History

OPG has undertaken a comprehensive effort to collect, organize and evaluate historical information relevant to PNGS Operations including a review of its Station Condition Records (or SCRs) to collect any adverse conditions that have occurred during its operations, as well as interviewing knowledgeable plant staff; this is also referred to as a Historical Site Assessment (HSA). The results of the HSA will be utilized to guide decommissioning characterization and any remediation efforts required.

Construction of PNGS-A started in 1966. The first unit (U1) entered commercial service on July 29, 1971, followed by U2 on December 30, 1971, Unit 3 on June 1, 1972, and U4 on June 17, 1973, [R-14].

All four PNGS-A units were successfully re-tubed during the Large-Scale Fuel Channel Replacement Program conducted between 1984 and 1992. During the re-tubing, it was discovered that some reactor systems had become contaminated with Carbon-14 particulate produced from nitrogen-14 in the annulus gas. Some contaminated components were removed from the reactor and transferred to Dry Storage Modules. These modules are now stored at the NSS-PWMF, and decommissioning of the Dry Storage Modules is covered in the NSS-PWMF PDP [R-4].

In 1997, U1 - U4 were shut down and subsequently laid-up. U1 and U4 were refurbished and restarted/returned to commercial operation in November 2005 and September 2003 respectively. U2 and U3 were not refurbished and never restarted since 1997. Both U2 and U3 have been defueled and the heavy water in both the moderator and the Heat Transport System have been completely drained [R-14]. OPG placed these two units in SWS and has no plans to restart them in the future.

In 2024, U1 and U4 are planned to be shut down and undergo transition activities from operations into SWS, which indicates the start of decommissioning. This includes, but is not limited to, defueling, and dewatering the units as well as any end stating of systems no longer required.

2.0 DECOMMISSIONING APPROACH

2.1 Separation of PNGS-A and PNGS-B

Should there be a decision to refurbish PNGS-B, there is a need to define the boundary between PNGS-A (U1 to U4) and PNGS-B (U5 to U8). Common systems and infrastructure will no longer be shared as each facility will be in a different lifecycle phase of a nuclear power plant:

- PNGS-A will enter the decommissioning phase of the lifecycle after Stabilization, and kept in SWS until decommissioned; and
- PNGS-B is planned to be refurbished (pending regulatory approval) and continue to be in the operational phase of the lifecycle.

The separation of PNGS-A and PNGS-B is denoted by the concept of an AB Gate which is illustrated in Figure 3 and has been defined for planning purposes, denoting the separation between the PNGS-B operating and the PNGS-A decommissioning stations. The planned engineering and physical modifications are addressed in the Stabilization Activity Plan (SAP) [R-9] and therefore are excluded from the scope of this DDP.

2.2 AB Gate Criteria

The AB Gate which is planned to separate PNGS-A Decommissioning from PNGS-B planned Refurbishment/Extended Operations. This gate was defined based on the following criteria:

- Systems on PNGS-A are to support SWS activities, while the systems on PNGS-B are to support planned extended operations of PNGS-B. By the time the separation of common system is complete, no PNGS-B systems required to support operations will be on PNGS-A.
- Terminal points to be established if required for energy sources crossing the AB gate barrier.
- The AB Gate may change location over time dependent on the overall site strategy.
- At the appropriate point in decommissioning, the AB Gate may become a physical barrier to separate the operating island from the active decommissioning island, enabling the following (depending on execution strategy):
 - (1) Implementation of different organizational and operational controlling authorities on each side of the AB Gate.
 - (2) Controlling/limiting movement of personnel and materials between PNGS-A and PNGS-B.
 - (3) Implementation of different security requirements on each side of the AB Gate.

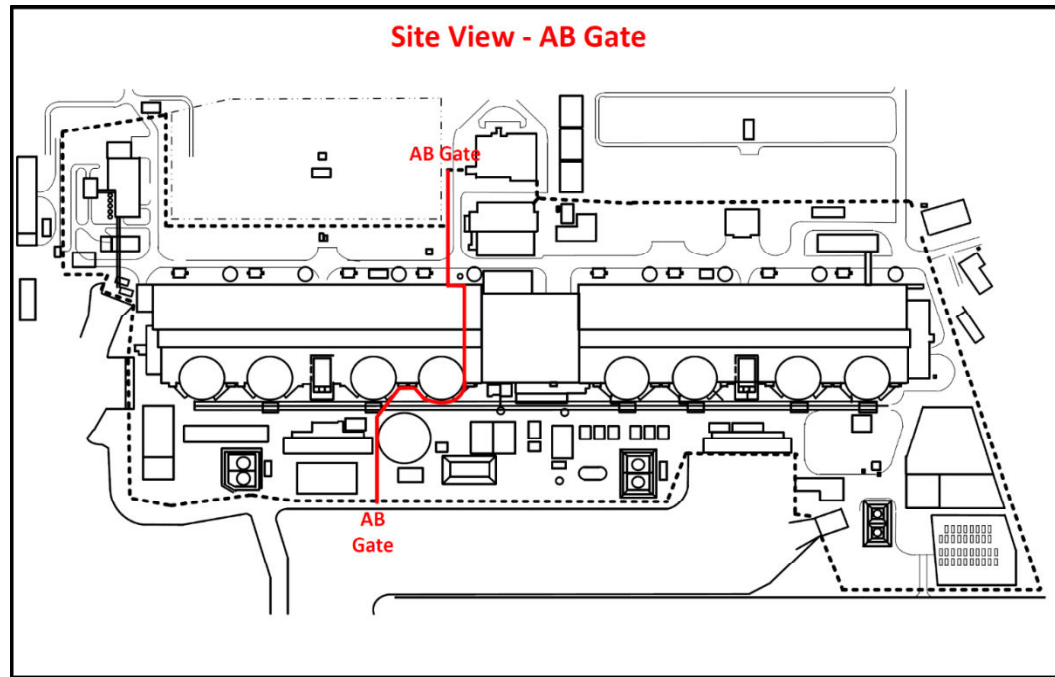


Figure 3 AB Gate

2.3 PE Descriptions

NOTE

As decommissioning planning and execution progresses, some outbuildings may be available for decommissioning or for dismantlement earlier than contemplated in the preliminary sub-categorization. In these instances, approved OPG processes and procedures may be used to advance the work, including notification to the CNSC, as required.

In accordance with REGDOC-2.11.2 [R-8], any work activities that fall within a given PE, even if not explicitly detailed, will undergo all mandatory preparatory activities. This will ensure comprehensive decommissioning planning and preparation as required by the regulatory framework.

2.3.1 PE-A: Out Buildings Removal

This envelope includes the dismantling and removal of Outbuildings. Outbuildings refers to Systems, Structures or Components (SSCs) within the PNGS-A protected area, but not part of the main Powerhouse structure. Dismantling scope for this DDP submission is either for the full removal of the structure or just the internals (leaving the structure intact) with details provided in Volume 1. The envelope has been preliminarily sub-categorized into three phases based on the timing for when the specific outbuilding is anticipated to no longer be required for continued use and will be available for decommissioning:

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- Group A-1: Post PNGS-A Shutdown: Outbuildings not required after PNGS-A shutdown (Figure 4).
- Group A-2: Post Separation of PNGS-A and PNGS-B: Outbuildings not required after common systems are separated along the AB Gate (Figure 5).
- Group A-3: Post Irradiated Fuel Bay Empty: Outbuildings not required after IFB-A and AIFB are emptied, drained and dried (Figure 6).

The outbuildings included in the decommissioning plan for PNGS-A are listed in Volume 1. This list is current as of the development of this DDP, as decommissioning and operational needs evolve there may be adjustments in the list which will be reflected in the next update of the DDP and PDP for PNGS. For a complete list of outbuildings at PNGS-A, PNGS-B and NSS-PWMF, refer to 'Pickering Site Overarching Document' [R-5].

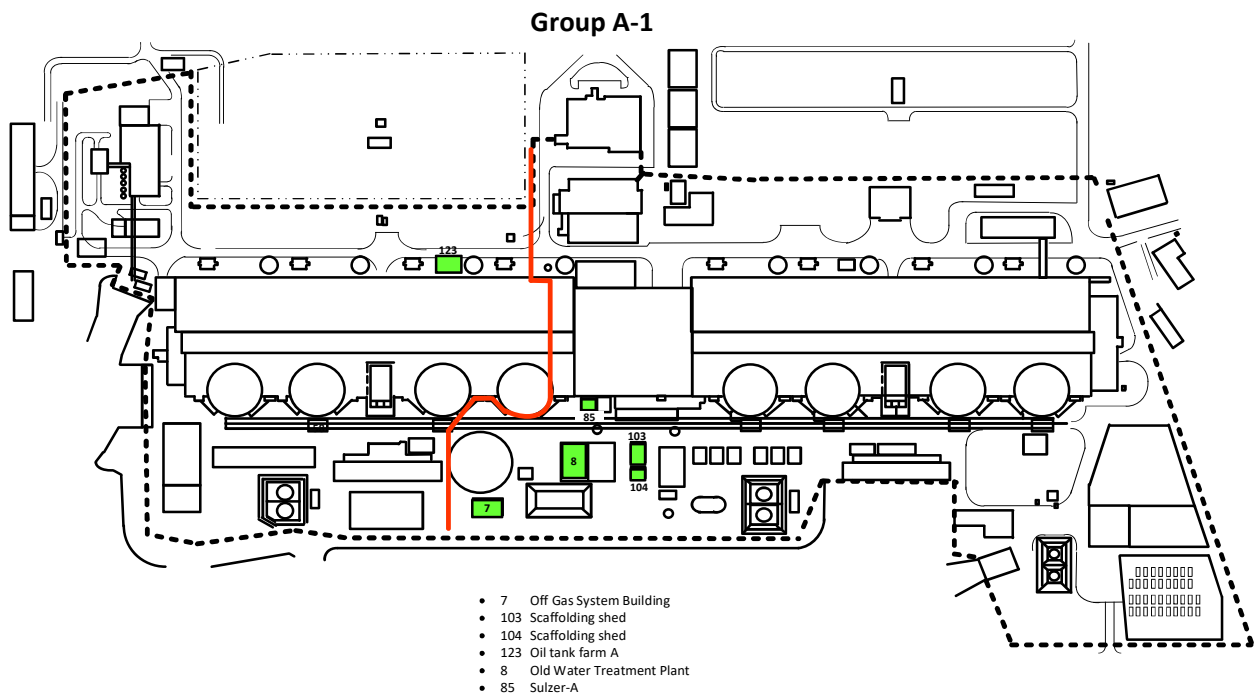


Figure 4 Planning Envelope A – Group A-1 Out Buildings Highlighted in Green

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Group A-2

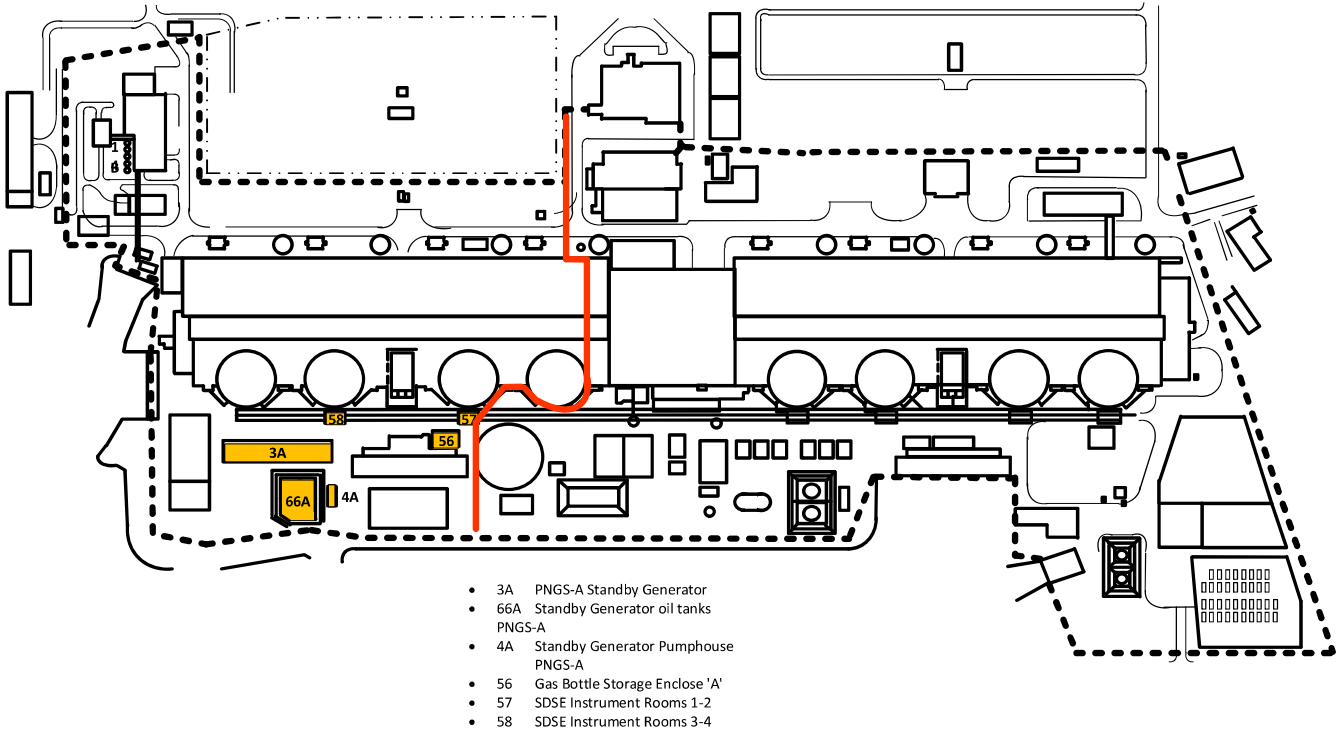


Figure 5 Planning Envelope A - Group A-2 Out Buildings Highlighted in Orange

Group A-3

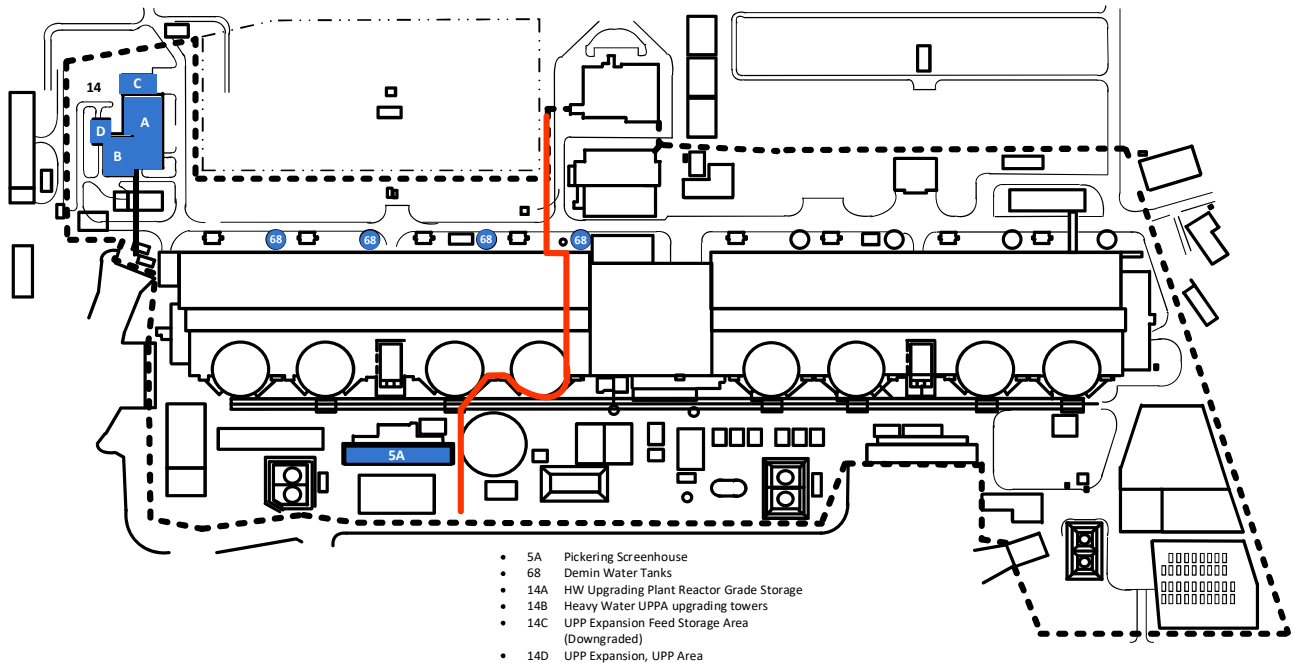


Figure 6 Planning Envelope A - Group A-3 Out Buildings Highlighted in Blue

2.3.2 PE-B: Non-Nuclear Systems and Component Removal

This envelope includes the dismantling and removal of safe stated/abandoned SSCs considered to be non-nuclear that are located within the Turbine Hall and Turbine Auxiliary Bay. The scope of this PE does not include the demolition of the Turbine Hall and Turbine Auxiliary Bay structure as that scope is captured in PE-E.

PE B has been preliminarily sub-categorized into two groups and located in Volume 2, with the groups based on the location and type of systems to be decommissioned:

- Group B-1: Systems and components, such as the turbine and generator, located within the Turbine Hall (Figure 7).
- Group B-2: Systems and components, such as the electrical supply and controls, located within the Turbine Auxiliary Bay (Figure 8).

The equipment included in this envelope is not anticipated to be radiologically contaminated.

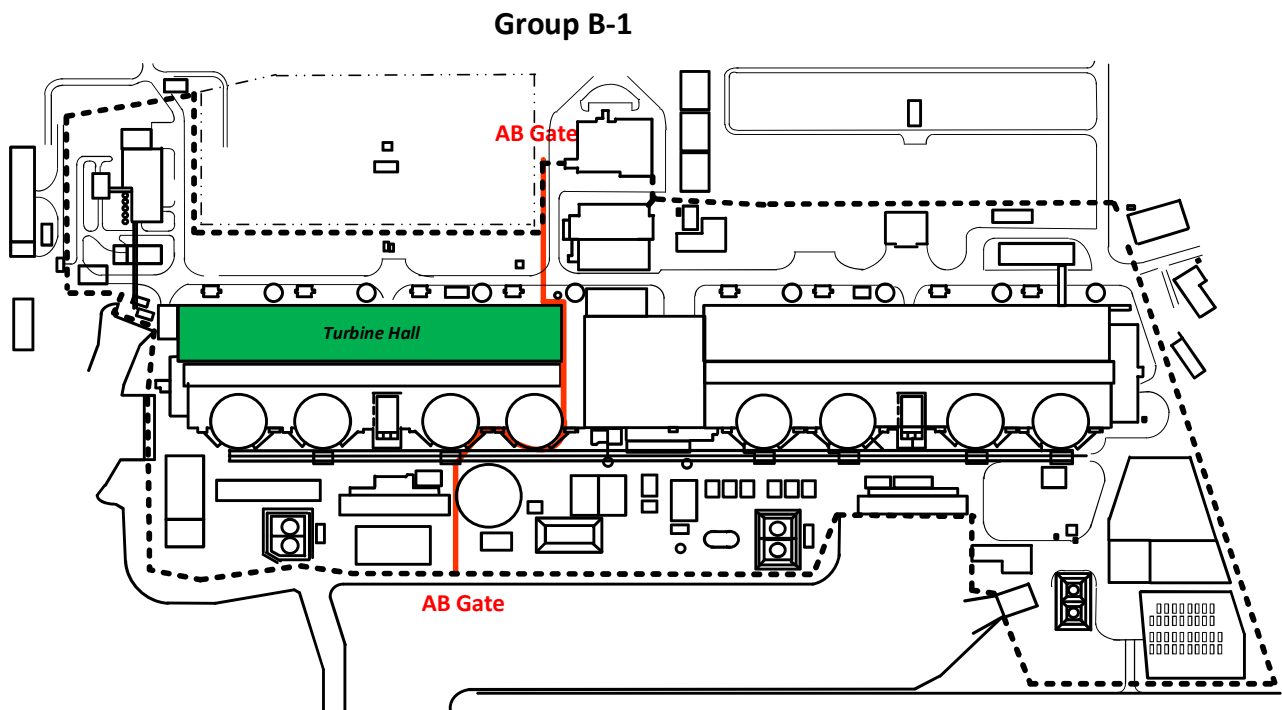


Figure 7 Planning Envelope B - Group B-1

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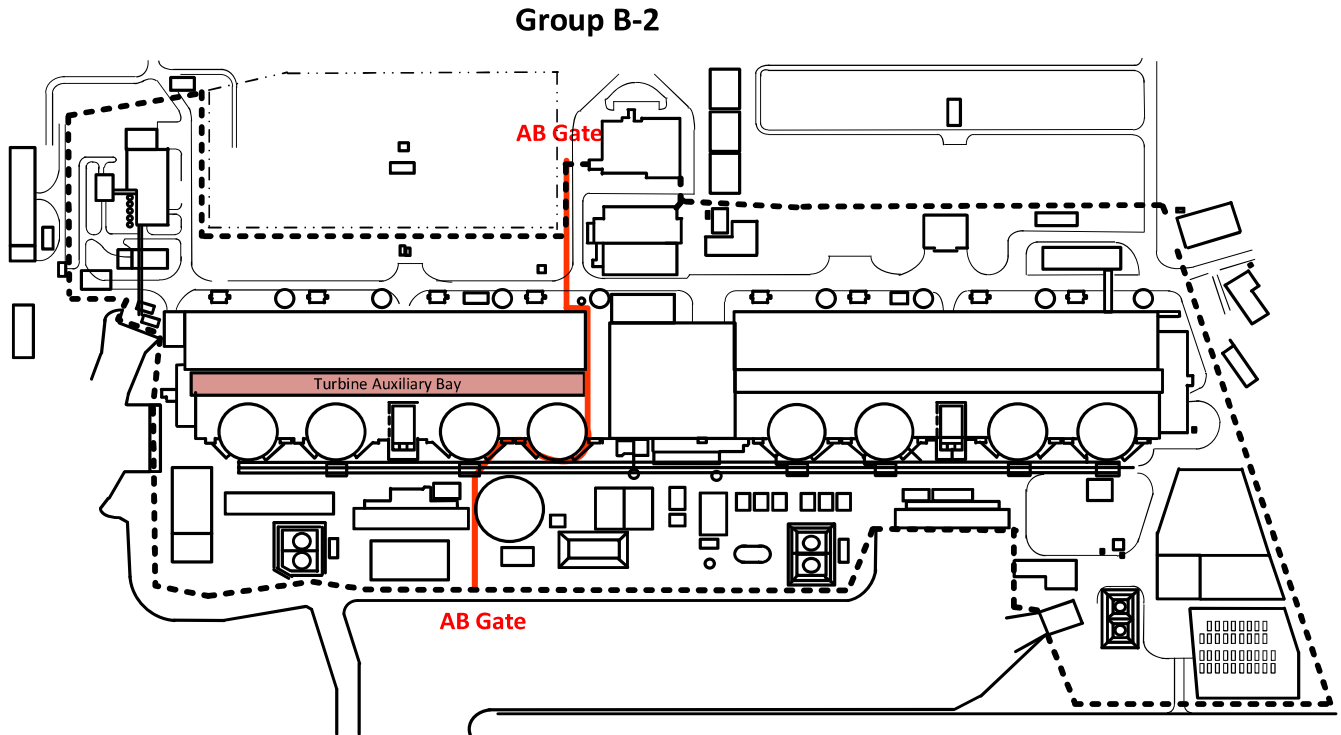


Figure 8 Planning Envelope B - Group B-2

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2.3.3 PE-C Nuclear Systems and Component Removal

This envelope includes the dismantling and removal of SSCs which make up the nuclear systems at PNGS-A. SSCs considered to be nuclear include the primary heat transport system, moderator systems and supporting systems that interface with heavy water. These systems contain radioactive contamination, with contamination levels varying from low to significant depending on the system and location. Additionally, many components, particularly those near or within the reactor core, will be radioactive due to neutron activation of the materials themselves. While neutron activation is most significant in core components, materials outside the reactor core may also be activated to varying degrees due to neutron fields present during reactor operation. The combination of contamination and activation can result in significant radiation fields that must be carefully managed during dismantling activities.

This envelope includes systems within the Reactor Auxiliary Bay (RAB) and the Reactor Building (RB) but does not include the demolition of the RAB and RB structures, which are covered in section 2.3.5 and 2.3.6, respectively. It also does not include the reactor, such as the calandria and calandria internals, which are covered in section 2.3.4. Figure 11 depicts the boundary between PE-C and PE-D, which is at the connection between the feeder pipes (PE-C) and the fuel channel end fittings (PE-D).

PE-C has been preliminarily divided into two groups based on the location of the system to be decommissioned:

- Group C-1: Nuclear Systems within the RAB (Figure 9).
- Group C-2: Nuclear Systems within the RB (Figure 10).

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Group C-1

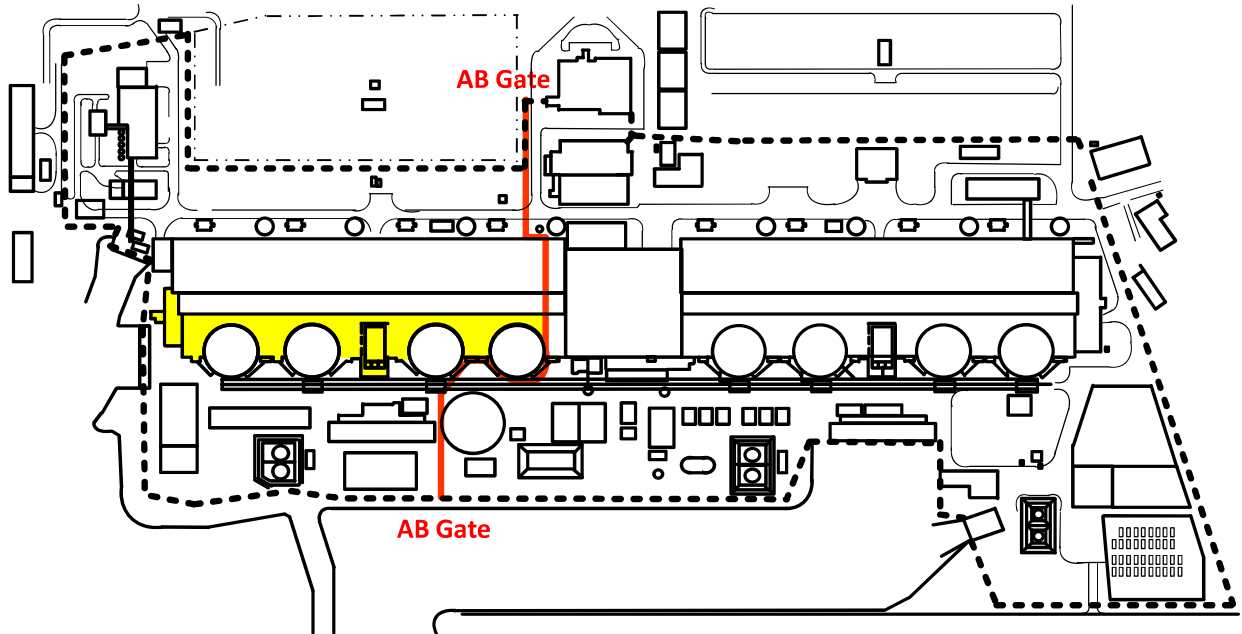


Figure 9 Planning Envelope C - Group C-1

Group C-2

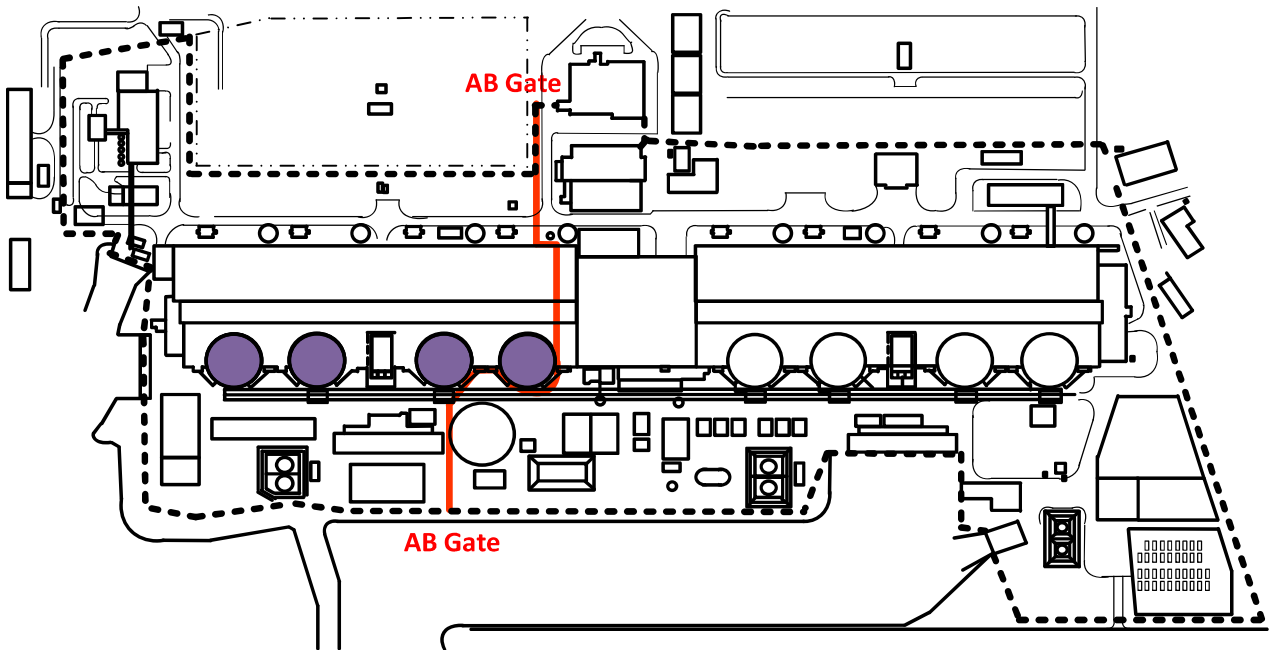


Figure 10 Planning Envelope C - Group C-2

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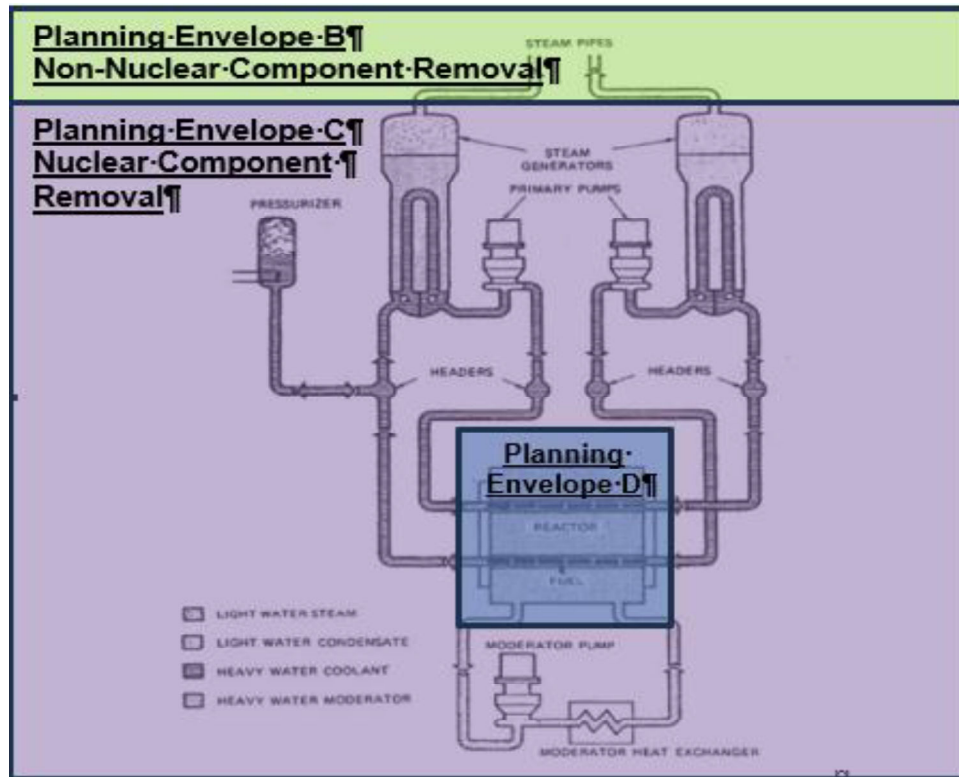


Figure 11 PNGS-A Primary Heat Transport System Breakdown Between Planning Envelopes B, C and D

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2.3.4 PE-D: Reactor Segmentation

This envelope includes the dismantling and removal of the reactor, internals and the calandria vault. These components were in close or direct contact with nuclear fuel and were subjected to activation products during operation. They are anticipated to have high dose rates and require specialized tooling to handle and package the waste. This PE is within the RB and includes the calandria vault but does not include the RB structure, which is covered in section 2.3.6. Figure 11 depicts the boundary between PE-C and PE-D which is at the connection between the feeder pipes (PE-C) and the fuel channel end fittings (PE-D).

The components included in this envelope are anticipated to be classified mostly as ILW or LLW and have been listed below.

- Calandria assembly:
 - Calandria tube, and calandria tube insert assemblies,
 - Calandria inlet and outlet nozzles,
 - Pressure relief system,
 - Calandria shell,
 - Calandria end shields.
- Fuel channel assemblies:
 - Pressure tubes,
 - End fittings,
 - Annulus Spacers
 - Shield plugs,
 - Channel closure,
 - Feeder coupling,
 - Channel annulus bellows.
- Reactivity control units:
 - Adjuster rods,
 - Shutoff rods,
 - In core flux detector,
 - Liquid zone control,

- Reactivity mechanism deck.
- Dump tank: The PNGS-A design includes a dump tank directly below the calandria for the heavy water moderator.
- Calandria vault structure are concrete chambers that house both the calandria and the dump tank.

Figure 11 PNGS-A Reactor Face, Figure 12 PNGS-A Calandria and Internals, Figure 14 PNGS-A Calandria Vault, and Figure 15 Planning Envelope D – Calandria Segmentation illustrate the scope included in PE-D and the location within the broader plant.

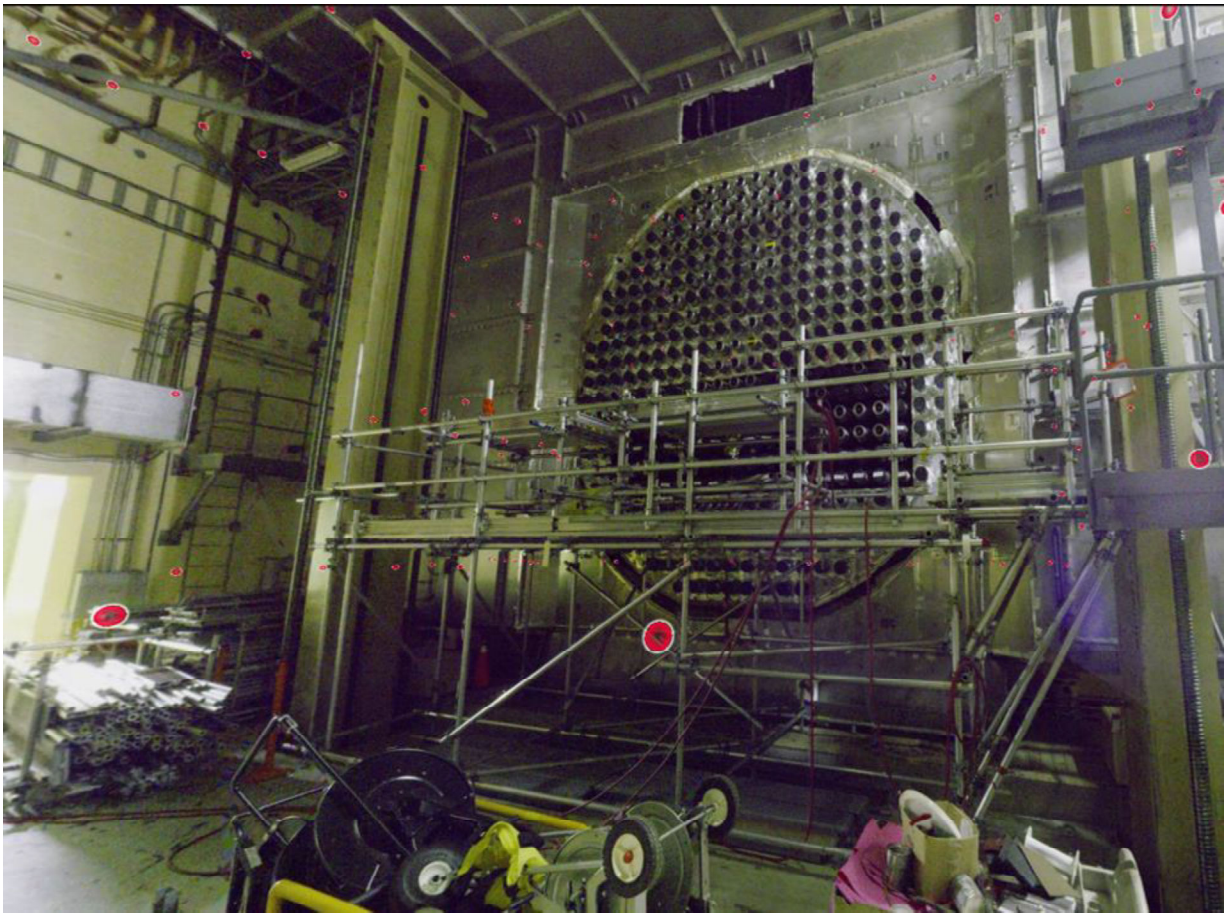


Figure 12 PNGS-A Reactor Face

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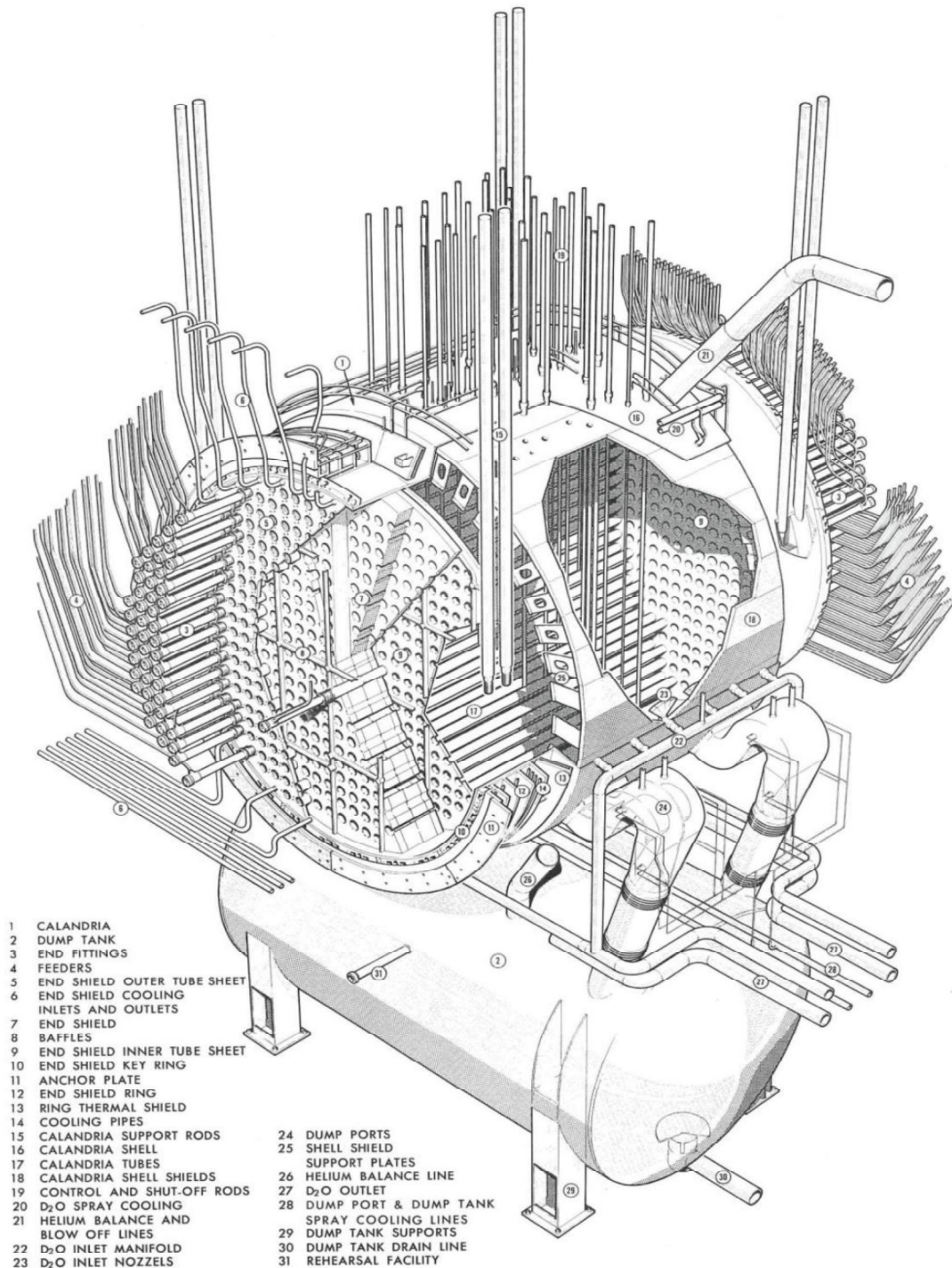


Figure 13 PNGS-A Calandria and Internals

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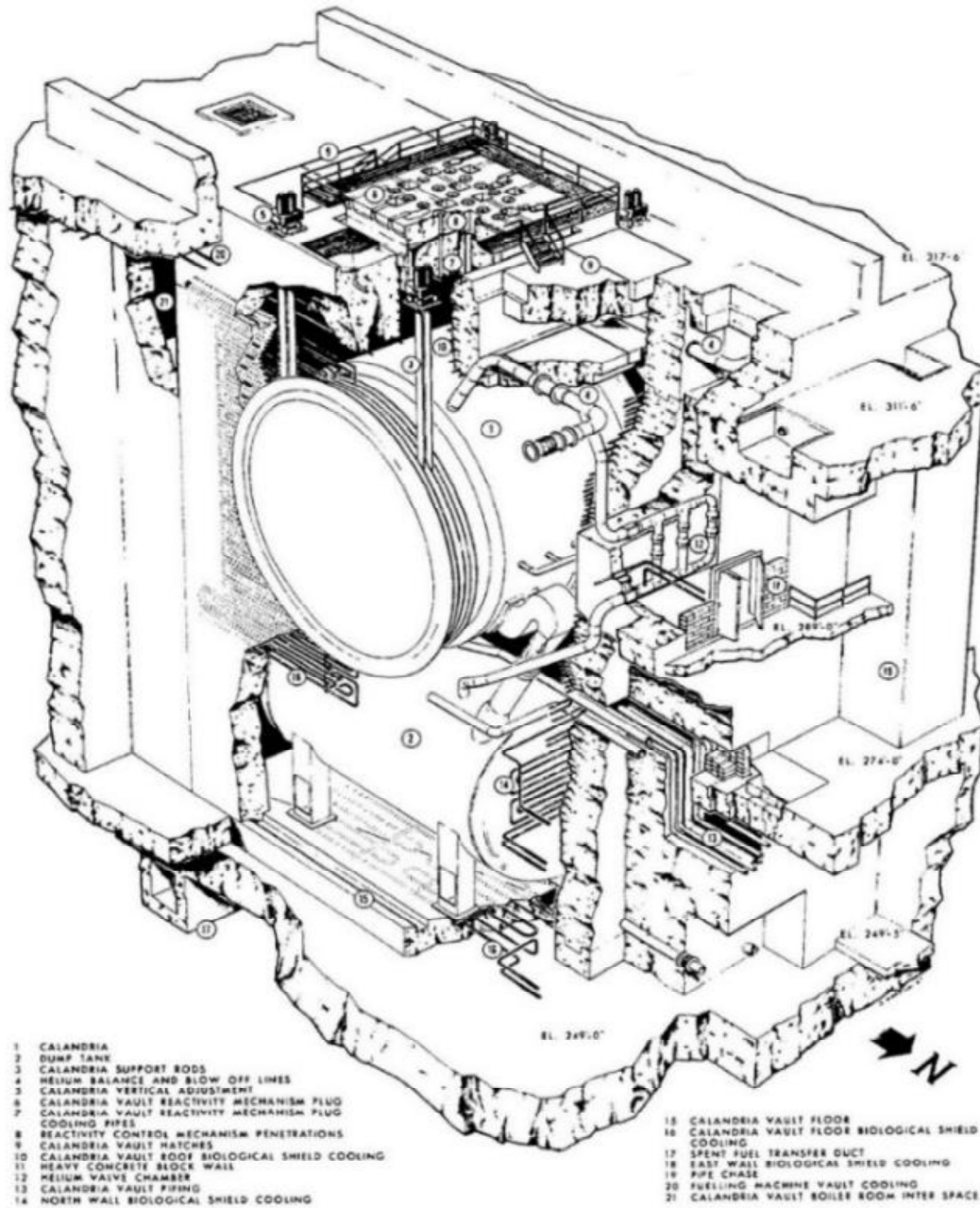
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Figure 14 PNGS-A Calandria Vault

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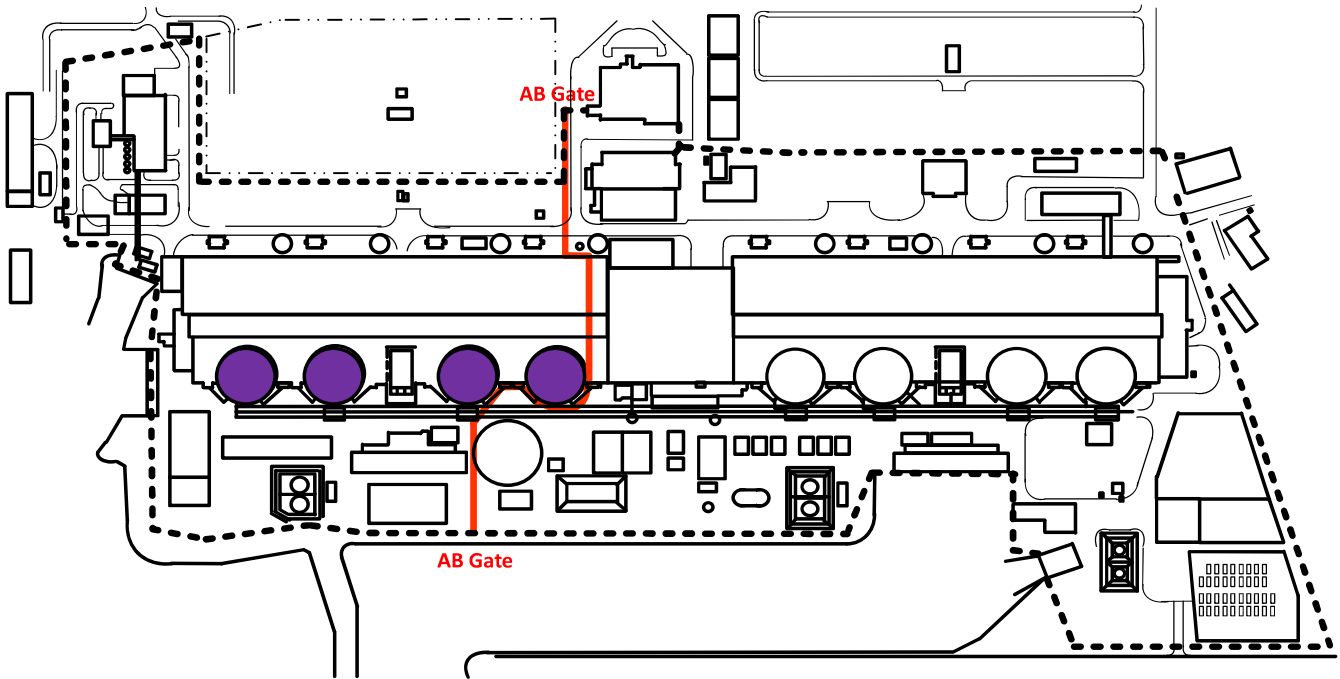


Figure 15 Planning Envelope D – Calandria Segmentation

2.3.5 PE-E: Powerhouse and Reactor Auxiliary Bay Structural Removal

PE-E includes the demolition of the Powerhouse (Turbine Hall (TH) and Turbine Auxiliary Bay (TAB)) and the RAB (Figure 16). These structures have been grouped together as they are structurally dependent and share similar support. The non-nuclear and nuclear system component removals, which are pre-requisites to this scope, are captured in PE-B and PE-C, respectively.

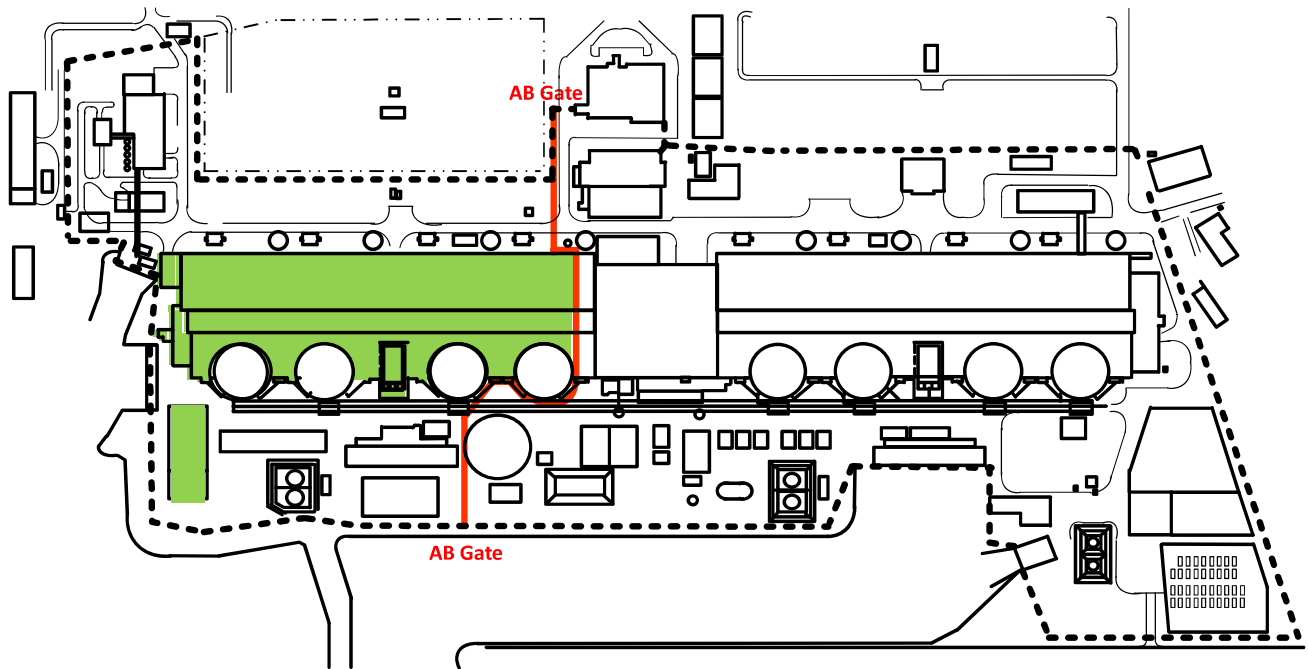


Figure 16 Planning Envelope E – Powerhouse and Reactor Auxiliary Bay Structural Removal

2.3.5.1 Turbine Hall

The Turbine Hall is the northernmost structure of the Powerhouse and lies between column line A to F (north to south).

Turbine Hall includes the following elevations:

- 225' elevation,
- 254' elevation,
- 274' elevation, and
- 294' elevation.

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2.3.5.2 Turbine Auxiliary Bay

The Turbine Auxiliary Bay is in the Powerhouse, south of the Turbine Hall and north of the Reactor Auxiliary Bay and lies between column line F to H (north to south). There is a concrete block wall and steam doors separating the Turbine Auxiliary Bay and the Reactor Auxiliary Bay at the H-line.

Turbine Auxiliary Bay includes the following elevations:

- 254' elevation,
- 278' (mezzanine) elevation,
- 294' elevation,
- 317' elevation, and
- 339' elevation.

2.3.5.3 Reactor Auxiliary Bay

The RAB runs the full length of the Powerhouse and is south of the Turbine Auxiliary Bay, sharing the same wall (at column H). The RBs are connected to the RAB as depicted in Figure 16.

NOTE

While these areas are grouped for decommissioning planning purposes, their radiological characteristics and associated hazards must be assessed and managed independently, as each area presents distinct radiological challenges based on its operational history and use.

For the purposes of decommissioning planning, the Irradiated Fuel Bays (IFBs) and the West Annex have been considered a part of the RAB, though their radiological hazards differ significantly, as follows:

- The Reactor Auxiliary Bay (RAB) contains various systems with different radiological characteristics depending on the specific system and its historical function.
- Irradiated Fuel Bay A (IFB-A) is in the Reactor Auxiliary Bay at the ground floor level between Reactor Buildings 2 and 3, with radiological hazards primarily associated with fuel handling and storage contamination.
- Auxiliary Irradiated Fuel Bay (AIFB) is located southwest of Unit 4 Reactor Building and is connected to the Reactor Auxiliary Bay by an enclosed corridor. It presents unique

radiological challenges due to its historical use with various radioactive materials including cobalt.

- West Annex is at the west end of the Reactor Auxiliary Bay.

2.3.6 PE-F: Reactor Building Structural Demolition

This envelope includes the removal of the four RB structures (U1, U2, U3 and U4, east to west respectively), and the portion of the Pressure Relief Duct (PRD) that is west of the Vacuum Building/AB Gate (Figure 17). The internal systems and reactor removals, which are pre-requisites to this scope, are covered in PE-C and PE-D, respectively.

The Reactor Building was part of the containment system, which prevented the escape of radioactivity, and provided radiation shielding when the reactor was operating. It is a cylindrical, reinforced concrete structure with an elliptical domed roof that is anticipated to have some level of contamination that will need to be controlled during demolition. Access to the Reactor Building is by means of airlocks so that the containment integrity could be maintained during operations. There are pairs of airlocks on three elevations. These airlocks may be modified and/or supplemented with additional access/egress openings made in the containment structure to support decommissioning activities.

Figure 18 depicts the layout of the reactor building and Figure 19 illustrates the relationship between PE-C, PE-D and PE-F.

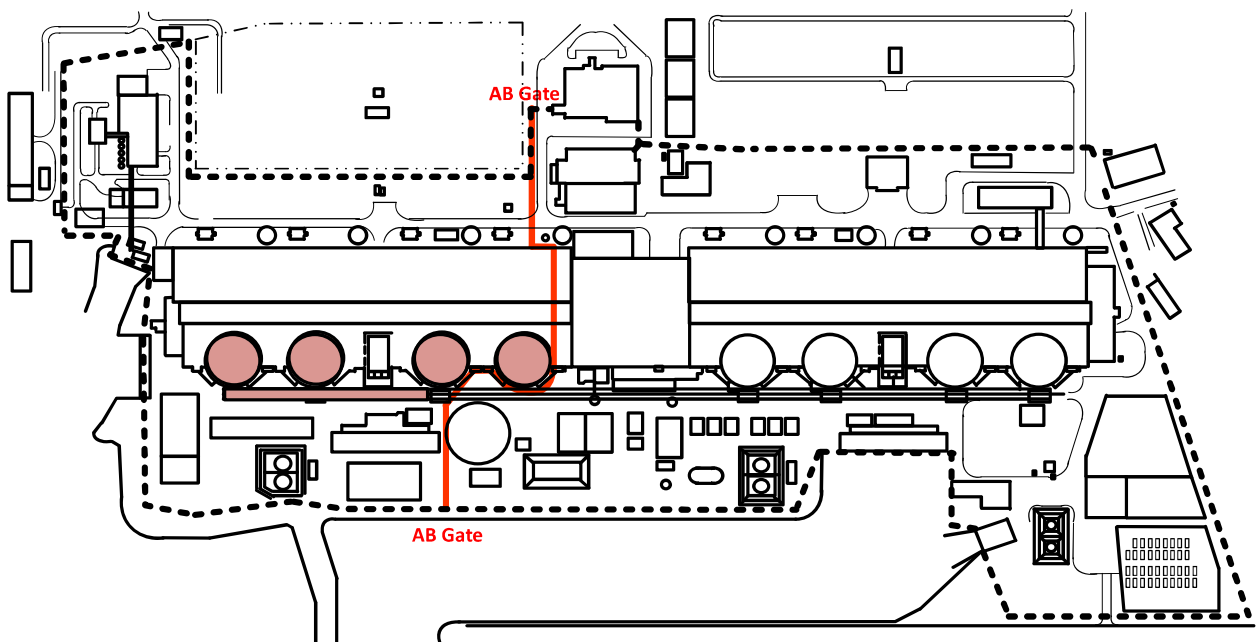


Figure 17 Planning Envelope F - Reactor Building Structure Removal

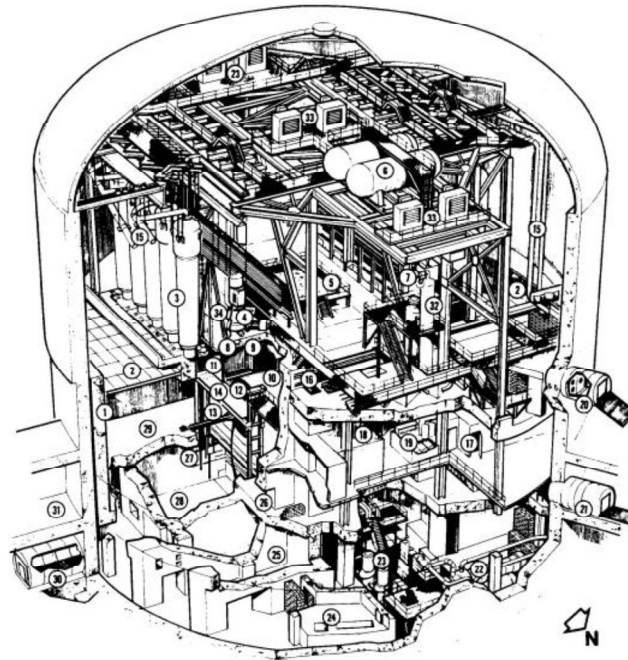


Figure 18 Planning Envelope F - Reactor Building Structure

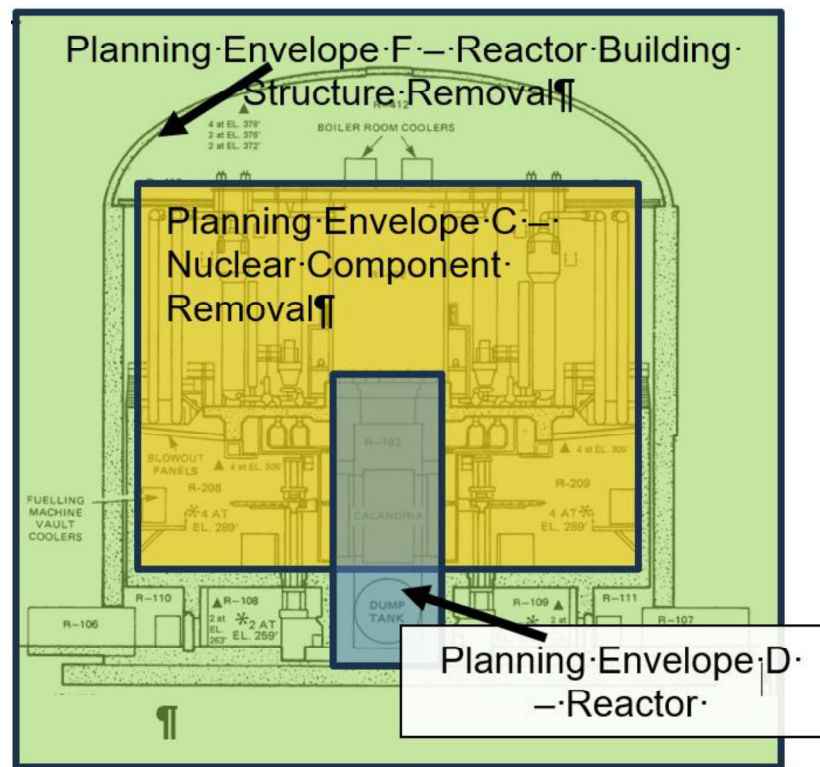


Figure 19 Planning Envelope C, D and F

2.3.7 PE-G: Site Remediation

This envelope includes the remediation of the site within the protected area and west of the AB gate, to achieve the Final-End State (Figure 20). Pre-requisites of this scope are the completion of all other PEs, A through F. This scope covers nuclear and non-nuclear aspects, including subsurface contamination. The completion of this envelope leads into the end state for PNGS-A, as discussed in Section 2.4.

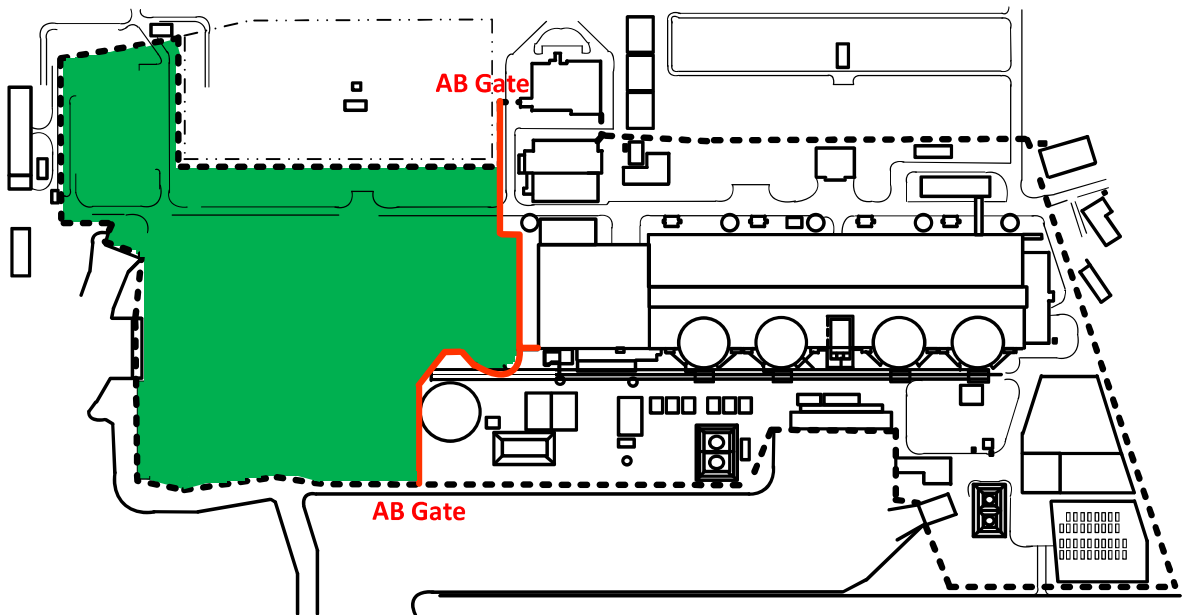


Figure 20 Planning Envelope G Site Restoration

2.4 End States

2.4.1 Interim-End State

The interim end states objectives for each PE are listed below and they have been grouped according to the nature of the work e.g., PEs B, C and D are grouped together as they pertain to the removal of components and/or systems which are anticipated to have similar interim end state objectives. The order in which the objectives have been listed is not necessarily reflective of the sequence of activities during project execution.

Prior to execution of any dismantling activities, Detailed Work Packages will be prepared. Each work package will include a description of the work including but not limited to the necessary radiological surveys to be performed, radiation protection, quality assurance and waste management.

2.4.1.1 Interim end-state objectives for PE-A include:

- All above ground structures, systems and components drained, de-energized and removed,
- All above ground structures, except for floor slabs and foundations are removed,
- All services (e.g., electrical, water, etc.) de-energized and abandoned in situ. Underground electrical or piping conduits cut off near the grade level,
- All necessary radiation surveys completed and documented in accordance with the Characterization and the Final Survey Program,
- Contamination in the soil, if present, will be addressed during PE-G: Site Remediation execution,
- All holes/voids in the ground from dismantling activities will be filled and graded in as required, and
- Interim End-State Report issued.

2.4.1.2 Interim end-state objectives for PE-B, C and D include:

- All systems and components drained, de-energized and removed,
- All services (e.g., electrical, water, etc.) de-energized and abandoned in situ. Electrical or piping conduits cut off near the floor level,
- All necessary radiation surveys completed and documented in accordance with the Characterization and the Final Survey Program,
- All holes/voids in the floor from dismantling activities will be filled as required, and
- Interim End-State Report Issued.

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2.4.1.3 Interim end-state objectives for PE-E and F include:

- All above ground structures removed. Subsurface structures removed to a minimum depth of one meter below grade. At-grade foundation slabs exceeding one metre in thickness abandoned in place,
- All necessary radiation surveys completed and documented in accordance with the Characterization and the Final Survey Program,
- All holes/voids, and channels will be sealed below one metre depth from grade,
- Area Backfilled and graded with gravel and/or topsoil, and landscaped, and
- Interim End-State Report issued.

2.4.2 Final-End State

By the end of the Dismantling & Demolition and Site Restoration phases, the site will be free of industrial and radiological hazards. All the station SSCs will have been dismantled and all non-essential buildings and site facilities will have been demolished to a depth of one meter below grade. The switchyard is anticipated to remain for continued use.

All radioactive contamination above the established clearance levels for a 'brownfield' [industrial] site and all other hazardous materials will have been removed from the site. It is expected that the clearance level used for the clean up of the site will not require institutional controls after the release from regulatory control.

Subsurface structures will have been drained and de-energized. These subsurface structures will also have been surveyed for contamination, decontaminated, if required, and dismantled to a nominal depth of one meter below grade (consistent with international practices), backfilled with concrete rubble and/or soil and graded over. The remaining site will have been backfilled to prevent future subsidence and restored to a state suitable for other OPG uses. By the end of this stage, the end-state objectives defined in the DDP will be verified to have been achieved and the site will meet the criteria to Release From Regulatory Control.

Since brownfield/ industrial reuse is being contemplated as the proposed end-state land use, the cleanup criteria will be based on, but not limited to, the following radiological, chemical, and physical objectives. These will be reviewed and, if required, updated regularly with each revision of the DDP.

- In terms of radiological activity, the intent is to remove contaminated structures and/or decontaminate them to clearance levels within the OPG RP Program [R-16] in place at the time. Recommendations by the International Commission on Radiological Protection in place at the time will be taken into consideration when developing a clean-up criterion.

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- With respect to chemical contaminants, the soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act, or the relevant requirements at the time will be used and
- Regarding the end-state physical state of the site, all aboveground structures and underground structures including foundations to a depth of one metre below grade will be removed, backfilled, and graded with gravel and topsoil, and landscaped. At-grade foundation slabs exceeding one metre in thickness will be abandoned in place and covered over with a 1m thick layer of backfill.

2.4.3 Release From Regulatory Control

At the completion of decommissioning work, and site restoration, OPG will inform the CNSC that OPG has achieved the criteria to release the site from further regulatory control. The final activities leading to this release are to allow abandonment or free use of site and will be further defined closer to the time of this part of the project. These activities could include, but not limited to, the following:

- Having a repository for Decommissioning records, documenting the facility's end state and regulatory filings,
- Completion of documentation (non-conformance reports, inspections, open items, survey, and final dose assessments),
- Implementation of environmental monitoring/ institutional controls, if required, and
- Preparation of a Project Completion Report.

At the completion of PNGS-A decommissioning, OPG will meet the end state objectives laid out in the End States Section 2.4.

It is expected that the clearance level used for the clean-up of the site will not require any further institutional controls after the release from regulatory control. A final-end state report on the decommissioning program will be prepared, see Appendix B:.

2.5 Decommissioning Strategy

2.5.1 Decommissioning Strategy Adopted by Ontario Power Generation

Three decommissioning options were considered, consistent with the CSA standard for decommissioning [R-13] and CNSC REGDOC for decommissioning [R-8]:

- (a) Prompt Decommissioning, where the reactors and station would be decontaminated and dismantled, and the site restored promptly after shutdown.
- (b) Deferred Decommissioning, where the reactors and stations would be safely stored for up to several decades after shutdown to allow radiation levels to decay prior to Dismantling & Demolition and Site Restoration.

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- (c) In-situ Decommissioning, where the facility would be placed in a safe and secure condition, in which some or all the radioactive contaminants will remain in-place, resulting in a waste disposal site.

OPG does not consider (c), In situ decommissioning as a sustainable decommissioning strategy so it was not considered in the assessment. Prompt (a) and deferred (b) strategies were reviewed against the factors and social considerations outlined in REGDOC-2.11.2 [R-3] that should be reviewed when determining a decommissioning strategy:

- Political factors,
- Socio-economic impact,
- Lifetime cost,
- Financial resources,
- Waste facilities & infrastructure,
- Reactor type & facility history,
- Resources, technologies, & tools,
- Security,
- Health & Safety, and
- Environment.

The key drivers in arriving at the strategy are as follows:

- (a) Reactor type & facility history - With a potential planned PNGS-B refurbishment post shutdown, there would be a challenge to execute two major programs at PNGS at the same time due to congestion, space limitations and availability of qualified resources.
- (b) Lifetime cost – IFB-A and the AIFB will take time to be emptied of fuel and contents. PNGS-A station systems support the operations of the bay. It would pose a challenge and add complexity to execute major dismantling work before all nuclear fuel is removed from PNGS-A and the station systems supporting fuel are end stated.
- (c) Waste facilities & infrastructure - Generating radioactive wastes prior to the availability of radioactive waste disposal facilities introduces cost and risk. With the deferred dismantling sequence, it is expected that there is sufficient time to implement long-term disposal strategies for used fuel, LLW, and ILW to limit double handling of materials.
- (d) Security - Allows for removal of nuclear controlled substances, such as heavy water, resin, and nuclear fuel, from PNGS-A prior to any major dismantling.
- (e) Health & Safety - A deferral of greater than 10 years prior to major dismantling of nuclear systems allows for radioactive decay, though the decay characteristics vary

significantly by radionuclide. While shorter-lived beta and gamma emitters decay relatively quickly, longer-lived radionuclides persist and become proportionally more significant over time. This changing radiological profile affects waste classification, handling requirements, and worker protection strategies. The deferral period can contribute to lower waste management costs associated with handling, packaging, shielding, transporting, and disposal, particularly for shorter-lived isotopes. While this generally improves worker safety through reduced radiation levels, comprehensive radiological characterization remains essential due to the complex decay patterns and presence of long-lived radionuclides. In summary, while the deferral period provides some radiological and economic benefits, these advantages must be evaluated within the context of the complex decay characteristics of different radionuclides present in the facility.

- (f) Resources, technologies, & tools - Growth continues in decommissioning and nuclear waste management experience and technology across the industry, and a deferral of decommissioning of nuclear systems will allow time to leverage this experience to drive efficiency, gain knowledge and decrease cost. There could also be potential opportunities to leverage infrastructure and resources from the planned PNGS-B refurbishment, once completed, to support major dismantling.
- (g) Socio-economic impact - Deferring dismantling provides valuable time to strategically engage stakeholders, plan future site uses, and align decommissioning end-states with evolving community needs, ultimately optimizing long-term socio-economic benefits for the region.
- (h) Indigenous engagement - Allowing sufficient time for Indigenous engagement is essential to ensure impacts to Indigenous and Treaty rights are fully assessed. Deferred decommissioning allows time for this engagement, aligning on decisions and subsequently addressing any potential impacts. See Public, Stakeholders and Indigenous Engagement for more details.
- (i) Knowledge & capability – Strategy is to start dismantling on less complex and more familiar activities, such as non-nuclear buildings and structures. This allows for building of knowledge and capability in decommissioning before progressing to more complex activities, such as nuclear systems and the reactor.

Deferred decommissioning of PNGS-A will proceed according to a sequence of dismantling activities and periods of SWS, prioritized, and planned to take into account resource availability, safety considerations, environmental hazards and conditions, and stakeholder inputs. Discussion of timelines for decommissioning activities is detailed in the Decommissioning Schedule section.

The dismantling and demolition sequence will be reassessed periodically considering experience, updated cost estimates, changing technology, liabilities or risks identified during decommissioning planning, opportunities for risk reduction, and the potential repurposing of the site for future use. It is recognized that deferring decommissioning for extended periods of time can introduce a risk of losing institutional knowledge, and as such opportunities to leverage available personnel from other nuclear decommissioning and planned refurbishment projects will be considered in the sequence and schedule of dismantling work. See Risk Reduction Strategy for more details.

The overall selection of a deferred decommissioning strategy discussed in the Pickering PDP [R-3] has not changed, however the following specific items have been refined within the overall deferred strategy:

- Advances major dismantling start date by approximately 20 years (from 2050s to 2030s),
- Extends decommissioning duration to account for “First of a Kind” challenges and industry experience,
- Accounts for modifications to isolate U1 - U4 from U5 - U8 as well as modifications to separate active systems supporting extended PNGS-B operations, and
- Aligns timing of U1 - U4 and U5 - U8 Reactor Building demolition, based on planned PNGS-B refurbishment, to address the relative proximity of the U1 - U4 RB structures to the U5 – U8 containment systems.

2.5.2 Deferred Decommissioning Strategy for PNGS-A

Applying the ‘Deferred Decommissioning’ strategy, the PNGS-A will pass through four distinct phases [R-8], [R-13]:

2.5.2.1 Planning for Decommissioning

Planning for Decommissioning occurred prior to the planned shut down of the last PNGS-A unit in 2024 and was captured in the Pickering Nuclear Site Preliminary Decommissioning Plan (PDP) [R-3].

2.5.2.2 Preparation for Decommissioning

The Preparation for Decommissioning Phase includes activities for permanent shutdown and for the transition to SWS. Units 1 and 4 are planned to be in this phase until the end of 2028. Transition from Operation to Decommissioning (Stabilization)

During the Preparation for Safe Storage (Stabilization), OPG will plan and execute the safe transition of the PNGS-A from the electricity generating state to a predetermined safe state suitable for storage with surveillance.

This transition involves the permanent shutdown of the PNGS-A, which will be followed by activities to transition the station from a permanent shutdown state to decommissioning, starting with SWS, in line with the Decommissioning Strategy Adopted by Ontario Power Generation.

Elements of the permanent shutdown plans are address in Pickering Sustainable Operations Plan (SOP), P-PLAN-09314-00001 [R-17] and the plans to transition PNGS-A into decommissioning are outlined in the Pickering Stabilization Activity Plan (SAP), P-PLAN-00990-00007 [R-9].

During the transition period, monitoring and maintenance activities will be conducted to ensure the health and safety of persons and the protection of the environment. Historical information

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will be preserved that is relevant to the eventual decommissioning of the facility and documented (e.g., historical site assessment).

2.5.2.3 Execution of Decommissioning

The Execution of Decommissioning phase begins for a unit after it has been permanently shut down, stabilized and all necessary regulatory approvals have been obtained. The following activities shall be performed during this phase:

(a) Storage with Surveillance

The SWS plan [R-6] for the PNGS-A will be implemented and maintained to ensure the facility/site is maintained in a safe configuration and the SSCs needed to maintain safe storage are functioning as required. The release of materials to the environment will be controlled, access by unauthorized persons will be prevented, and infestations of vermin and other organisms will be mitigated, so that decontamination, dismantling, and/or cleanup can be carried out safely. Surveys of hazards shall also be performed to support the safe performance of surveillance and maintenance activities during the SWS period following the plans detailed in the Characterization Strategy. During SWS, there are opportunities to deploy risk reduction strategies, as outlined in the Risk Reduction Strategy.

NOTE

U2 and U3 have been in SWS since 2010.

(b) Dismantling & Demolition

During SWS, the physical work will commence to dismantle and demolish as shown in the Decommissioning Schedule. This work shall be defined in terms of work packages and work procedures in the appropriate DDP volume to the level of detail required for safe, effective, and efficient decommissioning [R-20]. See Work Package Management for more details on the work package preparation procedure. Below are some key highlights:

- The PE sequence will be per the sequence laid out in the PE Sequencing Strategy section.
- As soon as the IFB-A and auxiliary irradiated fuel bay are empty, major SWS systems can be reduced or shut down.
- RB removal is deferred until PNGS-B is shut down after planned extended operations.
- OPG may perform risk reduction activities described in the Risk Reduction Strategy section.

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At the completion of the dismantling and demolition work packages, surveys shall be performed as detailed in Final Survey Program section.

(c) Site Restoration

Lands associated with the PNGS-A site that might have been impacted will be remediated to the degree required to meet the end-state criteria.

At the completion of this phase, final surveys of residual radioactive and hazardous materials will be performed in accordance with the Final Survey Program and documented to demonstrate that the final end-state for remaining SSCs and the site has been achieved in accordance with the End States.

2.5.2.4 Completion of Decommissioning

The Completion of Decommissioning phase involves verifying that all decommissioning activities have been completed satisfactorily, the final end-state has been reached, and all documentation has been completed.

Decommissioning ends with the release of the facility from CNSC regulatory control; refer to Release From Regulatory Control for more details. If unrestricted release cannot be achieved, institutional controls will be required to be in place and OPG shall submit post decommissioning plan(s) to the CNSC for review. Note that OPG anticipates being able to achieve unrestricted release based on current decommissioning plans.

The responsibility for institutional controls, if required, resides with OPG unless responsibility is transferred to a third party with CNSC's approval.

2.5.3 Risk Reduction Strategy

During the work package development, safety and environmental hazards will be assessed, and mitigation strategies developed. Based on this assessment, if opportunities arise to mitigate liabilities and risks through earlier dismantling and/or demolition of specific structures or systems, these work packages will be re-prioritized. More details of this strategy will be reflected as applicable in the decommissioning schedule.

Risk reduction activities as defined in CNSC's decommissioning regulatory document [R-3] may include:

- Reduction or removal of combustibles,
- Removal and recycling of non-contaminated or slightly contaminated equipment,
- Reduction or isolation of asbestos and other hazardous materials,
- Demolition of non-nuclear buildings or facilities, provided there are no safety impacts to the remainder of the site,
- Removal of accumulated radioactive waste to an offsite licenced storage or disposal facility or site, and

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- Reduction or removal of hazardous waste.

During the SWS period, OPG is planning on implementing a risk reduction strategy for several areas of PNGS-A. This strategy aims to mitigate potential risks to workers, the public, and the environment through prioritized selected dismantling and demolition activities, in accordance with the licence. Currently, U2 and U3 are in SWS Phase.

Unit 1 is currently undergoing Stabilization activities, and Unit 4 is expected to start stabilization once shut down at the end of 2024. Both units will enter SWS once Stabilization activities are complete. Stabilization activities are as per the SAP [R-9].

Risk reduction activities are expected on PE-A and PE-B, but they may also be performed on other PEs if required. Any risk reduction activities will be executed in accordance with the licence.

(a) PE-A

- Mostly removal of non-nuclear buildings or facilities on site that are no longer required to support PNGS-A operations or SWS.

(b) PE-B

- Removal of non-nuclear components and systems located within TH and TAB.

2.5.4 PE Sequencing Strategy

As introduced in PE Sequencing Strategy, the decommissioning plan for PNGS-A is organized into distinct PEs, each designated to manage specific aspects of the decommissioning process. The PEs are structured to facilitate sequencing of PNGS-A decommissioning beginning with demolition of outbuildings and removal of non-nuclear systems, followed by dismantling and demolition of nuclear systems and reactor components, and finally removal of building structures and subsequent site remediation.

Starting dismantling on less complex and more familiar activities, such as non-nuclear buildings and structures, allows for the team to build knowledge and capability in decommissioning before progressing to more complex activities.

Nuclear Component Removal and Reactor Segmentation involve different hazards, complexities, and radiological considerations that require distinct planning, specialized expertise, and targeted risk mitigation strategies that will be developed and proven as work progresses.

The chosen sequencing of the dismantling work allows for the use of smaller crew sizes which reduces the risk of scheduling pressures. These crews are expected to be largely comprised of demolition labourers which do not draw from the same trades groups that are required to progress OPG's other priorities; however, key experienced station staff and trades groups will be retained to ensure the historical site knowledge will be available to the decommissioning planners and that work is aligned with planned continued operation of U5 - U8.

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Finally, having defined waste pathways for all material streams is critical. For early work, existing waste streams can be leveraged while allowing time for development of innovative waste processing methods and radiological waste streams suited for decommissioning, as well as time for establishing waste disposal facilities to accept the decommissioning LLW and ILW.

NOTE

The activities related to PEs C through G detailed in the PNGS Preliminary Decommissioning Plan [R-3] remain applicable with validation occurring closer to execution, following the phased approach to decommissioning planning.

Planning Envelope	Focus Area	Grouping	Sequence Logic
PE-A	Out Buildings Removal	A-1	Structures within the protected area but outside the powerhouse that are available for decommissioning immediately following or shortly after shutdown of PNGS-A. Clearing these structures will reduce liability and open laydown and work areas for future decommissioning activities.
		A-2	Structures within the protected area but outside the Powerhouse that will be available for decommissioning following full separation of PNGS-A from PNGS-B.
		A-3	Structures within the protected area but outside the Powerhouse that must remain in place until IFB-A and AIFB have been emptied and drained. Once fuel bay activities are complete, these structures will be available for decommissioning.
PE-B	Non-Nuclear Component Removal	B-1	Components and systems within the Turbine Hall are considered to be non-nuclear, and not expected to be contaminated. These systems will be available for decommissioning immediately following or shortly after shutdown of PNGS-A. Dismantling these systems is a pre-requisite to removal of the Turbine Hall (PE-E).

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Planning Envelope	Focus Area	Grouping	Sequence Logic
		B-2	Components and systems within the Turbine Auxiliary Bay that are not considered to be nuclear systems, and not expected to be contaminated. Most of these systems will be available for decommissioning after shutdown of PNGS-A, except for systems required for IFB operations, which will be available for decommissioning following emptying of the fuel bays. Dismantling these systems is a pre-requisite to removal of the Turbine Auxiliary Bay (PE-E).
PE-C	Nuclear Component Removal	C-1	Components and systems within the Reactor Auxiliary Bay that are considered to be nuclear systems, and thus are expected to be contaminated. These systems will be removed following dismantling of non-nuclear systems to take advantage of lessons learned from the earlier, lower-complexity activities, and laydown areas created by the earlier work. Dismantling these systems is a pre-requisite to removal of the Reactor Auxiliary Bay (PE-E).
		C-2	Components and systems within the Reactor Building that are considered to be nuclear systems, and thus are expected to be contaminated. These systems will be removed following dismantling of non-nuclear systems to take advantage of lessons learned from the earlier, lower-complexity activities, and laydown areas created by the earlier work. Dismantling these systems is a pre-requisite to reactor segmentation work (PE-D) and removal of the reactor building (PE-F).
PE-D	Reactor Segmentation	D	Disassembly and removal of the reactor and internals. These systems are highly contaminated and occupational dose received by workers is anticipated to be higher than for earlier decommissioning activities. Allowing for a longer decay period will reduce worker dose exposures during dismantling of the reactor. This scope includes the removal of the reactor vault. Removal of the reactor is a pre-requisite to removal of the Reactor Building Structure (PE-F).

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Planning Envelope	Focus Area	Grouping	Sequence Logic
PE-E	Powerhouse Structure	E	Removal of the Turbine Hall, Turbine Auxiliary Bay, and Reactor Auxiliary Bay which make up the structure of the Powerhouse outside of the Reactor Building. This scope includes the removal of the AIFB. These structures have been grouped together as they are structurally dependent and share similar support, and they will be available for dismantling after removal of all non-nuclear and nuclear systems described in PE-B and PE-C.
PE-F	Reactor Building Structural Demolition	F	Removal of the Reactor Building structures. The RB contains and shields the reactor and internals and must remain in place until the nuclear systems and reactor and its internals have been removed (see PE-C and PE-D). The concrete of the reactor building is anticipated to be contaminated, and thus benefit from a longer decay period in order to reduce radiation hazards during demolition.
PE-G	Site Remediation	G	Remediation of the site within the protected area, including environmental clean-up and restoration. This is the final stage of decommissioning and requires completion of activities included in all other PEs.

Table 2 Planning Envelope Sequencing Strategy

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2.6 Waste Management Program

2.6.1 Standards and Procedures

Waste Management will be performed in accordance with OPG's Environment Health and Safety Managed System [R-15], Management of Waste and Other Environmentally Regulated Materials Standard [R-62], the Nuclear Waste Management Program [R-11] and the Radioactive Material Transportation Program [R-18]. The programs and standard outline the requirements for management of radiological and conventional waste streams, as well as other environmentally regulated materials within OPG ensuring compliance with all Federal and Provincial requirements.

2.6.2 Waste Management Plan

All waste generated during decommissioning activities require that a Waste Management Plan (WMP) be developed. Depending on the complexity of the activity, a WMP could be developed for an Envelope or a specific work package, and the associated waste volume estimates will be provided in the respective PE DDP volume. A WMP uses the conventional and radiological characteristics determined during scoping/characterization activities to document the approach for handling the waste throughout the decommissioning process and will include the following information:

- Overview of structures/services involved and relevant site history.
- Waste Classifications and Characteristics:
 - Conventional Waste.
 - Non-Contaminated Hazardous Waste (ex. Asbestos, Lead, etc.).
 - Radiological Waste (Low and/or Intermediate Level Waste).
- Estimated volumes.
- Waste Tracking/Documentation Requirements.
- Handling Requirements and Precautions.
- Potential Processing Options, including sorting and segregation, treatments, or potential volume reduction.
- Packaging.
- Transportation.
- Interim Storage and/or Disposal.

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2.6.2.1 Pathways

OPG waste is processed, stored, and/or disposed of in facilities that are licenced or approved by the applicable authorities.

Conventional Waste

- Conventional waste shall be determined to be free of radioactive contamination before leaving site following OPG's Radiation Protection Program [R-16].
- Waste will be sorted and segregated into approved containers emphasizing recycling/reuse and volume minimization, where reasonably possible.
- Conventional wastes will be disposed of at licensed facilities including recycling depots.
- Transportation will follow approved routes and in approved packages that could use road and/or rail.

Conventional Hazardous Waste

- Waste will be sorted and segregated into approved containers emphasizing recycling/reuse and volume minimization, where reasonably possible, following OPG's Segregation and Handling of Radioactive Waste Procedure [R-19].
- In-situ or general laydown areas will be setup for decommissioning activities depending on the needs and limitations of the work area.
- Hazardous Waste be disposed of at licensed facilities.
- Hazardous Waste will be determined to be free of radioactive contamination before leaving site following OPG's Radiation Protection Program [R-16].
- If the waste does not meet clearance levels, it will be treated as mixed waste, outlined below.

Radiological Waste

Radiological Waste can consist of Low-, Intermediate- and High- Level Waste.

- Low & Intermediate Level Waste:
 - Any LLW/ILW that is generated will be sorted and segregated following OPG's Segregation and Handling of Radioactive Waste Procedure [R-19].
 - Any radiological work will be completed in-situ and following approved work procedures.
 - Transportation will be in accordance with OPG's Radioactive Material Transportation Program [R-18].

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- After waste characterization and segregation, further processing will be explored. This may include metal melt, incineration, compaction etc.
- Interim storage of ILW/LLW will be in accordance with OPG's Nuclear Waste Management Program [R-11].
- High Level Waste
 - HLW will be removed from the fuel bays, processed, and stored in accordance with OPG's Nuclear Waste Management Program [R-11] at the NSS-PWMF.

Mixed Waste

Mixed waste refers to radiological waste (typically LLW) that also contains other notable hazardous substances/components. This is considered non-routine waste and must be managed on a case-by-case basis to ensure that all hazards – radiological and otherwise – are addressed appropriately.

- Mixed waste will be treated as radiological waste first and foremost, with special consideration given to the specific risks posed by the hazardous components of the waste.
- Management of mixed waste streams will adhere to the non-routine waste sections of OPG's Nuclear Waste Management Program [R-11] and any applicable facility Waste Acceptance Criteria (WAC).

2.6.3 Characterization Strategy

Characterization will be performed in accordance with the following:

- OPG's Waste Management Program [R-11],
- Section 10 of REGDOC-2.11.2, Decommissioning [R-8],
- REGDOC-2.11.1, Waste Management [R-21],
- REGDOC-2.7.1, Radiation Protection [R-22] and
- CSA N294:19, Decommissioning of facilities containing nuclear substances [R-13].

In addition to meeting the requirements of the standards and regulatory documents identified above, the characterization program establishes a comprehensive guide to characterization. This guide identifies the processes and practices to be applied for waste characterization of radiological and conventional constituents, as well as guidance on the application of the Radiation Survey and Site Investigation process, the Data Life Cycle, Data Quality Objectives process, and Data Quality Assessment process [R-23].

OPG has prepared a Characterization Implementation Strategy following industry best practices. This strategy establishes standard processes and practices for characterizing waste

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expected to be generated during the decommissioning of the PNGS-A units and their associated facilities. A plan has been prepared to forecast anticipated activities, guiding work planning for PNGS-A Characterization program over the coming decades. This strategic approach aims to achieve the long-term characterization objectives for PNGS-A. Forecasted activities include Hazardous Building Materials Assessments, a sampling and analysis program, scoping and characterization surveys using the Radiation Site Survey and Investigation process [R-23], and ongoing coordination with OPG Pickering's Radiation Protection programs [R-22] for waste clearance.

If for some operational and/or technical reasons, a system, equipment, or structure cannot be fully characterized prior to the commencement of dismantling and demolition activities, that information shall be documented in the relevant DDP Volume. If extensive, invasive procedures are required and a comprehensive characterization activity cannot be completed prior to the demolition phase, then an initial assessment (e.g., scoping survey) shall be conducted before dismantling and demolition of a work package, without compromising the safety of the workers or integrity of the system or structure. The scoping survey results will be considered while preparing dismantling activity of the work package. A comprehensive characterization study will be completed at the time of dismantling and demolition phase and affected sections of the work packages will be revised accordingly, if needed.

2.6.4 Final Survey Program

The final survey will be performed to verify that the facility has been remediated to such an extent that all remaining buildings, components, and the site itself have residual activity levels that are below the end state criteria referenced in the End States section. A Final Survey Plan will be developed before any of the final survey work begins, following the guidance provided in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) [R-23]. Additionally, OPG will adhere to its Characterization Strategy for the final surveys.

The survey plan will describe the survey work that will be performed, the schedule for that work, the methods that will be used to collect and analyze the data, and the structure of the final report that will be produced. The plan will also set out the performance criteria for the measurements and analyses that will be performed and the acceptance criteria for data from other sources, such as previous survey work, that will be incorporated into the Final Survey.

The final survey program will be conducted according to a comprehensive plan, which will be developed at a later date. This plan will outline a phased approach to the surveys, potentially occurring in phases across different units or work areas as appropriate. In order to ensure that the surveys are thorough, they will be performed when the remaining structures and materials are still accessible. However, the surveys will be performed as expeditiously as possible after the completion of the decontamination work. It is the goal that any residual contaminants identified in the survey will be below clearance levels. However, it is important to acknowledge that full remediation to below clearance levels may not always be achieved in the first attempt; in this case additional rounds of decontamination may be necessary and decision criteria will be established in advance for determining the effort level to achieve clearance levels versus declaring materials as LLW. Administrative and/or physical controls will be in place to isolate the surveyed areas and prevent recontamination. Demolition work may proceed once the final surveys have confirmed that the residual contamination levels in a work area or unit are below the established clearance levels.

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The final stage of the survey will be performed after all demolition work for both PNGS-A and PNGS-B have been completed to ensure that no activity exceeds the site's end state targets. Periods of deferral (called 'Survey Delays') may be incorporated into the decommissioning schedule, to ensure that all decommissioning work has been completed before this final stage of the survey work begins.

Upon completion of all survey work, a comprehensive Final Release Survey report will be prepared. This report will document the entire process, from planning to execution and analysis. Specifically, the report will include:

- The sampling strategies and methods employed during the survey,
- The instruments and laboratory methods used,
- The statistical techniques used to analyze and interpret the data,
- The criteria used to define the end-state,
- The methods and procedures used to ensure that the criteria were met,
- A detailed description of the Quality Assurance (QA) and quality control program implemented,
- The measurement data, including appropriate statistical analysis and systematic approaches,
- A thorough description of the methods used to collect and analyze the data,
- The results of the analyses performed and the interpretation of the data, and
- Documentation of all procedures and results, which will be prepared and retained.

Data from other surveys performed at earlier phases of the decommissioning process, such as the characterization survey and the remedial action surveys, may be incorporated in the final survey if they meet the acceptance criteria that were set out in the Final Survey Plan. The results of the analyses will be compared to the Interim-End State or Final-End State Criteria as required, and the conclusions drawn from that comparison will be included in the report.

2.7 Work Package Management

OPG will continue to employ the current Nuclear Management System [R-12] under the current licence. See Figure 21 for a visual representation of the implementing documents. Work management will be per an established and proven workplan preparation and development process [R-24]. This will be the primary procedure applied for scope evaluation, assessing, planning, work package assembly and closeout. An appropriate work package level will be determined and developed through this process, incorporating risk assessments, resource allocation, and timeline projections to ensure efficient and safe execution of decommissioning tasks.

The work package details for each PE will be contained in its appropriate DDP Volume as defined in Table 1 Decommissioning Planning Envelopes.

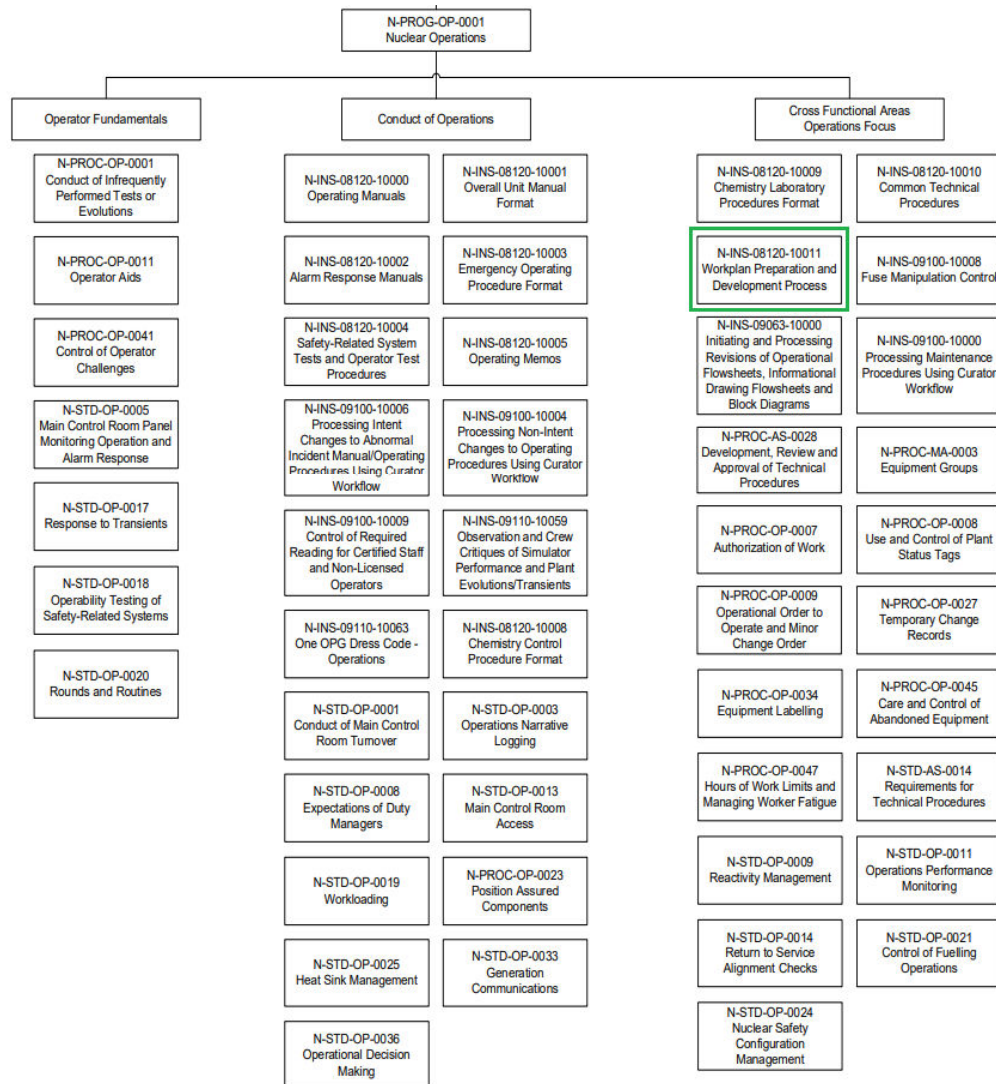


Figure 21 Nuclear Operations Implementing Documents

2.7.1 Work Package Closeout

Each work package will have a set of acceptance criteria established and will be designed to mirror the Interim-End State criteria established for each PE. This alignment is to ensure consistency in measuring the success of decommissioning activities and provide clear benchmarks for completion.

Upon achieving the Final-End State, a Final End State Report will be prepared as detailed in Appendix B:.

3.0 STORAGE WITH SURVEILLANCE

The CNSC REGDOC and CSA standard for decommissioning [R-8], [R-13] require an SWS Plan to be prepared as part of the detailed decommissioning plan. The SWS activities are covered in a standalone document, NA44-PLAN-00960-00001, Storage with Surveillance Plan [R-6].

3.1 Removals During SWS

The PNGS-A U2 and U3 have been in SWS since 2010 [R-1]. U1 and U4 are expected to be in SWS by 2028. Based on site strategy decisions and aligning with [R-8], OPG may advance dismantling activities to support Risk Reduction Strategy.

Dismantling activities for SSCs that could be advanced before 2028 will meet the following criteria:

- Part of the DDP.
- Adhere to PNGS PROL.
- Safe stated, and are not active systems supporting SWS, planned refurbishment, or extended operations.
- Follow procedures and processes as outlined in this DDP.
- Meet the requirements set out in the [R-8], such as a safety and hazard assessment, characterization of potential environmental impacts with mitigation actions and public, stakeholder and rights holders' engagement.

3.2 Removal of Used Fuel and Decommissioning IFBs

Post PNGS-A U1 and U4 shutdown in 2024, used fuel will be transferred to the IFB-A and AIFB for an initial cooling period. The fuel in the AIFB is stored in modules and the fuel in the IFB-A is stored in baskets; modules and baskets are stacked in the bays using frames. Used fuel that has been stored in the IFBs for the required minimum cooling period will continue to be loaded into Dry Storage Containers (DSCs) and transported to the NSS-PWMF using the existing programs and procedures for the management of used fuel. The required fuel bay infrastructure and support systems will continue to be kept active and maintained as outlined in the SWS Plan [R-6].

It is anticipated that by 2036 all the used fuel remaining in the IFBs will be transferred to dry storage so the transfers will be ongoing throughout the Stabilization period and SWS periods for PNGS-A. As fuel is removed from the bays, the associated baskets and frames are also planned to be removed.

3.2.1 Work Package Information

3.2.1.1 Scope

The location of IFB-A and the AIFB is shown in Figure 22 and currently contains a mix of intact, damaged, and defective fuel, along with non-fuel waste and used inspection equipment. During the stabilization and SWS period, a comprehensive clearance operation will be conducted. This process will involve removing all fuel bundles, non-fuel waste, and equipment, as well as clearing accumulated sludge and completely draining the bays. Once emptied, these facilities will transition into the decommissioning and dismantling phase, ensuring a safe and efficient progression in the overall decommissioning process.

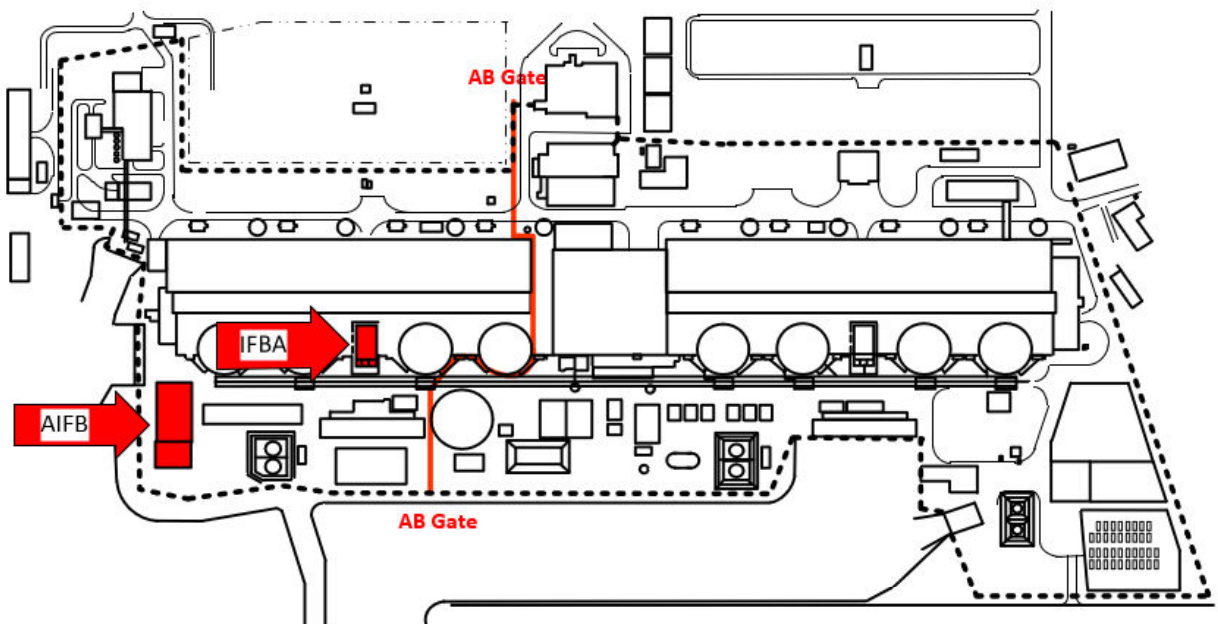


Figure 22 IFB-A and AIFB

The decommissioning of IFBs will follow a phased approach spanning the stabilization and SWS phases. The process of emptying the bays, is currently organized into four distinct Work Packages. While this plan may be subject to future modifications, the intended approach involves executing these detailed work packages to systematically clear and prepare the IFBs for subsequent decommissioning phases.

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- Used fuel and other contents within the IFBs will be removed during the Stabilization and SWS periods.
- Damaged fuel refers to CANDU fuel that has suffered mechanical alterations, including individual elements, bundles with missing elements, interlocked spacers, or cracked endplates.
- Defective fuel, on the other hand, has breached fuel sheaths, potentially releasing hazardous fission products. Both types require careful inspection and handling.
- To comply with CNSC and IAEA requirements, safeguard arrangements will be maintained until all the used fuel has been removed from the IFBs.
- Canning is a specialized containment method for managing damaged or degraded nuclear fuel that cannot meet standard handling, criticality safety, or confinement requirements.

3.2.1.2 Work Package 1: Intact Fuel

Work Package 1 addresses the ongoing loading of used fuel into DSCs.

Prior to decommissioning the IFBs, approximately 140,000 intact fuel bundles will need to be placed in modules and then loaded into DSCs for interim storage. These activities have been ongoing throughout the operating life of the station and will continue through stabilization and into SWS. Work will continue to be executed with existing operational procedures, leveraging established practices from previous fuel handling operations.

As fuel is removed, empty baskets and associated frames will be removed from the IFBs and disposed of using existing waste routes. This work will be undertaken to create space for installing equipment necessary for inspecting damaged fuel.

3.2.1.3 Work Package 2: Damaged and Defective Fuel

Work Package 2 addresses the handling of damaged and defective fuel in the IFBs.

The process for inspecting and removing damaged and defective fuel will incorporate operational experience from Hydro Quebec's Gentilly 2 facility and leverage the canning process which has been approved by the CNSC. Trained, experienced operations staff will perform this work, implementing measures to identify, mitigate, and monitor radiological hazards.

The sorting, segregation, and canning of damaged and defective fuel is a first-of-its-kind operation for OPG, expected to commence in 2029. OPG will follow existing Nuclear Managed Systems to implement any changes required for these activities.

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3.2.1.4 Work Package 3: Removal of Non-Fuel Components and Materials stored in the Fuel Bay

Work Package 3 addresses the removal of L&ILW from the IFBs.

Frames and baskets will be removed from the fuel bays as they are emptied of used fuel starting in 2025 (IFB-A) and 2026 (AIFB) and continue until 2034/2040, respectively.

For the Removal of Operational Non-fuel Components and Materials stored in the fuel bay, tooling and underwater containers are being developed to process and remove the waste from the bays between 2027 to 2039. OPG will follow existing Nuclear Managed Systems to implement any changes required for these activities.

3.2.1.5 Work Package 4: Water

Work Package 4 focuses on sludge removal and draining of the IFBs. Sludge removal operations are scheduled to take place between 2030 and 2041. The draining process will be completed in two stages: IFB-A is planned to be drained by 2034, followed by the AIFB by 2041. Further details on this work package will be addressed in future DDP submissions.

The draining of the bays is the final steps in preparing the IFBs for subsequent decommissioning and dismantling phases.

3.2.1.6 Post Fuel Bay Removal Activities

Once all the used fuel and other non-fuel operational waste has been removed, the AIFB and IFB-A will be end stated and secured for the remainder of the SWS period. This involves end stating of any remaining IFB systems no longer required. The dismantling and decommissioning of the IFB-A and AIFB are considered decommissioning and will be addressed in DDP PEs in future submissions.

3.2.2 Waste Management

The IFB-A and AIFB are expected generate the following types of waste:

- Intact, damaged, and defective used fuel,
- Other non-fuel ILW/LLW waste stored in the bays,
- Operational waste associated with maintaining the bays,
- Baskets and frames used to store the used fuel,
- Tritiated light water and sludge, and
- IFB supporting systems, structures, and components.

All work planned for this DDP period has available storage or waste disposal routes for the above waste, as applicable.

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3.2.3 Process Steps

The process for used fuel to be emptied from their wet bays into DSCs and transferred to interim storage at the NSS-PWMF will be per existing processes. Once the required waste has been removed from the IFBs, the following will be carried out:

- Mitigate any remaining hazards to workers through the erection of barriers and posting of warning signs,
- Conduct surveys to confirm that no fuel particles remain in the IFBs if fuel particles are found, the water will be treated to remove such particles,
- Collect samples of the IFB water and analyze it to confirm that it meets the radiological and chemical clearance levels that have been established,
- Drain the IFBs and dispose of the water in accordance with the applicable regulatory requirements,
- Remove ion exchange resins for disposal,
- Survey and if possible, decontaminate and seal the surfaces of the IFBs,
- Survey, decontaminate and seal the IFB surfaces, including comprehensive subsurface sampling and radiological characterization to validate contamination status,
- Perform a characterization survey of the fuel bays and surrounding areas to confirm extent of contamination,
- Secure the IFBs for the remainder of the storage period, and
- Seek approval to shut down and remove the safeguard monitoring equipment.

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4.0 DECOMMISSIONING COST ESTIMATE, SCHEDULE, AND FINANCIAL GUARANTEE ARRANGEMENTS

4.1 Decommissioning Cost Estimate

The decommissioning cost estimate update and cost associated with decommissioning PNGS-A can be found in [R-29]. The decommissioning cost is current as of the time of DDP approval. As OPG is currently in the process of preparing an updated Ontario Nuclear Funds Agreement (ONFA) Reference Plan, to be effective in 2027 and subject to the approval by the Province of Ontario, this decommissioning cost estimate may change pending further reviews. As part of each reference plan, OPG conducts comprehensive reviews of baseline cost estimates and underlying assumptions with respect its obligations for nuclear waste management and nuclear facilities decommissioning. Under the ONFA between OPG and the Province of Ontario, OPG maintains certain segregated funds for the purposes of paying for, among others, the decommissioning of PNGS-A.

The costs associated with the management of used fuel from PNGS-A including interim storage, transportation, and disposal are not included in the decommissioning cost estimate. Plans and cost estimates for these activities are described in separate documents.

OPG will continue to provide an annual status report to the CNSC staff detailing amounts accumulated in the applicable segregated funds for decommissioning and management of used fuel and other wastes, which are used to satisfy OPG's Financial Guarantee Arrangements. The report will also identify any material changes in decommissioning plans or cost estimates which may affect the financial guarantee requirement.

Only facilities and land within the licenced/ protected area are covered, with respect to decommissioning, by the segregated funds under the ONFA.

4.2 Decommissioning Schedule

A preliminary decommissioning project schedule for PNGS-A is shown in Figure 23 and Figure 24. The level 1 schedule lays out each of the pre-requisite activities, dismantling planning envelopes, and other interfacing programs at PNGS including planned PNGS-B refurbishment and extended operations.

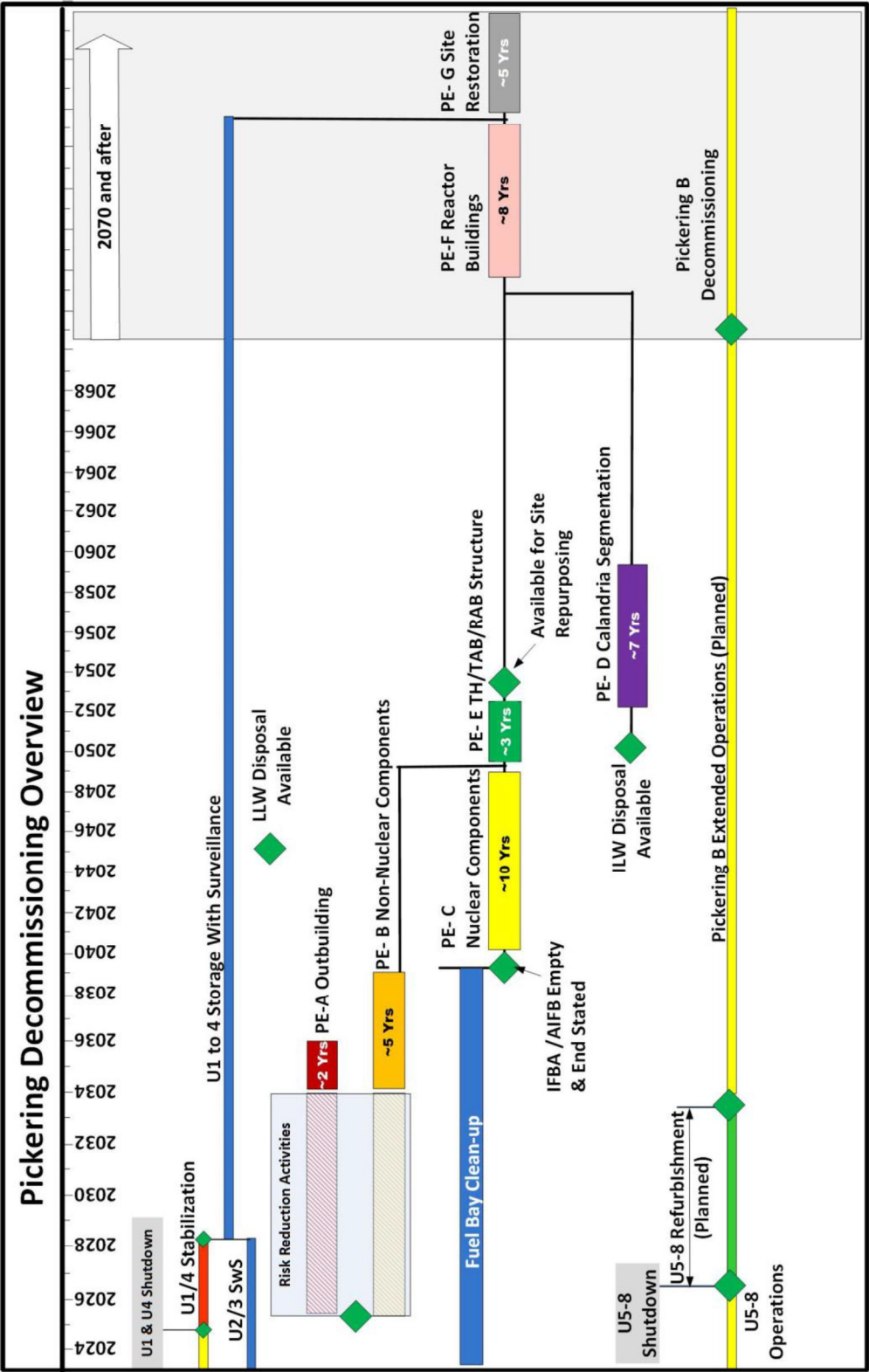


Figure 23 PNGS-A U1 to U4 Full Decommissioning Schedule

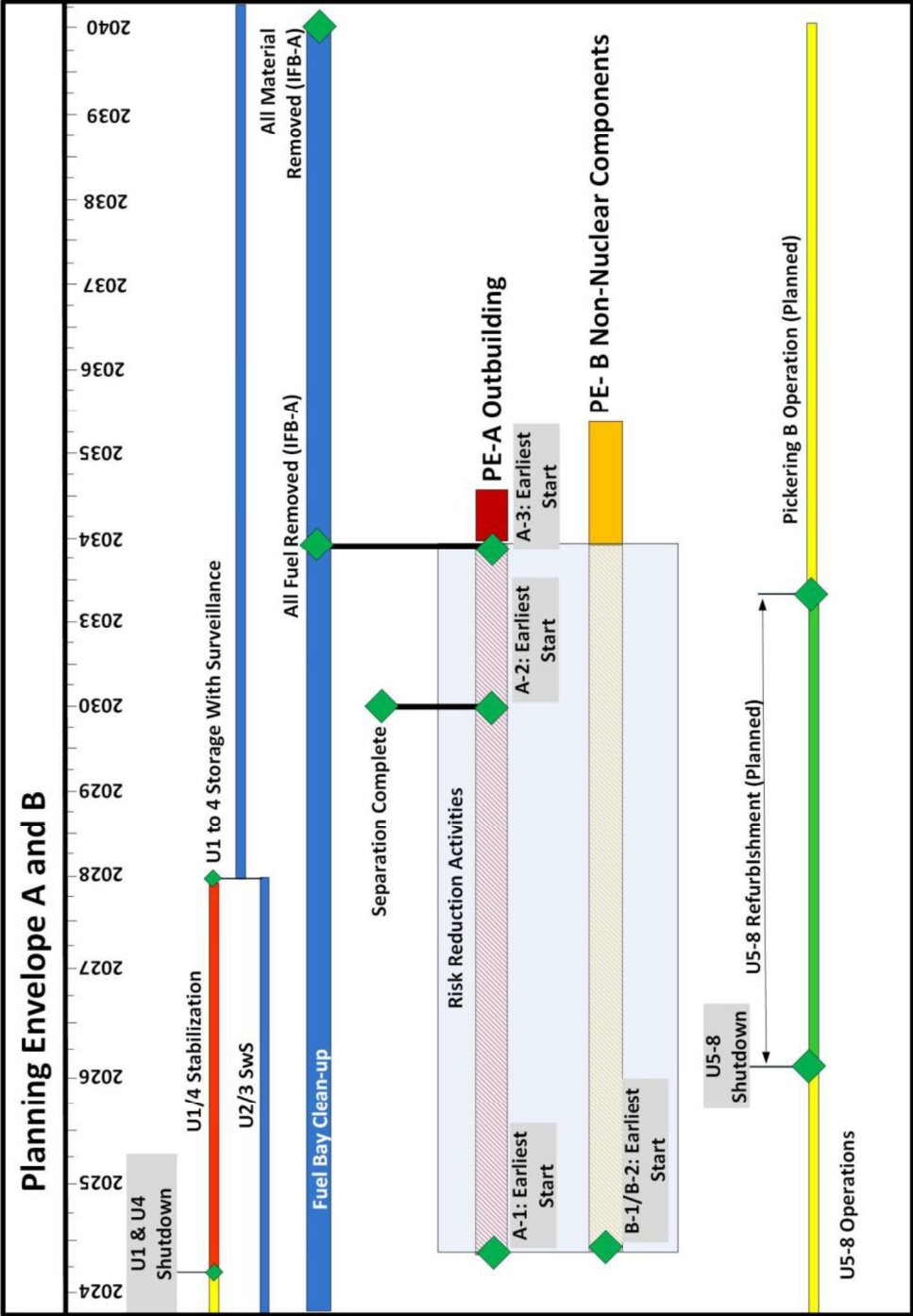


Figure 24 PNGS-A U1 to U4 Decommissioning Schedule for PE-A and PE-B

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All four PNGS-A units are planned to reach SWS by 2028, after the stabilization activities for U1 and U4 are complete. The SWS timeframe runs from Stabilization Complete until the last structures, the reactor buildings, have been removed from the site. The SWS program requirements will reduce over time as hazards are removed from the site and maintenance requirements are reduced. During the SWS period, risk reduction activities may be carried out on the units while they are in SWS.

The start of major dismantling is planned for 2034, after the anticipated PNGS B refurbishment completion. This will allow for sharing of infrastructure and minimization of interference between the two large programs.

Dismantling will start with Outbuildings and Non-Nuclear components using a lead and learn approach to build decommissioning capability and capacity. This will be followed by the start of Nuclear Component removal around 2039. The LLW repository is anticipated to be available in 2045.

The removal of the reactor is planned to start in the early 2050 after the anticipated availability of the ILW disposal facility.

The reactor building structure removal is planned to occur at the same time as the PNGS-B reactor building structure removal due to the proximity of the buildings and the presence of nuclear safety systems (containment) on PNGS-B. A summary of changes from the 2022 Preliminary Decommissioning Plan are shown in Table 3.

Item	PDP	DDP	Rationale
SWS Timeframe	30 years starting in 2028	6 years starting in 2028	Utilization of PNGS-B station and planned refurbishment resources. Allows for the defueling of the fuel bays. Note, SWS for U2 and U3 started in 2010. SWS for U1 and U4 will start by 2028.
Dismantling Start Date	2058	2034	Follows the anticipated completion of planned PNGS-B refurbishment.
Dismantling Duration	10 years	20+ years	Based on industry OPEX and estimate for first of a kind program.
Reactor Building Structure Removal	Removal of RB with the PNGS Powerhouse	Delay RB removal until PNGS-B Decommissioning	Technically challenging to remove the RB structures based on their proximity to the PNGS-B operating containment structure.

Table 3 Schedule Changes from the PDP

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4.3 Financial Guarantee Arrangements

In December 2022, the CNSC accepted OPG's proposed CNSC financial guarantee requirements for the 2023-2027 period to be satisfied by the federally mandated Ontario Nuclear Fuel Waste Act Trust and by providing the CNSC with access to the two segregated funds under the ONFA, without the requirement for a Provincial guarantee from the Province of Ontario [R-70].

As discussed in the Decommissioning Cost Estimate section, OPG will continue to provide an annual status update to the CNSC staff with respect to amounts accumulated in the above noted segregated vehicles and identify any material changes in decommissioning plans or cost estimates which may affect the financial guarantee requirement. An assessment of the impact on the financial guarantee requirement of the revised planned decommissioning activities as detailed in this DDP will be performed and provided as part of OPG's 2025 Annual Report for the 2023-2027 CNSC Financial Guarantee submission.

OPG's next consolidated financial guarantee submission to the CNSC will cover the 2028-2032 period and is expected to be submitted in 2027, following the finalization and approval of the updated ONFA Reference Plan to be effective in 2027.

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5.0 HUMAN AND ORGANIZATIONAL FACTORS

5.1 Human Factors

OPG has programs in place to address Human Factors (HF), including human performance aspects identified in the CNSC regulatory document, Policy on Human Factors. The Human Factor's program is embedded within OPG's NMS as defined in [R-27]. This program includes organizational and management structures, work requirements and controls, input into engineering design and safety-analysis, OPEX and Human Performance, training, staffing, the design of written procedures and the physical work environment. Additionally, Human Factors validation is conducted to ensure that systems can be used by trained personnel to carry out all necessary tasks successfully.

The program addresses human performance management and improvement through individual behaviours (all employees and contractors), organizational process, and management and leadership behaviours.

5.2 Conventional Health and Safety Associated Training

Conventional Health and Safety issues will be identified and addressed through OPG's robust Health and Safety program and Systematic Approach to Training program. Documented protection programs will be in place for all issues identified, and safety assessments will be used throughout the project to identify any newly emerging hazards ensuring all conventional health and safety issues are identified and managed appropriately.

A thorough assessment of the radiological, chemical and construction safety hazards that might be encountered during the decommissioning project will be performed during the preparation for decommissioning. A preliminary assessment of some of the hazards likely to be encountered during the decommissioning of the PNGS is summarized in Appendix C:. This preliminary hazard assessment served as input to the decommissioning safety assessment OPG carried out. The outcome of the assessment is detailed in the Integrated Decommissioning Safety Assessment Report [R-71].

5.3 Organizational Structure

OPG's nuclear organizational structure is defined in the Nuclear Management System Organizations standard [R-12]. This standard also defines the general accountabilities and authorization authority for programs within the nuclear management system. Included are interfacing organizations that do not report to the Chief Nuclear Officer but support the nuclear line of business. This Standard defines the relationships and interfaces that have been established to ensure effective control of activities that are performed to support the nuclear line of business in line with CSA N286-12 standard [R-30].

During the 2025 to 2028 period, U1 and U4 will undergo stabilization and be placed into a safe state. U2 and U3 will remain in Storage with Surveillance. The existing Pickering Operations resources will continue to complete the required operations and maintenance activities on U2 and U3 until 2027. Potential Risk Reduction activities that will be completed prior to 2028 will be planned and executed by the Enterprise Projects Organization with support from the broader Nuclear Organization.

Plan

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It is anticipated that the dismantling & demolition stage will begin in 2034. The organization required to oversee the decommissioning program will be assembled from available OPG station staff and outside resources as needed. While the following information represents the current planning basis, detailed organizational structures and contractor arrangements will be further developed and included in the next update to the DDP.

Decommissioning contractor(s) will be retained to perform the dismantling, demolition, and site restoration work. OPG will provide the necessary oversight during planning and execution of the work. The decommissioning contractor(s) will be a company or consortium selected based on factors such as decommissioning experience, safety record, overall approach, and cost. OPG will remain the owner and licensee of the PNGS throughout the course of PNGS-A decommissioning, but the decommissioning contractor(s) may be given charge and control of the site during the dismantling & demolition and site restoration. Other contractors may also be given charge and control of designated portions of the site during certain phases of the decommissioning. During these periods, the contractor will become the 'Constructor' for the decommissioning work as defined by the construction safety regulations made pursuant to the Occupational Health and Safety Act. The decommissioning contractor(s) and sub-contractors will be required to comply with OPG procedures related to Nuclear Energy Workers and all federal and provincial regulations.

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6.0 RISKS OF POTENTIAL ENVIRONMENTAL EFFECTS

In accordance with REGDOC-2.11.2 [R-8], this section provides a characterization of the risk of potential environmental effects associated with the decommissioning activities planned for PNGS-A from 2025 through 2033.

6.1 Predictive Effects Assessments within the Current Licence

The changes that result from the implementation of Stabilization and Storage with Surveillance phases have previously been assessed through two key reports:

- P-REP-07701-00002, "Predictive Effects Assessment for PNGS Safe Storage" (2017) [R-31]
- N-REP-07701-00006, "Predictive Effects Assessment for PNGS Safe Storage – 2022 Addendum Report" [R-32]

Both reports [R-31], [R-32] concluded that no potential adverse effects are predicted from the Stabilization and SWS activities evaluated.

6.2 Interim Assessment for PNGS-A Detailed Decommissioning Plan

To support the development of the DDP for PNGS-A and inform data-driven decision-making, OPG commissioned an interim assessment [R-33]. This assessment evaluates the potential environmental impacts of decommissioning activities, per DDP Volumes 1 and 2, against the baseline data established in the 2022 Addendum Report [R-32].

The interim assessment concluded that the dismantling and demolishing activities proposed for 2025 to 2033 will not present any significant risk to the environment nor to human health. Potential effects can be adequately mitigated through construction best practices and the implementation of a site-specific Environmental Management Plan for the project that aligns with the requirements of OPG's Environmental, Health and Safety Managed Systems [R-15].

6.3 Predictive Environmental Risk Assessment

OPG is currently conducting a Predictive Environmental Risk Assessment (PERA) that will encompass the full scope of activities for planned PNGS-B Refurbishment and PNGS-A decommissioning projects, specifically those covered in DDP Volumes 1 and 2.

6.4 Mitigation Measures

The following general mitigation approaches will be employed throughout the decommissioning process:

- Continued oversight and periodic review of environmental monitoring programs, including quality assurance processes, adequacy assessments, and systematic evaluation of enhancement opportunities.
- A site-specific project Environmental Management Plan with mitigation measures identified and any necessary monitoring identified will be prepared.

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- Carrying out activities in a manner consistent with requirements of OPG's Environment, Health, and Safety Managed Systems Program [R-15],
- Ongoing engagement with regulatory bodies, stakeholders, and Rightsholders.

Based on the interim assessment, the planned decommissioning activities for PNGS-A (DDP Volumes 1 and 2) are not expected to result in significant adverse environmental effects. The PERA will provide further validation and detail.

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7.0 DECOMMISSIONING SAFETY ASSESSMENT

7.1 Assessment Methodology

The methodology that was applied while performing the decommissioning safety assessment for SWS activities, as well as the PE-A and PE-B scope, is based on the IAEA Safety Report Series (SRS) NO. 77 [R-35] and General Safety Report Series No. 4 [R-36]. The overall Safety Assessment process, shown in [Figure 25](#), encompasses comprehensive analysis of both routine activities and potential accident scenarios.

The assessment process includes these major elements:

(a) Confirmation of Decommissioning Activities:

- Detailed review of planned decommissioning activities, equipment, and materials,
- Assessment of activity locations and workspace conditions,
- Evaluation of facility state at start and end of each group,
- Definition of end states and interfaces between work groups,
- Team alignment on scope and sequence of activities.

(b) Systematic hazard identification and screening using:

- Application of systematic checklist methodology derived from IAEA SRS 77 [R-35],
- Integration of Hazardous Building Materials Assessments,
- Consideration of PNGS-B and Waste Management Facility interactions,
- Assessment of both planned activities and potential incidents/accidents,
- Review of operational experience from Safety Assessment Team,
- Analysis of temporal applicability of identified hazards.

(c) Safety Functions and Mitigating Measures:

- Identification of required safety functions,
- Assessment of engineered barriers (guards, isolation systems, containment),
- Evaluation of administrative controls (procedures, training, access control),
- Definition of mitigating measures (PPE, emergency equipment),

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- Designation of safety related SSCs (monitoring systems, fire protection),
 - Demonstration of defense-in-depth adequacy.
- (d) Hazard Analysis:
- Risk classification for radiological and non-radiological hazards,
 - Assessment of cumulative and interactive effects,
 - Evaluation of system interdependencies,
 - Analysis of potential accident scenarios.

These assessments were conducted through structured workshops for PE groups A-1, A-2, B-1, and B-2 and the Storage with Surveillance phase. Through these evaluations, several significant industrial hazards were identified, including kinetic energy, potential energy, working at heights, falling objects, vehicle traffic, and heavy lifts. All these identified risks can be effectively mitigated through both physical and procedural measures. Additionally, all equipment will be surveyed prior to loading to transport for final disposal. The detailed assessment methodology, analysis results, and technical basis for safety conclusions are documented in [R-37].

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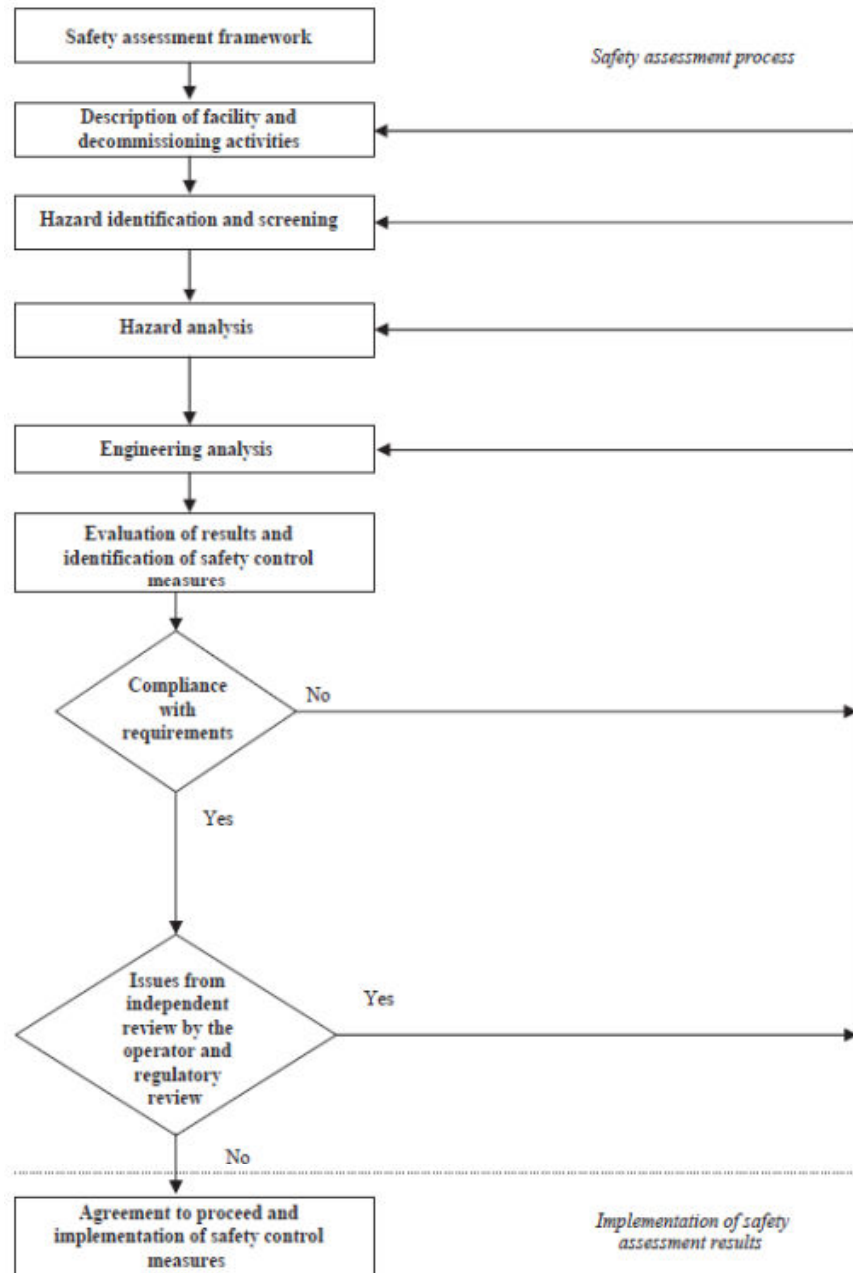


Figure 25 Decommissioning Safety Assessment Methodology

8.0 SECURITY AND SAFEGUARDS

8.1 Security

During decommissioning, OPG will continue to comply with the CNSC regulations on the physical security of nuclear facilities. OPG will be responsible for the security of the site throughout the course of the decommissioning project.

OPG will ensure the security of the site and the Decommissioning Contractor(s), and sub-contractors will be required to comply with licensing conditions and OPG procedures regarding the physical security.

8.2 Safeguards

In accordance with an agreement between the Government of Canada and the IAEA, nuclear safeguards are implemented at OPG's NGSs.

The existing safeguards arrangements for used fuel will continue until modified or terminated by agreement with the CNSC.

8.2.1 Decommissioning Criticality

8.2.1.1 Background

The critical mass of a fissionable substance is the minimum amount of fissionable material that will support a self-sustaining chain reaction. At this mass, the neutrons released as a product of one fission reaction can cause neighboring atoms to fission. Criticality occurs when sufficient fissionable material (a critical mass) accumulates in a small volume such that each fission, on average, produces a neutron that in turn strikes another fissile atom causing another fission; this causes the chain reaction to become self-sustaining within the mass of material. This sustainability is fundamentally dependent on meeting exacting conditions of the material including nuclear fission cross-section, density, geometry, enrichment, purity, temperature, and surrounding environment. Decommissioning will start with all the fuel removed from the reactors; therefore criticality is not possible to achieve in the cores, and related criticality accident scenarios are not applicable.

8.2.1.2 Criticality Following Shutdown

Following shutdown of U1 and U4, all fuel bundles from the reactor cores will be removed and stored in the IFBs, while the units themselves will be dewatered and systems dried. The current safety analysis for PNGS considers various accident scenarios involving these fuel bays which remain bounding throughout decommissioning. The amount of fuel stored within the bays will be kept within approved design/safety analysis limits, such that any postulated accident remains among those considered in station design and/or Licence documentation. The fuel bays' storage capacity is 22 station years irradiated fuel accumulation [R-14]. Due primarily to the complete absence of heavy water moderator and exacting geometry required to support a sustainable nuclear fission reaction (which geometry is prevented in the IFBs due to the way fuel is stored in racks), fuel stored in the IFBs cannot be made critical in any configuration. In addition, the U-235 fraction is depleted and the Pu-239 buildup is too small to increase the spent fuels reactivity above that of fresh fuel. The IFBs utilize only light water for

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cooling the bundles which are arranged in approved containers. The fuel bundles will remain submerged in fuel bay water for approximately ten years before being loaded into reinforced high density concrete DSCs. Each DSC undergoes a meticulous loading, sealing and inspection process that ensures safe containment during transfer and storage prior to final disposal. Transfer of the fuel from the IFB to dry fuel storage locations is detailed in both station and waste facility safety reports, with no additional safety analysis required to support decommissioning activities [R-14].

There is no potential to achieve criticality within the spent fuel bays of CANDU stations, nor are there feasible accident scenarios that differ in nature or consequence to those presently analyzed for OPG's licensed facilities. All decommissioning work will be assessed following the Decommissioning Safety Assessment methodology.

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9.0 RECORDS AND RECORDS RETENTION

9.1 Records

The operating records [R-25] and decommissioning records [R-26] required for long-term retention will be prepared, stored, and preserved electronically in accordance with OPG's Nuclear Management System [R-12] requirements.

Records will include, but not be limited, to the following:

- Operating Records, such as Operating Logs, Waste Records, Operations Manuals, Procedures, Conditions and Maintenance Records.
- Configuration Records, such as Maps, Drawings, Photographs, Engineering Records, Design Records, Technical/Materials Specifications, Change Control Information.
- Environmental/Radiological/Incident/Regulatory Records, such as Annual Reports, Unplanned Event Reports, Radiation Zone Surveys, Survey Logs, Hazardous Materials Inventory/Controls, Licensing Reports, Compliance Reports, Safety Analysis Reports.
- Decommissioning Records, such as Detailed Work Plans, Characterization Reports, Assessment Reports, Project Plans, Detailed Work Plans, SwS Plans, Quality Assurance Records, Licences, Permits, Schedules, Remediation Verification Results, and Interim and Final End State Reports.

Additional Records Management System OPEX and Lessons Learned from IAEA guidance on records documented will be consulted for additional guidance.

9.2 Records Retention

Records filing and retention are governed by OPG's Information Management program, which identifies records relevant to decommissioning as permanent records.

At the completion of decommissioning, all appropriate records will be retained for the purpose of:

- Confirmation of completion of decommissioning activities,
- Recording the disposition of wastes, materials, and premises, and
- Responding to possible liability claims.

Decommissioning records will be kept in the storage medium in standard use at the time of decommissioning. All records will be assembled and maintained in accordance with the document and record management process and governance. Because of the long timeframe anticipated for the decommissioning, records will be periodically checked to ensure their preservation and protection from loss, deterioration, and destruction.

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10.0 PUBLIC, STAKEHOLDERS AND INDIGENOUS ENGAGEMENT

OPG believes in timely, open and transparent communication to maintain positive and supportive relationships and confidence of key stakeholders, and Indigenous Nations and communities, in accordance with CNSC REGDOC-3.2.1, Public Information and Disclosure [R-38] and REGDOC-3.2.2, Indigenous Engagement [R-39]. As such, OPG regularly and proactively provides information to the public and Indigenous Nations and communities, on current operations and potential projects.

10.1 Public and Stakeholder Engagement Program

OPG values the relationships it has with local communities, the public, and all its stakeholders, and fosters open and ongoing communications through a comprehensive public outreach program (Public Information and Disclosure Protocol).

The public and stakeholder engagement program complies with the applicable requirements of [R-38], OPG reports on this program annually to the CNSC. The program includes a variety of communication methods and engagement opportunities that meet the needs of the audience and the objectives of the business.

In relation to the DDP and related activities, including the environmental risk assessment, the program ensures communications are informative, timely and accurate which allows the public to make informed, objective decisions through readily accessible information, open dialogue, and opportunities to ask questions.

Communication methods utilized to distribute information, and to solicit feedback and input, can include updates to opg.com, annual public open house, information sessions and workshops, community councils and committee meetings, stations tours and presentations.

Specific to the DDP, information has been shared through a variety of means, through direct dialogue with Community Advisory Councils (CACs), Durham Nuclear Health Committee (DNHC), Neighbours newsletters, tours and presentations, and public information sessions and stakeholder workshops.

10.2 Engagement with Indigenous Nations and Communities

10.2.1 Overview

OPG is committed to taking concrete and measurable actions to advance reconciliation with Indigenous peoples and to regularly report on the company's activities and progress in achieving established goals. In the fall of 2021, OPG launched its Reconciliation Action Plan (RAP). The RAP is a public document that serves as a roadmap to reconciliation and the 2021 edition included many specific actions and commitments with clear deliverables and timelines spanning between 2022 and 2031.

The Indigenous Relations Policy, OPG-POL-0027 [R-40], describes OPG's commitment to work with Indigenous Nations and communities and peoples, p This policy governs OPG's engagement with Indigenous peoples with respect to end of commercial operations, planned PNGS-B refurbishment, safe storage and eventual decommissioning of PNGS.

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10.2.2 Approach to Indigenous Engagement at Pickering NGS

To guide engagement, OPG developed an Indigenous Engagement Plan (IEP) that identifies engagement scope and activities for ongoing and proposed initiatives at PNGS, including decommissioning and the DDP. OPG pursued the development of a site-wide IEP based on interests shared from Indigenous Nations and communities for a holistic and coordinated approach to support effective engagement at PNGS.

A draft of the IEP was shared with the Williams Treaties First Nations, Huron-Wendat Nation, Mohawks of the Bay of Quinte, Métis Nation of Ontario – Region 8 and Six Nations of the Grand River in January 2024. Based on comments and recommendations from Indigenous Nations and communities, OPG provided responses to all comments received, updated the IEP, and issued a final working version of the IEP in May 2024. Additionally, a Memorandum of Understanding (MoU) and Capacity Agreements with each of the Michi Saagiig have been developed and are being reviewed by the Nations.

The IEP is intended to be a living document that can be updated over time to respond to engagement priorities and needs. As a demonstration of this intent, OPG added the Saugeen Ojibway Nation as an Indigenous Nation expressing interest in PNGS and shared the IEP with the Saugeen Ojibway Nation for review and comment in September 2024.

10.3 Engagement Summary on Decommissioning and the DDP

OPG has been engaging and will continue to engage Indigenous Nations and communities about proposed decommissioning activities at PNGS, including the DDP. OPG continuously hears that nuclear waste and waste management operations is an important issue to Indigenous Nations and communities, including waste streams and volumes. To support this, decommissioning-specific presentations have been shared with the Michi Saagiig Nations (Alderville First Nation, Curve Lake First Nation, Hiawatha First Nation and Mississaugas of Scugog Island First Nation). In addition, a briefing was shared to provide a summary of the DDP as well as a draft version of the DDP, to seek feedback and comments. OPG's Indigenous Relations team continues to engage with the Chippewa Nations (Beausoleil First Nation, Georgina Island First Nation and Rama First Nation) to begin relationship building. A plan is in development to determine the best path to information sharing with these nations.

OPG continues to host site visits and meetings and to visit communities to share information, answer questions, and raise awareness of the work being undertaken to manage both the nuclear and conventional waste at the company's various facilities. To respond to the interests of the Michi Saagiig Nations, OPG and the Michi Saagiig Nations established a Waste Table in August 2024 to have a coordinated, holistic and comprehensive engagement approach to waste across PNGS and the Darlington Nuclear Generating Station.

10.4 OPG's Centre for Canadian Nuclear Sustainability (2020-2023)

In October 2020, OPG launched the Centre for Canadian Nuclear Sustainability (CCNS) in Pickering, Ontario. The centre was dedicated to the safe and responsible decommissioning of nuclear facilities and focused on developing best practices and innovative approaches to manage decommissioning processes while prioritizing environmental protection and community engagement, particularly for the Pickering Decommissioning project. An essential aspect of the CCNS was its Indigenous Advisory Council (IAC), which played a crucial role in

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ensuring that Indigenous perspectives and knowledge are integrated into decommissioning activities. This collaborative effort aimed to address community concerns, foster transparency, and enhance the long-term sustainability of nuclear energy in Canada by promoting strategies that minimize waste and ensure safe site transitions post-decommissioning.

Throughout 2020-2023, the CCNS team delivered initiatives to its members through innovation funding, Indigenous Knowledge sharing webinars, industry networking opportunities and community programing while simultaneously exploring additional strategic opportunities. In 2023, after much discussion with CCNS members, community stakeholders and the IAC, the conclusion that the successes of the CCNS could continue without need for a physical space and associated membership model. Additionally, it was important to engage with the Williams Treaties First Nations (Rightsholders) in the territory and with this, the decision was made to wind down the membership and operations of the CCNS.

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11.0 OPERATIONAL EXPERIENCE AND LESSONS LEARNED

11.1 Decommissioning Strategy OPEX

11.1.1 Domestic Decommissioning Strategies and Experience

OPG has successful decommissioning experience at both the Bruce Heavy Water Plant (HWP) and the Spent Solvent Treatment Facility (SSTF), which are both located on the Bruce Nuclear site.

OPG has an active decommissioning planning program and maintains formal knowledge exchange networks through the CANDU Owners Group (COG), the IAEA, and other international organizations. This includes both learning from other utilities' decommissioning experiences and committing to share its own decommissioning experience and lessons learned through established industry forums. Regular participation in technical committees, working groups, and peer reviews ensures systematic capture and exchange of operational experience, emerging technologies, and best practices.

Decommissioning strategies adopted in Canada for nuclear facilities are summarized below.

11.1.1.1 Bruce Heavy Water Plant

The Bruce HWP was in continuous operation from April 1973 until March 1998 for the purpose of producing reactor-grade heavy water [R-42]. After it was no longer in operation, the Bruce HWP decommissioning project was carried out in accordance with a DDP, remediation and an environmental assessment and follow-up program. Demolition began in October 2004 and was completed in 2006. The buildings were demolished using standard demolition techniques. The debris was removed from the site for recycling or disposal. Bioremediation of oil-contaminated soil in the effluent lagoons was required and began in 2006. About 25% of the soil was bioremediated to below the end-state criteria and was used as clean backfill in the immediate area. Any soil that did not meet the end state criteria was disposed of off-site at a licensed facility. The radiological end state was that no nuclear substances would remain within the Bruce HWP facility boundaries, and the remaining structures, equipment and grounds were free of significant radiological contamination. To demonstrate that this end state criterion was met, a final radiological survey was performed in 2012 using the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) methodology [R-23]. This survey found no radioactive contamination on the Bruce HWP site [R-43], [R-44] and a licence to abandon the facility was granted by the CNSC in 2014 [R-45].

11.1.1.2 Spent Solvent Treatment Facility

From May to December 2018, OPG completed decontamination of all radiologically contaminated piping in the SSTF. As decontamination progressed, each room or section was systematically surveyed and sampled for radiation in accordance with the MARSSIM methodology [R-23]. A Site Survey and Characterization report was prepared and approved by OPG in March 2019. This report concluded that radioactivity levels in the SSTF were below the site unconditional release criteria. The CNSC also concluded that OPG satisfactorily demonstrated that the SSTF was free of any contamination above the regulatory limits [R-46], [R-47], [R-48]. This resulted in CNSC acceptance of OPG's request to remove the SSTF from licensing control [R-49]. In November 2019, demolition of the above ground structure was

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completed. Most of the underground infrastructure was removed in February 2020, with the exception of some Bruce Power water lines that remained. Final site grading and remediation was completed in June 2020.

11.1.1.3 Gentilly-2 Nuclear Power Plant

Gentilly-2 Nuclear Power Plant (NPP), owned by Hydro-Québec, was shut down in 2012 and is currently in the SWS phase for approximately 40 years. Some of the main activities that have taken place from Gentilly-2 shutdown to reactor Stabilization and transition to SWS were [R-50]:

- Placing Gentilly-2 in guaranteed shutdown state,
- Removal of the fuel from the reactor,
- Transfer of resins and tank repairs,
- Emptying and transfer of heavy water,
- Preparations, modifications, removal of systems,
- Construction of infrastructure required for dry storage, and
- Transfer of fuel from the pool to dry storage (yearly summer campaign on site).

Hydro-Québec was granted (in June 2016) a 10-year power reactor decommissioning licence from the CNSC to continue activities related to the preparation for the decommissioning of Gentilly-2. Under this decommissioning licence, the activities include but are not limited to the following [R-50]:

- Construction of infrastructure required for dry storage, and
- Continuation of the transfer of fuel from the pool to dry storage (yearly summer campaign on site).

While emptying the fuel bays, Hydro-Québec utilized innovative technologies for canning and dry storage of damaged/defective fuel as well as waste segmentation tooling for ILW. This FOAK approach is being evaluated for potential use within OPG.

11.1.1.4 Point Lepreau NGS

The Point Lepreau NGS, owned by New Brunswick Power (NBP) Corporation, has been operating since it was last refurbished in 2012. Currently, NBP has opted for the deferred decommissioning strategy.

11.1.1.5 Canadian Nuclear Laboratories Managed Facilities

Canadian Nuclear Laboratories (CNL) currently maintains several reactors in SWS including three prototype reactors (Nuclear Power Demonstration (NPD), Douglas Point (DP) and Gentilly-1 (G-1)) and several research reactors (Whiteshell Reactor (WR-1), National

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Research Experimental (NRX), Multipurpose Applied Physics Lattice Experiment (MAPLE)-1 and MAPLE-2). An eighth reactor, National Research Universal (NRU), is in a permanent shutdown state after ceasing operations in 2018. CNL originally proposed a deferred decommissioning strategy for all these reactors but changed to In-situ decommissioning for NPD and WR-1. This strategy has been adopted for small reactors in several countries but is rarely used for a large power reactor. Both the Zero Energy Experimental Pile (ZEEP) reactor and the Pool Test Reactor (PTR) have been completely decommissioned. In addition to the reactors, CNL has been actively decommissioning legacy research and isotope production facilities and other support facilities across its sites.

The In-situ decommissioning strategy is usually limited to a small number of facilities in a given country, particularly to remote sites, in order to prevent the proliferation of waste disposal sites [R-51]. In 2019, the CNSC amended CNL's Waste Facility Decommissioning Licence into three separate licences for NPD, DP, and G-1. Under these new licences, CNL can proceed with the different decommissioning strategies and timelines for each site [R-52]. CNL is currently planning to proceed with final active decommissioning of nuclear facilities as well as continuing with its planned removal of remaining non-nuclear area facilities at the DP site [R-53], [R-54].

Within the last 10 years, CNL has accelerated its decommissioning timelines to reduce legacy liabilities and support the larger revitalization effort of its Chalk River campus. CNL applies a graded approach to its decommissioning activities that considers the unique radiological and non-radiological characteristics of facilities. In addition, CNL is considering multiple decommissioning strategies (prompt, deferred, and in-situ) for its portfolio of reactors and research facilities. Below is an update of the decommissioning plans for CNL's eight main reactors:

- At the NPD and WR-1, CNL continues to plan for in-situ disposal of the reactors and remaining systems,
- At DP and G-1, CNL is advancing the decommissioning of non-reactor components and hazard reduction while planning for the dismantlement of the calandria and reactor building internal systems, and
- At Chalk River (NRX, NRU, MAPLE-1, and MAPLE-2), decommissioning strategies are being explored to support the revitalization of the site. The NRX, MAPLE-1 and MAPLE-2 reactors have been in safe storage for several years while the NRU reactor was permanently shutdown in 2018. CNL is evaluating strategies to decommission these reactors in the near future to support construction of new Science and Technology research facilities. Characterization activities are currently in progress for these facilities, to help inform decommissioning strategies.

11.1.2 International Decommissioning Strategies and Experience

Decommissioning strategies adopted by the operators of other nuclear facilities around the world vary from Prompt Decommissioning (as referred to as immediate dismantling) to a variety of different Deferred Decommissioning approaches. The choice between Prompt and Deferred Decommissioning is influenced by many factors, as described in several publications prepared by the IAEA [R-55], [R-56] and [R-57].

Internationally, several small and some full-size power reactors have been successfully decommissioned and the sites made available for other uses. As of December 2023, 209 power reactors worldwide have been permanently shut down. Of these, 20 power reactors had been fully decommissioned. Decommissioning strategies for these 20 power reactors were as follows: 4 Deferred Decommissioning, 9 Prompt Decommissioning, 1 In-situ decommissioning and 6 adopted a different decommissioning strategy [R-73].

OPG has conducted several benchmarking activities to gain experience and lessons learned from ongoing international Decommissioning projects (Refer to Table 4). The international experience and lessons learned have been key inputs into the Decommissioning planning for PNGS-A to date. A summary of these activities is outlined in the following table:

Benchmark Date	Operator & Site(s)	Scope of Visit and Benchmark Areas
May 2022	Holtec Indian Point Nuclear Power Facility (USA) Oyster Creek Nuclear Power Facility (USA)	Site visit to stations undergoing execution of decommissioning. Benchmarking areas included technical aspects such as demolition strategy, waste management and site characterization; stakeholder consultation; regulatory approval process; and decommissioning project planning.
February 2023	Energy Solutions Diablo Canyon Power Plant (USA) San Onofre Nuclear Generating Station (USA)	Site visit to stations undergoing execution of decommissioning. Benchmark areas included planning for transition from operations to decommissioning; community engagement; regulatory strategy; commercial strategy; technical aspects such as waste strategy, reactor segmentation and site characterization; and decommissioning project planning.
June 2023	Nuclear Decommissioning Authority Sellafield Site (UK)	Site visit to station to observe decommissioning field work (e.g. fuel bay emptying) and waste storage. Benchmarking discussions around decommissioning strategy and program development; waste strategy; technical option development; and challenges.

Benchmark Date	Operator & Site(s)	Scope of Visit and Benchmark Areas
January 2024	Pacific Gas and Electric Company Humboldt Bay Nuclear Power Plant (USA)	Conference call to review status of decommissioning project as well as discuss technical project challenges and lessons learned. Benchmarking areas included managed system changes; work package development and work sequencing; security changes; licensing and permitting; resourcing; and waste strategy.
2024	Fortum Loviisa Nuclear Power Plant (Finland)	Site Visit to Fortum to share OPEX on waste handling processes. Shared knowledge and initiatives OPEX on waste minimization, and processing (including water processing), and nuclear waste interim storage and long-term disposal. Also discussed safety cases in relation to long term disposal.

Table 4 Decommissioning OPEX Summary

OPG representatives have also gathered international benchmarking activities through participation at various conferences and industry groups. Some examples include:

- Power Plant Decommissioning Operational Excellence Conference;
- Waste Management Symposium;
- International Conference on Nuclear Decommissioning;
- IAEA Technical Working Group for Decommissioning; and
- CANDU Owners Group (COG) Waste Management and Decommissioning Peer Group.

11.2 Records Management System OPEX and Lessons Learned

The implementation of a robust Records Management System (RMS) has proven to be a critical factor in the successful planning and execution of decommissioning activities. Drawing from operational experience and the guidance provided by the IAEA [R-41], several key lessons and best practices have emerged:

- **Strategic Importance:** An effective RMS is fundamental in providing comprehensive, up-to-date information to decommissioning teams and stakeholders. This enables informed decision-making throughout the planning and implementation phases, potentially averting significant financial consequences associated with inadequate documentation.
- **Lifecycle Approach:** The foundation of a successful RMS lies in the meticulous preservation of records spanning the entire facility lifecycle – from design and

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construction through operation and shutdown. This underscores the importance of early planning and the operator's responsibility in maintaining these critical records.

- **Proactive Planning:** Incorporating decommissioning considerations into the facility's design and operational phases has proven highly beneficial. This foresight ensures that essential information is readily available and easily transferable when needed, streamlining future decommissioning efforts.
- **Early Establishment:** The early implementation and continuous maintenance of an RMS have been crucial in preserving vital information throughout the active post-shutdown phase, safe enclosure period, and final dismantling phases.
- **Safety and Efficiency:** A well-structured RMS has consistently demonstrated its value in facilitating safer and more efficient decommissioning processes.
- **Regular Auditing:** Regular, independent audits of the records archive, with a primary focus on decommissioning requirements, have been instrumental in maintaining the integrity and relevance of the RMS.
- **Gap Identification:** Implementing a robust auditing process has proven effective in identifying and addressing gaps within the RMS, ensuring the archives remain useful and comprehensive for decommissioning purposes.
- **Long-term Usability:** Given the potential for technological changes and diminishing facility knowledge over time, ensuring the long-term usability and understandability of transferred information has emerged as a critical consideration.
- **Continuity of Knowledge:** Maintaining control over both records and institutional knowledge throughout the entire decommissioning process has been identified as essential for success.
- **System Resilience:** Incorporating redundancy and diversity within the RMS has proven necessary for effective long-term records management.
- **Media Selection:** Careful selection of storage media, prioritizing durability, readability, and retrievability, has been crucial in ensuring the long-term preservation and accessibility of critical information.

These lessons learned highlight the pivotal role of a well-designed and maintained RMS in facilitating successful decommissioning outcomes. By incorporating these insights into its approach, OPG can enhance its preparedness and efficiency in future decommissioning projects.

11.3 Schedule OPEX and Lessons Learned

Based on US decommissioning programs such as Oyster Creek Nuclear Generating Station (OCNGS) (Lacey Township, NJ), Pilgrim Nuclear Power Station (PNPS) (Plymouth, MA) and Indian Point Energy Center (IPEC) (Buchanan, NY), a single unit site will take between six (6) and ten (10) years to complete decommissioning activities. The Indian Point site, a 3-reactor

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unit decommissioning project, is currently the largest commercial nuclear decommissioning project in the US. It is anticipated to take approximately 12 years to complete the decommissioning activities required to terminate that Part 50 licence. In addition, the Yankee Rowe (Rowe, MA) decommissioning project took approximately 10 years to complete.

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13.0 ACRONYMS

Acronym	Definition
AHJ	Authorities Having Jurisdiction
AIFB	Auxiliary Irradiated Fuel Bay
ALARA	As Low As Reasonably Achievable
APM	Adaptive Phased Management
CACs	Community Advisory Councils
CNSC	Canadian Nuclear Safety Commission
COG	CANDU Owners Group
CSA	Canadian Standards Association
D2O	Heavy Water
DDP	Detailed Decommissioning Plan
DNHC	Durham Nuclear Health Committee
DSC	Dry Storage Container
DSM	Dry Storage Modules
ECO	End of Commercial Operations
EMS	Environmental Management System
FOAK	First Of A Kind
HLW	High Level Waste
HSA	Historical Site Assessment
IAEA	International Atomic Energy Agency
IEP	Indigenous Engagement Plan
IFB	Irradiated Fuel Bay
IFB-A	Irradiated Fuel Bay for Pickering A
ILW	Intermediate Level Waste
L&ILW	Low and Intermediate Level Waste

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Acronym	Definition
LCH	License Conditions Handbook
LLW	Low Level Waste
MOU	Memorandum of Understanding
NMS	Nuclear Management System
OHSA	Occupational Health and Safety Act
ONFA	Ontario Nuclear Funds Agreement
OP&Ps	Operating Policies and Principles
OPEX	Operating Experience
OPG	Ontario Power Generation
PDP	Preliminary Decommissioning Plan
PE	Planning Envelope
PEA	Predictive Environmental Assessment
PERA	Predictive Environmental Risk Assessment
PNGS	Pickering Nuclear Generating Station
PNGS-A	Pickering Nuclear Generating Station A
PNGS-B	Pickering Nuclear Generating Station B
NSS-PWMF	Pickering Waste Management Facility
RAB	Reactor Auxiliary Building
RAP	Reconciliation Action Plan
RB	Reactor Building
REGDOC	Regulatory Document
RMS	Records Management System
RP	Radiation Protection
SAP	Stabilization Activity Plan
SOP	Sustainable Operations Plan

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Acronym	Definition
SRS	Safety Report Series
SSC	System, Structure or Component
SSS	Safe Storage State
SWS	Storage With Surveillance
TAB	Turbine Auxiliary Bay
TH	Turbine Hall
U1	Pickering Unit 1
U2	Pickering Unit 2
U3	Pickering Unit 3
U4	Pickering Unit 4
U5	Pickering Unit 5
U8	Pickering Unit 8
UFDSFs	Used Fuel Dry Storage Facilities
WANO	World Association of Nuclear Operators
WFOLs	Waste Facility Operating Licenses
WMP	Waste Management Plan

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Appendix A: DDP Verification Matrix

REGDOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 Appendix C.1	CSA Requirement Description	DDP Section Reference
Bullet 1	A description of, and diagram showing, the areas, components and structures to be decommissioned, grouped, where appropriate, into logical decommissioning planning envelopes	A)	A description of, and diagram showing, the areas, components, and structures to be decommissioned, grouped where appropriate into logical decommissioning planning envelopes	Section 2.3
Bullet 2	The operational history, including incidents or accidents that could affect decommissioning	B)	The operational history, including incidents or accidents that could affect decommissioning	Section 1.7
Bullet 3	The storage with surveillance stage, as applicable, and requirements of the: functional building services monitoring and surveillance activities inspection activities usage boundaries during storage with surveillance	C)	The SWS stage and requirements: functional building services; monitoring and surveillance activities; inspection activities; and usage boundaries during SWS;	Section 3.0
Bullet 4	The final radiological, physical and chemical end-state objectives, and interim end-state objectives, as applicable	D)	The final radiological, physical, and chemical end-state objectives. Where more than one DDP is required in a phased program, interim end-state objectives and monitoring programs for deferral periods shall be provided for each detailed plan.	Section 2.4
Bullet 5	A description of the requirements for any institutional controls	E)	A description of the requirements for long-term institutional controls	Section 2.4.3

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REGDOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 Appendix C.1	CSA Requirement Description	DDP Section Reference
Bullet 6	Comprehensive and systematic survey results of radiological and other potentially hazardous conditions, including identification and description of the remaining significant gaps or uncertainties in the measurement or prediction of such conditions	F)	Comprehensive and systematic survey results of radiological and other potentially hazardous conditions, including identification and description of the remaining significant gaps or uncertainties in the measurement or prediction of such conditions	Section 2.6.4
Bullet 7	A decommissioning strategy for each planning envelope that highlights any significant changes from the strategy identified in the PDP	G)	A decommissioning strategy for each planning envelope that highlights any significant changes from the strategy in the PDP	Section 2.3 and 2.5
Bullet 8	A description of the decommissioning work packages, including: a step-wise technical approach the nature and source of potential significant risks to workers, the public and the environment (including estimates of doses), as well as species at risk, the procedures or technologies proposed to mitigate risks the quantities, characteristics and disposition methods of waste.	H)	A description of the decommissioning work packages, including: a step-wise technical approach; the nature and source of potential significant risks to workers, the public, and the environment (including estimates of doses) as well as species at risk; procedures or technologies proposed to mitigate risks; and quantities, characteristics, and disposition methods of all wastes;	Section 2.7 and Each Planning Envelope Volume (1 through 7)

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REGDOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 Appendix C.1	CSA Requirement Description	DDP Section Reference
Bullet 9	A schedule of the execution of decommissioning activities showing: the start date of the proposed execution of decommissioning activities the approximate duration and sequence of work packages (and periods of storage with surveillance, if applicable) the anticipated date of completion of decommissioning activities	I)	A schedule showing the proposed start date; the approximate duration and sequence of work packages (and periods of SWS, if applicable); and the anticipated completion date;	Section 4.2
Bullet 10	A waste management plan	J)	A waste management plan	Section 2.6
Bullet 11	A characterization of potential environmental effects and the measures to be employed to mitigate and monitor these effects	K)	A characterization of potential environmental effects and the measures that will be employed to mitigate and monitor the effects	Section 6.0
Bullet 12	A conservative cost estimate (based on the work packages), as described in REGDOC-3.3.1, <i>Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities</i> , for labour, materials, equipment, waste management, environmental assessment, monitoring and administration (e.g., training, safety, licensing, project management, government and public liaison)	L)	An itemized conservative cost estimate	Section 4.1
Bullet 13	Financial guarantee arrangements	M)	Financial guarantee arrangements	Section 4.3

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REGDOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 Appendix C.1	CSA Requirement Description	DDP Section Reference
Bullet 14	A summary report of any public and Indigenous consultations undertaken in preparing the plan, including issues raised and how they were considered and dispositioned	N)	A summary report of any public and Indigenous engagement undertaken in preparing the plan, including issues raised and how they were considered and dispositioned	Section 10.0
Bullet 15	The project management structure	O)	The project management structure	Section 5.3
Bullet 16	Applicable programs (e.g., management system, emergency response, site security, radiation protection, environmental protection, fire, and personnel training) (Note: this includes programs applicable during storage with surveillance and decommissioning)	P)	Applicable programs (e.g., management system, emergency response, site security, radiation protection, environmental protection and monitoring, fire protection, personnel training)	Section 1.5
Bullet 17	A human factors program that includes: human factors analysis training provisions use of contractors procedural development ergonomic issues	Q)	A human factors program that includes human factors analysis; training provisions; use of contractors; procedural development; and ergonomic issues;	Section 5.0
Bullet 18	Conventional occupational health and safety issues and associated training and protection programs	R)	Conventional occupational health and safety issues and associated training and protection programs;	Sections 5.2 and 7.0
Bullet 19	A list of federal and provincial regulatory agencies involved in the project	S)	AHJs involved in the project;	Section 1.4

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REGDOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 Appendix C.1	CSA Requirement Description	DDP Section Reference
Bullet 20	The final survey program with interpretation criteria	T)	The final survey program with interpretation criteria	Section 2.6.4
Bullet 21	The operating and decommissioning records that will be retained, and the method of retention	U)	The operating and decommissioning records required for long-term retention and the method of retention	Section 9.0
Bullet 22	A table of contents for the final end-state report, outlining the topics to be covered	V)	A table of contents for the final end-state report that outlines the topics to be covered	Appendix B:
Bullet 23	Operational experience and lessons learned from the decommissioning of similar nuclear facilities	W)	Operational experience and lessons learned of the decommissioning of similar nuclear facilities.	Section 11.0
Bullet 24	Criticality safety assessment, as required, and planned actions involving fissile material	N/A	N/A	Section 8.2.1

Appendix B: Table of Contents - Final End State Report

Upon completion of decommissioning, the Pickering Nuclear Site (including PNGS-A, PNGS-B as well as NSS-PWMF) will be in a condition that will support its removal from regulatory control. A final end-state report on the decommissioning program will be prepared closer to when completion of decommissioning is expected to occur (currently decades into the future).

The table of contents of the final end-state report will meet the requirements of the latest regulatory requirements in place at the time. According to REGDOC-2.11.2, Decommissioning [R-3] the end state report shall include the following elements:

Section	Title	Compliance
1.	INTRODUCTION	
2.	DECOMMISSIONING SUMMARY	
2.1	Scope of Work	
2.2	Summary of Work Completed	Decommissioning work undertaken
2.3	Deviations from Detailed Decommissioning Plan	Significant deviations from the DDP
2.4	Deviations from Work Plan	Significant deviations from the DDP
2.5	Hazards and Dose Summary	Summary of radiological doses received by workers
2.5.1	Radiological Hazards	Final physical and radiological status, including any remaining hazards
2.5.2	Non-Radiological Hazards	Final physical and radiological status, including any remaining hazards
2.6	OPEX and Lessons Learned	
2.6.1	OPEX	Summary of abnormal occurrences or incidents during decommissioning
2.6.2	Lessons Learned	Lessons learned
2.6.2.1	Opportunities for Improvement	
2.6.2.2	Project Successes	
3.	END STATE	
3.1	Reference End-State	
3.2	Survey Results	Final Survey Results; actual survey results
3.3	Deviations from Detailed Decommissioning Plan End-State	If applicable, this section will detail deviations from detailed decommissioning

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Section	Title	Compliance
		plan end-state, with a discussion to why the end state was not met.
3.4	Status	Documentation that planned end-state conditions have been met, and if not, why not
3.5	Radiological Status	Final physical and radiological status, including any remaining hazards
3.6	Environmental Status	Final physical and radiological status, including any remaining hazards
3.7	Hazardous Materials Status	List of any hazardous materials left
3.8	Release Criteria	Outlines the radiological and non-radiological criteria used as the basis for the release of the equipment, building or areas from regulatory control
4.	WASTE SUMMARY	
4.1	Waste Quantities and Disposition	Summary of waste quantities generated and managed, and disposition routes
4.2	Radioactive Waste	
4.3	Non-Radioactive Waste	
4.3.1	Hazardous Waste	
4.3.2	Recyclables	
4.3.3	Re-Usable	
4.4	Environmental Impact	Environmental impact
5.	FUTURE LICENCE REQUIREMENTS	
5.1	Any proposed further licence requirements or institutional controls for the site	Proposed further licence requirements or institutional controls for the site
5.2	The future use of, or any restrictions on the future use of, the facility and remaining structures, including any institutional controls	Future use of, or any restrictions on the future use of, the facility and remaining structures, including any institutional controls
6.	REMAINING ENTITIES	
6.1	Any remaining SSCs	List of SSCs designated for restricted use. Inventory of nuclear substances that will remain on site

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Section	Title	Compliance
7.	RECORDS RETENTION AND PROJECT DOCUMENTATION	
7.1	References to decommissioning records	References to decommissioning records
8.	REFERENCES	

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Appendix C: Conventional Health and Safety Issues and Associated Training and Protection

Conventional Health and Safety Issues ¹	Training	Protection Program
Chemical exposure hazards (Asbestos, solvents, toxic elements / metals or compounds (Ingestion, inhalation, skin))	WHMIS Spill Management Safe Work Planning Human Performance	WHMIS Portal EHS- Spill Management PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Mechanical impacts (drop of heavy items, collapse of structures)	Engineering Change Control Safe Work Planning Human Performance	Engineering Change Control PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Noise (Machinery, close working quarters)	Hearing Conservation Hazardous Physical Agents Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Confined spaces	Confined Space Safe Work Planning Human Performance	Confined Space Management PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management

¹ IAEA Decommissioning of Nuclear Facilities Decommissioning of Nuclear Facilities - Health and Safety, Ernst Warnecke; NSRW R²D²Project: Basics of Decommissioning of Research Reactors / Manila; 16-20 October 2006

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Conventional Health and Safety Issues ¹	Training	Protection Program
Light exposure (Laser, ultraviolet, infrared, etc.)	Hazardous Physical Agents Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Ergonomics (Vibration, heavy equipment, computers, laboratory equipment, lifting of devices, etc.)	Musculoskeletal Disorders Awareness and Prevention Hazardous Physical Agents Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Biological hazards (Agents in ventilation systems and static areas, Droppings from animals in the building, Plants, infected animals and insects)	Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Electrical (Removal of services, Temporary services)	Workplace Electrical Safety Lock-out/Tag Out Safe Work Planning Human Performance	Corporate Work Protection Code PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Explosives (Facilities working with explosives, demolition, construction-nail guns)	Explosive Actuated Tools Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management

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Conventional Health and Safety Issues ¹	Training	Protection Program
High pressure systems (compressed air, gas bottles etc.)	Lock-out/Tag-Out Safe Work Planning Human Performance	Corporate Work Protection Code PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Operation of heavy equipment and power tools	Transport and Work Equipment Safe Work Planning Human Performance	Corporate Work Protection Code PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Overhead work (Falling objects, struck against (door, iron bar etc.))	Falling Material Control Fall Protection Safe Work Planning Human Performance	Corporate Work Protection Code PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Environmental conditions (Heat, cold, wet, slippery, limited visibility)	Hazardous Physical Agents Safe Work Planning Human Performance	
Housekeeping (Construction debris, dismantlement debris)	Housekeeping Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management

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Welding and cutting (Industrial hazard, fumes, fire)	Welding Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Material handling (lifting, stacking etc)	Material Handling Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Excavations	Excavation Barriers and Signs Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Rigging and hoisting	Rigging and Hoisting Barriers and Signs Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Toxic and hazardous substances (Chemicals, radioactive materials)	WHMIS Spill Management Safe Work Planning Human Performance Radiation Protection	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management

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Conventional Health and Safety Issues ¹	Training	Protection Program
Fall hazards	Fall Protection Slips, Trips and Falls Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Field sanitation	Spill Management Safe Work Planning Human Performance	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management
Insufficient illumination of working areas	Ergonomics Human Performance Safe Work Planning	PPE&C eSWP - Electronic Safe Work Planning and Pre-Job Briefing Operational Health and Risk Assessment Operational Health and Safety Risk Register Contractor Safety Management

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Glossary

Term	Definition
AB Gate	A conceptual then physical (planned post 2034) boundary established to separate the operational and decommissioning areas of the Pickering nuclear power plant site during concurrent activities.
Canning	A specialized containment method for managing damaged or degraded nuclear fuel that cannot meet standard handling, criticality safety, or confinement requirements.
Clearance	Process of determining if a material containing a nuclear substance(s) can be removed from further regulatory control by the AHJ.
Clearance level	With respect to radioactivity levels, the maximum permissible concentrations of radioactivity in or on materials, equipment, and sites to be released from regulatory control (for example, becquerels per gram or per square centimeter, near-contact dose rates).
Conditional clearance	Clearance that takes into account the reasonable exposure pathways applicable to the specified behaviour and characteristics of the material being considered for exemption.
Damaged Fuel	The classification for damaged nuclear fuel varies from unusual scrapes to bundles that have been geometrically altered in form or shape but all fuel sheaths remain intact, providing containment for the enclosed radioactive materials. It includes individual pencils, bundles with missing pencils, interlocked spacers, or cracked endplates, where the fuel sheaths are intact.
Decommissioning Waste	Waste generated during the decommissioning phase in support of decommissioning activities. This encompasses materials and substances produced during dismantling and removal of structures, systems, and components under a CNSC approved decommissioning plan.
Defective fuel	Nuclear fuel that has breached fuel sheaths, potentially releasing hazardous fission products.

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Term	Definition
Final End State	The ultimate condition of the site after completion of all decommissioning activities, including Dismantling & Demolition and Site Restoration phases. In this state, the site is free of industrial and radiological hazards, with all station SSCs dismantled and non-essential buildings demolished to one meter below grade. The site meets established clearance levels for a 'brownfield' (industrial) site, requires no institutional controls, and is suitable for other OPG uses. Subsurface structures are addressed, and the site is available for potential industrial reuse, meeting all criteria for release from regulatory control.
Interim End State	The condition of a specific Planning Envelope or group of envelopes after completion of designated decommissioning activities, but before reaching the final end state. This includes the removal of specific SSCs, draining and de-energizing of systems, and completion of necessary radiological surveys. Interim end states are defined for each Planning Envelope and may involve partial dismantling, decontamination, or other preparatory steps for the final end state.
Operational Waste	Waste generated during the commercial operations phase of a nuclear power plant in support of commercial operations activities. This includes materials and substances produced as a result of day-to-day operations, maintenance, and routine processes and transition to permanent shutdown. For example: Fuel Bay Baskets, etc.
Outbuilding(s)	Outbuildings refers to Systems, Structures or Components (SSCs) within the PNGS-A protected area, but not part of the main Powerhouse structure.
Planning Envelope	A definable part or area of a facility that is sufficiently removed from, or otherwise independent of, other parts or areas such that the strategic approach to decommissioning that part or area can be planned in a relatively independent manner.
Safe State	A condition during the decommissioning process of a nuclear facility where the facility or specific areas within it have been safely stabilized and/or abandoned and SWS can commence. Note: Safe state can also mean "End State" of a system as per the SAP [R-9].
Safe Storage	Same meaning as Storage with Surveillance Phase.
Stabilization	The activities performed to transition a facility from permanent shutdown state to commencement of decommissioning.

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Term	Definition
Storage with Surveillance (SWS) Phase	A planned stage during a decommissioning program during which the remaining nuclear substances, equipment, and site(s) are placed and maintained in a safe condition until decontamination and dismantling actions are performed. This state might also be referred to as care and maintenance.
Unconditional Clearance	Clearance that takes into account all reasonable exposure routes and types of materials, irrespective of how the material is used and where it might be directed.
Work Package	A logical grouping of closely linked decommissioning tasks aimed at achieving a particular step in the overall decommissioning.

ATTACHMENT 2

OPG Letter, P. Seguin to R. Richardson, "Pickering NGS, Units 1 to 4 – Submission of the Detailed Decommissioning Plan and Storage with Surveillance Plan".

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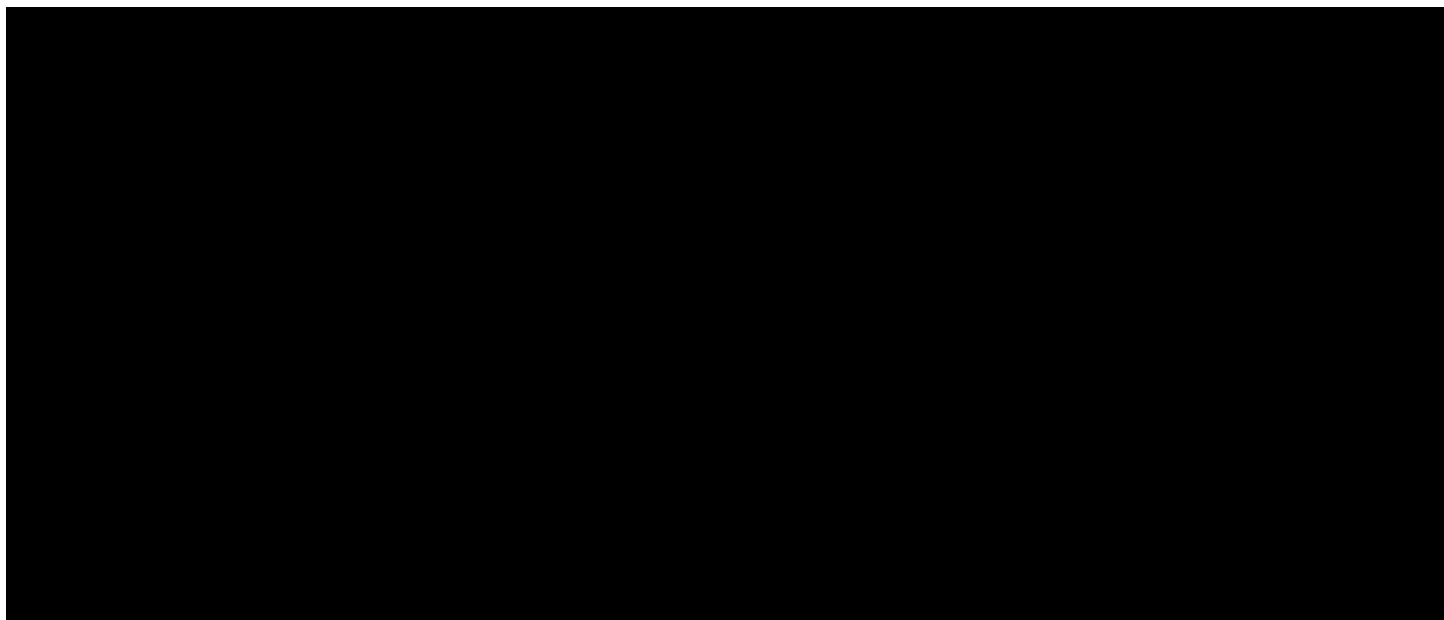
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1.0 INTRODUCTION

This Detailed Decommissioning Plan (DDP) volume focuses on Planning Envelope A (PE-A) and includes the dismantling and removal of Outbuildings. Outbuildings refers to Systems, Structures or Components (SSCs) within the PNGS-A protected area, but not part of the main Powerhouse structure. Dismantling scope for this DDP submission is either for the full removal of the structure or just the internals (leaving the structure intact). Within 5 years of submission, the scope and contents of this volume will be reviewed and revised as required.

PE-A has been preliminarily sub-categorized into three groups based on the timing for when the specific outbuilding is anticipated to no longer be required for continued use and will be available for decommissioning:

- Group A-1: Post PNGS-A Shutdown: Outbuildings not required after PNGS-A shutdown.
- Group A-2: Post Separation of PNGS-A and PNGS-B: Outbuildings not required after common systems are separated along the AB Gate.
- Group A-3: Post Irradiated Fuel Bay Empty: Outbuildings not required after IFB-A & AIFB are emptied, drained and dried.

The Outbuildings included in the decommissioning plan for PNGS-A are detailed in Section 2.0. This information is current as of the development of this DDP, as decommissioning and operational needs evolve there may be adjustments made, which will be reflected in the next update of the DDP and PDP for PNGS. For a complete list of Outbuildings at PNGS-A, PNGS-B and NSS-PWMF, refer to 'Pickering Site Overarching Document' [R-19]

NOTE

As decommissioning planning and execution progresses, some outbuildings may be available earlier than originally contemplated in the preliminary sub-categorization. In these instances, approved OPG processes and procedures will be used to advance the work, including consultation with the CNSC as required.

In accordance with REGDOC-2.11.2 [R-1], any work activities that fall within PE-A, even if not explicitly detailed, will undergo all mandatory preparatory activities. This ensures comprehensive decommissioning planning and preparation as required by the regulatory framework.

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2.0 GENERAL DESCRIPTION & BREAKDOWN OF PLANNING ENVELOPE A

This section includes a description of all the outbuildings that have been included in the scope for decommissioning of PNGS-A.

2.1 Planning Envelope A-1: Outbuildings not Required after PNGS-A Shutdown

2.1.1 #103 and #104 Scaffolding Shed Buildings

The scaffolding shed buildings are located south of the Service Wing and were used to store scaffolding and fibreglass insulation. The scaffolding sheds are temporary structures, consisting of light construction sheet metal/steel on pads.



Figure 1 Scaffold Shed Buildings

2.1.2 #123 Oil Tank Farm A

The Oil Tank Farm A contains 6 oil storage tanks located north of Powerhouse, between the U2 and U3 Transformers, near the U2 Demineralized Water Tank. The tank farm formed part of the turbine and generator lubricating and governing oil system.



Figure 2 Oil Tank Farm A

2.1.3 #7 Off Gas System Building

The purpose of the Off Gas Management System (OGMS) was to reduce the release of gaseous radioactive effluents from the station and to recover deuterium and heavy water. The Off Gas Building is located just south of the vacuum building and is connected to the Vacuum Building with an underground concrete service duct. The system was never put in service and was abandoned [R-2], and modifications of the High-Pressure Service Water (HPSW) lines were performed to remove some of the energy sources in the system. Tie-ins to station systems are still in place, including electrical, instrument and breathing air, service water, service air and nitrogen system.



Figure 3 Off Gas Management Building

2.1.4 #8 Old Water Treatment Plant

The Old Water Treatment Plant (OWTP) is located south of the Service Wing and is bordered by the Vacuum Building to the west and by the scaffold yard structures to the east. The building includes a ground floor level, a basement level, a mezzanine level above the ground floor, and an enclosed stairwell providing access between the floors.



Figure 4 Old Water Treatment Plant

2.1.5 Helium Storage Trailers and Hydrogen Skids

There are 2 Helium storage trailers used for bulk helium storage and 2 hydrogen skids used to store hydrogen bottles. Both skids have supporting steel structures, electrical and instrumentation connections, and at-grade concrete pads. They are located in the un-zoned area south of U1 & U2 and U3 & U4 respectively.



Figure 5 Hydrogen Skid



Figure 6 Helium Storage Trailer

2.1.6 #85 Sulzer-A

Sulzer A is a tall, narrow building on the south side of the Pickering Service Wing, sharing a common wall and entrance with Sulzer B. Originally an upgrading plant designed to process moderator water with high tritium content, Sulzer A separated mixtures of light and heavy water into products richer in one or the other through rectification. The equipment, primarily constructed of stainless steel except for the copper Sulzer-Packing in the column, includes legacy interfaces with Sulzer B that must be separated before dismantling.

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Figure 7 Sulzer A

2.2 Planning Envelope A-2: SSCs not Required after Common Systems are Separated Along the AB Gate

2.2.1 #56 Gas Bottle Storage Enclosure 'A'

The Gas Bottle Storage Enclosure 'A' is located north of PNGS-A screenhouse building, between the U2 and U3 Reactor buildings. The structure has an area of approximately 2,700 ft² (250.84 m²) and a height of 18 ft (5.49 m). It is open at east wall for ventilation (wire mesh wall).



Figure 8 Gas Bottle Storage Enclosure

2.2.2 #57 SDSE Instrument Room 1-2 and #58 SDSE Instrument Room 3-4

The SDSE Instrument Rooms (IRs) are unitized instrument rooms and are situated south of the U2 and U3 reactor buildings, under and attached to the pressure relief duct at ground level. They house the trip logic and the instrumentation of the Shutdown System Enhancement (SDSE).



Figure 9 SDSE Instrument Room 1-2

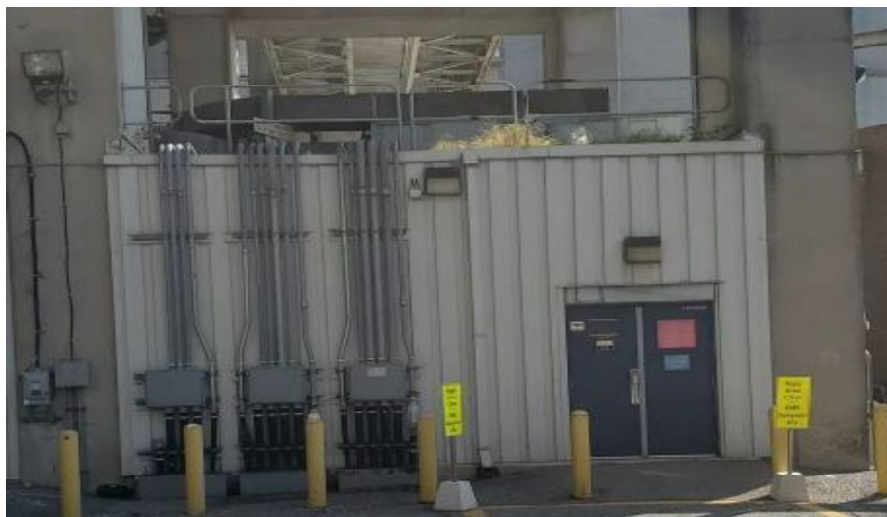


Figure 10 SDSE Instrument Room 3-4

2.2.3 Standby Power System (#3A, #57, #66A, #4A)

The standby power system at PNGS-A comprises six standalone Orenda jet engines, each coupled to a generator capable of supplying adequate electrical power for safety and safety support systems, Figure 11. Each unit includes a drive, a generator, and a control cubicle housing the equipment.

Fuel oil for these generators is stored in two large outdoor tanks within a lined containment berm equipped with foam fire protection Figure 12. Fuel is delivered to the generators' day tanks via fuel forwarding pumps—two per standby generator—located in a fuel oil pumphouse south of the generators.

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The pumphouse Figure 13 contains two separate rooms: one housing the pumps, motors, strainers, and filters protected by CO₂ fire suppression, and another holding the electrical and control panels for the pumps and fire suppression systems.



Figure 11 PNGS-A Standby Generators



Figure 12 PNGS-A Standby Generator Oil Tanks

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Figure 13 Standby Generator Pumphouse

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2.3 Planning Envelope A-3: SSCs not Required after IFB-A & AIFB are Emptied, Drained and Dried

2.3.1 #14A Heavy Water Upgrading Plant



Figure 14 Heavy Water Upgrading Plant

The heavy water upgrading plant houses process equipment, product handling and storage facilities; it also provides space for laboratory facilities, process control room, electrical switchgear room, locker room, record, and file storage space, change room and sanitary facilities for the personnel. The heavy water upgrading plant is located north-west of U4 and was used to manage the upgrading of the Primary Heat Transport (PHT) and other low-tritium heavy water received from U1 to U8.

2.3.2 #14B Heavy Water UPPA Upgrading Towers



Figure 15 Heavy Water UPPA Upgrading Towers

The Heavy Water Upgrader installation is a vacuum distillation plant that was used to upgrade low isotopic, low curie, Heat Transport D2O to reactor grade make up. It is located towards the northwest corner of the protected area and serviced both PNGS-A and PNGS-B needs. The original five upgrading towers known as "UPP A" have been under safe storage for several decades and upgrading duties have been transferred to "UPP B" which continues to meet the station's upgrading requirements. Associated with the UPP towers are the common feed and storage tanks, vacuum systems, head, and bottom product tanks, reboilers, evaporators and coolers as well as their associated support system.

2.3.3 #14C UPP Expansion Feed Storage Area

The UPP expansion feed storage area previously received and processed downgraded heavy water. The downgraded heavy water from the UPP expansion feed storage area was then routed to the UPP B expansion area for upgrading. The UPP B expansion areas are no longer used for heavy water separating. The various pumps, vacuums, heat exchangers and other equipment originally used for upgrading heavy water have been removed or are out of service.

2.3.4 #14D UPP Expansion Area, UPP Area

The UPP Expansion area was built around 2007 timeframe and was used to house the Heat Transport water that came from dewatering U2 and U3 and is now emptied. It consists of four 100 Mg stainless steel tanks located inside the UPP building. These tanks complete with

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nitrogen cover gas, heating, monitoring and annunciation, transfer piping and pumps are housed inside a dyke capable of handling up to 110% of each tank's capacity.

2.3.5 #5A PNGS-A Screenhouse



Figure 16 PNGS-A Screenhouse

The Screenhouse currently serves all four PNGS-A units and is located to the south of the Powerhouse Complex. The building is divided into two sections separated by a concrete block wall. The north portion includes three rooms: the Chlorine Room, Chlorinator Room, and an Eyewash/Shower Room. The south portion consists of a large open space that includes the Screen Area and the Pump Area. The Pump Area occupies the north portion of the space with its finished floor level at a lower elevation than the Screen Area to the south, which houses the traveling screens and other filtration equipment used for intake water for the Powerhouse Complex.

The interior walls and exposed structures of the Screenhouse are concrete and steel paneling, painted or unfinished. The ceiling finish consists of steel structural members and metal decking. Floor finishes mostly consist of concrete or metal grating.

2.3.6 #68 Demineralized Water Tanks



Figure 17 Demineralized Water Tank

Demineralized water is normally required throughout the plant for use in systems where normally strained service water is not suitable. The major load on the system is the condensate feedwater makeup to the boilers. Demineralized water is piped into the power plant from a treatment facility located outside the protected area. This water is then stored in eight large 500,000 gal. tanks, one per unit, connected to a common distribution header. In turn these tanks feed their respective loads and the common make up pumps that supply water to a head tank (one head tank per unit pair) for distribution to smaller loads such as battery rooms, laboratories, Irradiated Fuel Bay (IFB) makeup water, chemical feed tanks and head tanks for the Biological, End shield and Recirculation cooling systems.

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3.0 CURRENT STATUS

The DDP for Planning Envelope A encompasses the comprehensive assessment and planning for decommissioning of out buildings at OPG's PNGS-A facility. In preparation for the upcoming decommissioning activities, scoping surveys and Hazardous Building Material Assessments (HBMA's) are currently in progress. They will be completed in accordance with OPG's NMS prior to completing the work.

This projected start date aligns with the decommissioning timeline discussed in the Program Overview DDP [R-3] and is contingent upon securing the necessary authorizations from regulatory bodies to ensure compliance with all applicable safety and environmental regulations.

4.0 DECOMMISSIONING WORK PACKAGES AND SAFETY ASSESSMENT

The PE-A scope is broken down into several work packages detailed below. Work package development is ongoing and will progress into work plans to support execution of the work. The development of work packages will follow the established procedures detailed in the work package management section of Program Overview DDP [R-3].

The equipment and structures within planning Envelope A (PE-A) have been preliminarily grouped into work packages based on geographical location. The goal of each work package is to document the plan to remove all abandoned equipment and structures from the work area, and in some cases, to remove the building structure down to grade, and reach an interim end state. This includes any tanks, piping, pumps, cables, electrical equipment and instrumentation, control cabinets, HVAC systems, as well as roofs, walls, concrete pads, and foundations. All material and equipment are planned to be processed and removed for recycling or disposal as waste. The interim and final-end state objectives are set out in the Program Overview DDP Vol 0 [R-3].

4.1 Occupational Dose Assessment

Anticipated occupational dose assessments have been conducted by OPG's Responsible Health Physicist (RHP) for Planning Envelope A-1 and A-2. Based on historical surveys and available data, the SSCs within this planning envelope are expected to present minimal radiological hazards.

4.2 Decommissioning Safety Assessment

A decommissioning safety assessment has been performed in accordance with the methodology detailed in Program Overview DDP [R-3] for each work package scope to systematically identify potential hazards and evaluate associated risks. The identified hazards and their corresponding mitigation measures have been discussed in the Safety Assessment Report [R-18] and shown below.

Hazard Category	Hazard/Events Description	Mitigation Measures
Radiological	Potential tritiated exit signs	Characterize the material as needed, remove following OPG Radiation Protection Program [R-4].
	Direct radiation sources from residual water in system	Compliance with OPG Radiation Protection Program [R-4].
	Radioactive liquid spill	Compliance with OPG Radiation Protection Program [R-4] and adequate Safe Work Planning and Pre-Job Briefing [R-11].
	Loose beta-gamma contamination	Compliance with OPG Radiation Protection Program [R-4] and adequate Safe Work Planning and Pre-Job Briefing [R-11].

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Hazard Category	Hazard/Events Description	Mitigation Measures
	Fixed contamination in system piping	Compliance with OPG Radiation Protection Program [R-4].
	Failure of radioactive work ventilation during cutting operation	Compliance with OPG Radiation Protection Program [R-4] and adequate Safe Work Planning and Pre-Job Briefing [R-11].
Environmental	Spills from residual oil in tanks and lines, during removal and due to incorrect capping/packaging during lifts and transport	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-6] and adequate Safe Work Planning and Pre-Job Briefing [R-11]
Non-Radiological	Hot work hazards from cutting pipes and equipment	Compliance with OPG's Control of Ignition Sources And Hot Work Activities [R-20] and adequate Safe Work Planning and Pre-Job Briefing [R-11].
	Inadequately disconnected circuits from building power supply.	Adequate Safe Work Planning and Pre-Job Briefing [R-11]
	PCBs from lights	Compliance with OPG's Management of Designated Substances procedure [R-8]
	Asbestos in gaskets, tiles, and insulation	Compliance with OPG's Asbestos management procedure [R-7]
	Lead paint	Compliance with OPG's Management of Designated Substances procedure [R-8]
	Mercury in switches and light fixtures	Compliance with OPG's Management of Designated Substances procedure [R-8]
	Animal wastes, bird droppings	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-6] and adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Working at heights	Compliance with OPG's Working at Heights procedure [R-9] and adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Inadequate illumination and ventilation in the work area	Compliance with OPG's Environment Health and Safety Managed Systems

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Hazard Category	Hazard/Events Description	Mitigation Measures
		Program [R-6] and adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Degraded or degrading structures, systems, and components	Adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Falling objects	Compliance with OPG's Falling Material Control procedure [R-10] and adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Heavy equipment traffic	Adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Building Collapse	Adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Noise	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-6]
	Dust	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-6]
	Dangerous or faulty equipment	Adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Pinch points	Adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Confined space work	Compliance with OPG's Confined Space Procedures [R-12]
	Fire and explosion hazards from flammable materials and compressed gasses	Compliance with the Fire Protection Program [R-5] and adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Work area congestion, traffic, proximity to other work areas and facilities	Adequate Safe Work Planning and Pre-Job Briefing [R-11]
	Buried Services	Adequate Safe Work Planning and Pre-Job Briefing [R-11]
	PNGS-B Emergencies	Emergency Management plan [R-15]

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Hazard Category	Hazard/Events Description	Mitigation Measures
Unexpected Event	Surveys find radiological material	Characterize the material as needed, cut out and remove following OPG Radiation Protection Program [R-4]
	Asbestos found in insulation or other building materials	Compliance with OPG's Asbestos management procedure [R-7]
	Building collapse	Adequate Safe Work Planning and Pre-Job Briefing [R-11]

Table 1 Hazard Assessment with Mitigation Measures

For any emergent work identified during the DDP implementation period, the existing Nuclear Management System (NMS) change control process will be utilized to evaluate whether the work falls within the existing safety assessment envelope. If the emergent work presents new or different hazards not previously considered, or if risk levels exceed those analyzed in the current safety assessment, an update to the DDP Safety Assessment will be required prior to proceeding with the work.

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4.3 Decommissioning Work Packages

Table 2 summarizes the work packages for A-1 and A-2 and their associated equipment/structures. Additional details will be added for A-3 in a subsequent revision of this volume of the DDP as the timing for decommissioning advances.

Group	ID	Work Package Description	List of Buildings/ Equipment	Associated Equipment
A-1	1	Scaffolding Sheds	#104 Scaffolding shed and #103 Scaffolding shed	Lighting - Miscellaneous
				Building Electrical Services 120 V / 208 V AC - Miscellaneous
	2	Oil Tank Farm	#123 Oil tank farm A	Lube oil system
				Transformer oil system
	3	Off Gas Building	#7 Off Gas System Building	Lighting - Off Gas Building
				Building Electrical Services 120 V / 208 V AC - Main Ground Bus
				Radiation Protection Equipment - Fixed Area Radiation Monitors
				Inactive Drainage System - Inactive Drainage
				Inactive Drainage System - Roof Drainage
				Heating & Ventilation Systems - Off Gas System Building
				Communications - Public Address
				Communications - Telephone
	4	Old Water Treatment Plant	#8 Old Water Treatment Plant - Internals Only	Lighting – Water Treatment Building
				Building Electrical Services 120 V / 208 V AC – Water Treatment Building
				Electrical Auxiliary Systems – Main Ground Bus
				Communications - Public Address

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Group	ID	Work Package Description	List of Buildings/ Equipment	Associated Equipment
				Communications - Maintenance Communications
				Site Instrumentation - Radiological Equipment
				Inactive Drainage System - Yard Fire Protection
				Inactive Drainage System - Inactive Drainage
				Inactive Drainage System - Roof Drainage
				Heating & Ventilation Systems - Water Treatment Building
				Cranes and Hoists - Water Treatment Building
	5	Helium Trailers and Hydrogen Skids	He Trailers x2 and H2 Skids x2	He Trailers x2 and H2 Skids x2
	6	Sulzer-A	#85 Sulzer-A – Internals Only	Lighting D2O Upgrading Plant Sulzer Process and Controls - D2O Upgrading Tower
				Building Electrical Services 120 V / 208 V AC - D2O
				Upgrading Tower
				Electrical Auxiliary Systems – Main Ground Bus
				Communications - Public Address
				Communications - Telephone
				Radiation Protection Equipment - Hand and Foot Monitors, Whole Body Monitors, and Portal Monitors
				Fixed Contamination Monitors
				Fixed Gaseous Monitors
				Inactive Drainage System - Inactive Drainage
				Inactive Drainage System – Roof Drainage
				Heating & Ventilation Systems - Heating Steam

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Group	ID	Work Package Description	List of Buildings/ Equipment	Associated Equipment
				Heating & Ventilation Systems - Chilled Water
				Heating & Ventilation Systems - D2O Upgrading Tower
A-2	1	Gas Bottle Storage Enclosure	#56 Gas Bottle Storage Enclosure 'A'	Lighting - Miscellaneous
				Building Electrical Services 120 V / 208 V AC – Miscellaneous
				Electrical Auxiliary Systems – Main Ground Bus
				Communications - Telephones
	2	SDSE Instrument Buildings	#57 SDSE Instrument Rooms 1-2 and #58 SDSE Instrument Rooms 3-4	Lighting – SDSE Instrument Rooms
				Building Electrical Services 120 V / 208 V AC - Vacuum Building, Ducts & Emergency Control Centres
				Electrical Auxiliary Systems – Main Ground Bus
				Communications - Telephone
				Communications – Maintenance Communications
				Light Water Systems Fire Detection and Alarms
				Heating & Ventilation Systems PNGS-A SDSE – SDSE Instrument Room HVAC
	3	Standby Power System	#3A PNGS-A Standby Generator, #66A Standby Generator oil tanks PNGSA and #4A Pumphouse	Standby Generators
				Governing System
				Excitation System
				Fuel Oil System
				Standby Generator Sets
				Governing System
				Excitation System
				Fuel Oil System

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Group	ID	Work Package Description	List of Buildings/ Equipment	Associated Equipment
				Fuel Oil Waste Disposal
				Fuel Oil Waste Disposal

Table 2 Work Packages and Associated Equipment

NOTE

A standardized nomenclature system has been developed to uniquely identify and organize work packages throughout the decommissioning project. This system ensures consistent identification of work locations, groups, and sequences across all planning envelopes. For example, a Work Package ID of PE-A-1-1 is interpreted as follows:

- PE: Planning Envelope – Indicates that the work package is associated with a specific planning envelope within the decommissioning project.
- A: Planning Envelope A – Specifies the planning envelope to which the work package belongs.
- 1: Group 1 – Denotes the group or subcategory within the planning envelope, organizing work packages into manageable segments.
- 1: Work Package 1 – Identifies the sequence number of the work package within the group.

So, *PE-A-1-1 means*: Planning Envelope: A, Group: 1, Work Package: 1

4.3.1 Planning Envelope A-1: Outbuildings not Required after PNGS-A Shutdown

The buildings and equipment making up the scope of Group A-1 consist of buildings not required once PNGS-A has been shut down, including some equipment that is already out-of-service or abandoned. The pre-requisites for execution of these work packages are:

- Verification that buildings or equipment are not required to support PNGS-A stabilization or safe storage.
- Verification that buildings or equipment are not required to support planned PNGS operations, including PNGS-B, IFB, or D₂O storage at the time of removal.
- Verification that equipment/systems within the buildings have been end stated/separated and abandoned/retired.
- Confirmation of the As-Left condition and the work area has been turned over for decommissioning.

4.3.1.1 PE-A-1-1 Scaffolding Sheds

The #103 and #104 Scaffolding Shed Buildings currently have wooden beams in the ground as footings, with the structure built on top. The building is connected to the station electrical supply for lights and power outlets.

Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

The Scaffold Sheds are incorporated into the Protected Area open land Survey Units and is not assigned an individual MARSSIM Classification or Survey Units.

Radiological Scoping Survey: No scoping surveys have been completed for these structures.

Hazardous Materials Assessments: A hazardous building materials assessment (HBMA) identifies and evaluates the presence of hazardous materials in a building, such as asbestos, lead, mold, and polychlorinated biphenyls (PCBs). The following HBMA's were completed.

Building #	Building Name	Associated Work Package ID	Hazardous Material Identified
#103	Scaffold Shed	PE-A-1-1	Lead Paint, Metal in Paint, Mercury, Silica, PCBs
#104	Insulation Shed	PE-A-1-1	Lead Paint, Metal in Paint, Mercury, Silica, PCBs

Table 3 PE-A-1-1 Completed HBMA's

Outstanding Activities: Outstanding scoping surveys will be performed following the guidance discussed in the Program Overview DDP [R-3]. Any remaining gaps and uncertainty observed will have tailored mitigation plans developed as required. These activities are deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-3].

Stepwise Technical Approach

The #103 and #104 Scaffolding Shed Buildings work package details the steps needed to remove the services from the buildings, demolish the structures including removing the building footing, and repairing the site for re-use. The following is a listing of all work to be completed as part of this work package:

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- Conduct a sweep of the work area to locate and disposition buried services.
- Complete characterization of the work area to identify and document any unexpected radiological and chemical or toxic hazards.
- Remediate any identified hazards.
- Disconnect electrical supply and remove electrical components (lights, cables, outlets).
- Dismantle building structure to grade.
- Remove building footing below grade.
- Repair pavement to allow for re-use of the area, if required.

Work Package Closeout

Both buildings will be demolished down to grade per the interim end state described for PE-A [R-3].

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4.3.1.2 PE-A-1-2 Oil Tank Farm “A”

The #123 Oil Tank Farm A work package includes associated piping, instrumentation, and electrical connections to the tanks.

Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

The Oil Tank Farm was not included in the HSA because all non-real site property and temporary structures such as project trailers, temporary buildings and enclosures are considered a part of the outdoors due to unrestricted movement of personnel, equipment and potentially the weather elements. In addition, outdoor storage tanks and other large equipment such as generators and transformers are also considered a part of the outdoors.

Radiological Scoping Survey: No scoping surveys have been completed for the oil tank farm.

Hazardous Materials Assessments: A hazardous materials assessment (HMA) is performed to identify and evaluate the presence of hazardous materials in an area/system, such as asbestos, lead, mold, and polychlorinated biphenyls (PCBs). No hazardous materials assessments have been completed for this area.

Outstanding Activities: Outstanding scoping surveys will be performed following the guidance discussed in the Program Overview DDP [R-3]. Any remaining gaps and uncertainty observed will have tailored mitigation plans developed as required. These activities are deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-3].

Stepwise Technical Approach

The #123 Oil Tank Farm A work package details the steps needed to remove six oil storage tanks (three lube oil tanks and three transformer oil tanks), their concrete pad, and associated piping, instrumentation, and electrical connections. The following is a listing of all work to be completed as part of this work package:

- Conduct a sweep of the work area to locate and disposition buried services.
- Complete characterization of the work area to identify and document any unexpected radiological and chemical or toxic hazards.
- Remediate any identified hazards.

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- Cut and cap oil lines running to/from the tanks.
- Disconnect electrical supply and remove electrical components.
- Dismantle and remove oil lines.
- Remove oil tanks and supports.
- Remove concrete pad and backfill to grade.
- Repair ground/pavement to allow for re-use of the area, if required.

Work Package Closeout

The oil tank farm will be removed down to grade and backfilled as required per the interim end state described for PE-A [R-3].

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4.3.1.3 PE-A-1-3 Off Gas Building

The #7 Off Gas System Building houses the OGMS, which was designed to reduce the release of gaseous radioactive effluents and recover deuterium and heavy water. The building is a concrete and brick construction with 2-3ft. thick concrete walls. Equipment includes:

- Charcoal delay tanks,
- Guard beds,
- Water removal skids,
- Diaphragm compressor skids,
- Water-ring compressor skids,
- Refrigeration units,
- Off-gas control panel, and
- Analyser panel.

The OGMS was never commissioned or put into service. Support system interfaces including electrical, instrument and breathing air, service water, service air and nitrogen have been tied into station systems and will require end-stating and disconnection prior to dismantling.

Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

The Off-Gas Building is divided into 3 elevations for a total of 7 Survey Units with a preliminary MARSSIM Classification of 1.

MARSSIM Class 1 indicates potential areas impacted with concentrations of residual radioactivity that may exceed the preliminary clearance levels.

Radiological Scoping Survey: Radiological scoping surveys have been completed for the Off-Gas System Building, with results summarized:

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Building #	Building Name	Associated Work Package ID	Results
#7	Off-Gas System Building	PE-A-1-3	Confirmed no contamination likely present

Table 4 PE-A-1-3 Scoping Surveys

Hazardous Materials Assessments: A hazardous building materials assessment (HBMA) is performed to identify and evaluate the presence of hazardous materials in an area/system, such as asbestos, lead, mold, and polychlorinated biphenyls (PCBs). The following HBMA was completed.

Building #	Building Name	Associated Work Package ID	Hazardous Material Identified
#7	Off Gas System Building	PE-A-1-3	Lead Paint, Metal in Paint, Mercury, Asbestos, Silica, PCBs, Mould

Table 5 PE-A-1-3 HBMA

Outstanding Activities: Outstanding scoping surveys will be performed following the guidance discussed in the Program Overview DDP [R-3]. Any remaining gaps and uncertainty observed will have tailored mitigation plans developed as required. These activities are deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-3].

Stepwise Technical Approach

The #7 Off Gas System Building work package details the steps needed to decommission the OGMS and associated equipment while preserving the building structure for potential future use. The following is a listing of all work to be completed as part of this work package:

- Conduct a sweep of the work area to locate and disposition buried services.
- Complete characterization of the work area to identify and document any unexpected radiological and chemical or toxic hazards.
- Remediate any identified hazards, including potential mold.
- Isolate and disconnect the off-gas equipment.
- Remove or redirect building services, if required.
- Remove off-gas equipment and components.

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- Leave the building floor and structure in a safe state.

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Work Package Closeout

The internal components and equipment will be removed while maintaining the building envelope and services for potential repurposing, per the interim end state described for PE-A [R-3].

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4.3.1.4 PE-A-1-4 Old Water Treatment Plant

The major equipment within the #8 Old Water Treatment Plant includes:

- Densator tanks,
- Ionexer Exchangers,
- Anexer Exchangers,
- Catexer Exchangers,
- Purifiers,
- Associated feeders, pumps, agitators, piping,
- Sampling and monitoring equipment, and
- Control panels.

The facility has been shut down for several decades, but some energized equipment remains, including an active de-chlorination system required to service the Pickering site.

Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

The Old Water Treatment Plant is divided into 1 Survey Unit with a preliminary MARSSIM Classification of 3.

MARSSIM Class 3 indicates potential impacted areas that are not expected to contain any radioactive contamination or are expected to contain radioactive contamination at levels that are a small fraction of the preliminary clearance levels.

The HSA identified that the settling pond associated with the old water treatment plant is still utilized, and it may contain some chemical contaminants. Water was pumped from the old water treatment plant to the settling pond. Additionally, the HSA identified that there may have been a lime spill at one time, during the 1980s.

Radiological Scoping Survey: No scoping surveys have been completed for these structures.

Hazardous Materials Assessments: A hazardous materials assessment (HBMA) is performed to identify and evaluate the presence of hazardous materials in an area/system,

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such as asbestos, lead, mold, and polychlorinated biphenyls (PCBs). No hazardous materials assessments have been completed for this area.

Outstanding Activities: Outstanding scoping surveys will be performed following the guidance discussed in the Program Overview DDP [R-3]. Any remaining gaps and uncertainty observed will have tailored mitigation plans developed as required. These activities are deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-3].

Stepwise Technical Approach

The #8 Old Water Treatment Plant work package details the steps needed to remove abandoned water treatment equipment while maintaining active de-chlorination systems that currently service the Pickering site. The following is a listing of all work to be completed as part of this work package:

- Conduct a sweep of the work area to locate and disposition buried services.
- Complete characterization of the work area to identify and document any unexpected radiological and chemical or toxic hazards.
- Remediate any identified hazards.
- Perform vessel inspection to confirm if there is any content (resin, sand, charcoal).
- Erect live equipment barriers to protect in-service sodium meta-bisulfate addition equipment and sampling systems.
- Isolate and disconnect abandoned water treatment equipment.
- Remove water treatment system tanks, valves, pumps, pipes, etc.
- Remove associated panels, instruments, cables, while retaining building services.
- Leave the building floor and structure in a safe state.

Work Package Closeout

The abandoned internal components and equipment will be removed while maintaining the building envelope and services for potential repurposing, per the interim end state described for PE-A [R-3].

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4.3.1.5 PE-A-1-5 Helium Trailers and Hydrogen Skids

The tanks on the Helium Storage Trailers and Hydrogen Skids are planned to be removed during stabilization, leaving the supporting structures and pads for decommissioning.

Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

The Helium Trailers and Hydrogen Skids were not included in the HSA because all non-real site property and temporary structures such as project trailers, temporary buildings and enclosures are considered a part of the outdoors due to unrestricted movement of personnel, equipment and potentially the weather elements. In addition, outdoor storage tanks and other large equipment such as generators and transformers are also considered a part of the outdoors.

Radiological Scoping Survey: No scoping surveys have been completed for these structures/systems.

Hazardous Materials Assessments: A hazardous materials assessment (HMA) is performed to identify and evaluate the presence of hazardous materials in an area/system, such as asbestos, lead, mold, and polychlorinated biphenyls (PCBs). No hazardous materials assessments have been completed for this area.

Outstanding Activities: Outstanding scoping surveys will be performed following the guidance discussed in the Program Overview DDP [R-3]. Any remaining gaps and uncertainty observed will have tailored mitigation plans developed as required. These activities are deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-3].

Stepwise Technical Approach

The Helium Storage Trailers and Hydrogen Skids work package details the steps needed to remove the supporting structures and pads following the planned removal of tanks during stabilization. The following is a listing of all work to be completed as part of this work package:

- Conduct a sweep of the work area to locate and disposition buried services.
- Complete characterization of the work area to identify and document any unexpected radiological and chemical or toxic hazards.
- Remediate any identified hazards.

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- Disconnect electrical supply and remove electrical components and instruments.
- Dismantle metal structures.
- Remove the concrete plinths down to grade.
- Complete any repairs required to allow for re-use of the area.

Work Package Closeout

- The remaining steel structures, electrical components, instruments, and concrete plinths will be removed down to grade, per the interim end state described for PE-A [R-3].

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4.3.1.6 PE-A-1-6 Sulzer A (Contaminated)

The #85 Sulzer-A facility has been shut down for several decades, but residual contamination should be considered as no steam cleaning of the systems was completed.

Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

The Sulzer A Building (Referred to as D2O Upgrading Tower A in the HSA) is divided into 1 Survey Unit with a preliminary MARSSIM Classification of 1.

MARSSIM Class 1 indicates potential areas impacted with concentrations of residual radioactivity that may exceed the preliminary clearance levels.

The HSA identified that elevated H-3 levels exist in the general area of the Upgrading Plant.

Radiological Scoping Survey: No scoping surveys have been completed for this structure/system.

Hazardous Materials Assessments: A hazardous materials assessment (HBMA) is performed to identify and evaluate the presence of hazardous materials in a building, such as asbestos, lead, mold, and polychlorinated biphenyls (PCBs). No hazardous materials assessments have been completed for this structure.

Outstanding Activities: Outstanding scoping surveys will be performed following the guidance discussed in the Program Overview DDP [R-3]. Any remaining gaps and uncertainty observed will have tailored mitigation plans developed as required. These activities are deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-3].

Stepwise Technical Approach

The #85 Sulzer-A work package details the steps needed to remove contaminated equipment and systems. The following is a listing of all work to be completed as part of this work package:

- Conduct a sweep of the work area to locate and disposition buried services.
- Complete characterization of the work area to identify and document any unexpected radiological and chemical or toxic hazards.
- Remediate any identified hazards.

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- Perform vessel inspection to confirm if there is any content.
- Identify & protect live systems and equipment.
- Isolate and disconnect upgrader equipment.
- Perform asbestos remediation.
- Prepare crane footprint and place crane.
- Remove roof structure.
- Remove tower and auxiliary equipment.
- Repair the building floor and structure, and install temporary supports and roof, as required to leave it in a safe state.

Work Package Closeout

The abandoned internal components and equipment will be removed while maintaining the structure of the building for repurposing, per the interim end state described for PE-A [R-3].

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4.3.2 Planning Envelope A-2: SSCs not Required after Common Systems are Separated Along the AB Gate

The buildings and equipment making up the scope of Group A-2 consist of buildings not required once PNGS-A has been shut down, including some equipment that is already out-of-service or abandoned. The pre-requisites for execution of these work packages are:

- Buildings or equipment are not required to support PNGS-A stabilization or safe storage.
- Buildings or equipment are not required to support PNGS operations, including PNGS-B, IFB, or D₂O storage at the time of removal.
- Equipment/systems within the buildings have been end stated/separated and abandoned/retired.
- The As-Left condition has been verified and the work area has been turned over for decommissioning.

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4.3.2.1 PE-A-2-1 Gas Bottle Storage Enclosure

Below are some added characteristics of the #56 Gas Bottle Storage Enclosure 'A':

- Area: approximately 2,700 ft² (250.84 m²).
- Height: 18 ft (5.49 m).
- Double walls made of metal cladding with insulation in between.
- Built on existing pavement.
- Open east wall for ventilation (wire mesh wall).
- Connected to station electrical supply for lights and power outlets.

The gas bottles will be removed prior to the start of decommissioning.

Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

The Gas Bottle Storage Enclosure is incorporated into the Protected Area open land Survey Units and is not assigned an individual MARSSIM Classification or Survey Units.

Radiological Scoping Survey: No scoping surveys have been completed for these structures.

Hazardous Materials Assessments: A hazardous materials assessment (HMA) is performed to identify and evaluate the presence of hazardous materials in an area/system, such as asbestos, lead, mold, and polychlorinated biphenyls (PCBs). The following HMA was completed.

Building #	Building Name	Associated Work Package ID	Hazardous Material Identified
#56	Gas Bottle Storage Enclosure	PE-A-1-3	Lead Paint, Metal in Paint, Asbestos, Silica, PCBs

Table 6 PE-A-2-1 HBMA

Outstanding Activities: Outstanding scoping surveys will be performed following the guidance discussed in the Program Overview DDP [R-3]. Any remaining gaps and uncertainty observed will have tailored mitigation plans developed as required. These activities are

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deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-3].

Stepwise Technical Approach

The #56 Gas Bottle Storage Enclosure 'A' work package details the steps needed to remove the metal structure following the removal of gas bottles prior to decommissioning. The following is a listing of all work to be completed as part of this work package:

- Conduct a sweep of the work area to locate and disposition buried services.
- Complete characterization of the work area to identify and document any unexpected radiological and chemical or toxic hazards.
- Remediate any identified hazards.
- Disconnect electrical supply and remove electrical components (lights, cables, outlets).
- Dismantle building structure to grade.
- Remove building pad/footing to grade.
- Repair pavement to allow for re-use of the area, if required.

Work Package Closeout

- The building will be demolished down to grade per the interim end state described for PE-A [R-3].

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4.3.2.2 PE-A-2-2 SDSE Instrument Buildings

The two SDS Instrument Rooms (IRs), #57 SDSE Instrument Room 1-2 and #58 SDSE Instrument Room 3-4, have the following characteristics:

- Self-contained structures.
- House instruments and electronics associated with the shutdown system SDSE.
- Complete with air conditioning and ventilation systems.

The IRs will become obsolete once the reactor units are defueled.

Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

SDSE Instrument Rooms 1-2 and SDSE Instrument Rooms 3-4 are each divided into 1 Survey Unit with a preliminary MARSSIM Classification of 2.

MARSSIM Class 2 indicates potential impacted areas where concentrations of residual radioactivity are not expected to exceed the preliminary clearance levels.

Radiological Scoping Survey: Scoping surveys have not been completed for these structures.

Hazardous Materials Assessments: A hazardous materials assessment (HMA) is performed to identify and evaluate the presence of hazardous materials in a building, such as asbestos, lead, mold, and polychlorinated biphenyls (PCBs). No hazardous materials assessments have been completed for this structure.

Outstanding Activities: Outstanding scoping surveys will be performed following the guidance discussed in the Program Overview DDP [R-3]. Any remaining gaps and uncertainty observed will have tailored mitigation plans developed as required. These activities are deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-3].

Stepwise Technical Approach

The #57 SDSE Instrument Room 1-2 and #58 SDSE Instrument Room 3-4 work package details the steps needed to remove these self-contained structures that house shutdown system SDSE instruments and electronics. The following is a listing of all work to be completed as part of this work package:

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- Conduct a sweep of the work area to locate and disposition buried services.
- Complete characterization of the work area to identify and document any unexpected radiological and chemical or toxic hazards.
- Remediate any identified hazards.
- Establish any protection or supports necessary to safeguard the PRD and it's support columns.
- Disconnect electrical supply and remove electrical components and instruments.
- Remove or redirect building services, if required.
- Disconnect and remove building HVAC and other systems.
- Dismantle building structure.
- Remove building pad down to grade.
- Repair ground/pavement to allow for re-use of the area, if required.

Work Package Closeout

- The SDSE instrument rooms will be removed, including all associated electronics, leaving only the building pad at grade, per the interim end state described for PE-A [R-3].

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4.3.2.3 PE-A-2-3 Standby Power System

The Standby Power System (#3A, #57, #66A, #4A) consists of standby generators, oil tanks, and pumphouse.

Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

The Standby Power System is divided into 1 Survey Unit with a preliminary MARSSIM Classification of 3.

MARSSIM Class 3 indicates potential impacted areas that are not expected to contain any radioactive contamination or are expected to contain radioactive contamination at levels that are a small fraction of the preliminary clearance levels.

The HSA identified that in the early 1990s, the area was used as temporary storage for radioactive waste, indicating the potential for contamination. Additionally, the HSA identified several oil leak events related to Standby Generators at Pickering A. The area was remediated under project # 13-40474 following these events, and there should be minimal conventional contamination remaining.

Radiological Scoping Survey: No scoping surveys have been completed for these structures.

Hazardous Materials Assessments: A hazardous materials assessment (HMA) is performed to identify and evaluate the presence of hazardous materials in an area/system, such as asbestos, lead, mold, and polychlorinated biphenyls (PCBs). No hazardous materials assessments have been completed for this area.

Outstanding Activities: Outstanding scoping surveys will be performed following the guidance discussed in the Program Overview DDP [R-3]. Any remaining gaps and uncertainty observed will have tailored mitigation plans developed as required. These activities are deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-3].

Stepwise Technical Approach

The Standby Power System work package details the steps needed to remove the standby generators, oil tanks, pumphouse, and all associated piping, electrical systems, supports, and structures. The following is a listing of all work to be completed as part of this work package:

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- Establish construction work area including standby generators, oil tanks, containment berm, and pumphouse.
- Conduct a sweep of the work area to locate and disposition buried services.
- Complete characterization of the work area to identify and document any unexpected radiological and chemical or toxic hazards.
- Remediate any identified hazards.
- Cut and cap oil lines running to/from the oil tanks.
- Disconnect oil tank electrical supply and remove electrical components.
- Remove oil lines piping and components.
- Disconnect oil tank fire suppression system and remove components.
- Remove oil tanks and associated civil components (supports, stairs, etc.).
- Remove containment berm and lining and backfill to grade.
- Remove or redirect pumphouse building services, if required.
- Disconnect pumphouse electrical supply and remove electrical components and instruments.
- Disconnect and remove pumphouse mechanical systems and piping.
- Disconnect any remaining services, including fire suppression, building HVAC, lighting, etc.
- Dismantle building structure to grade.
- Remove building pad down to grade.
- Cut and cap any remaining oil lines to the standby generators.
- Disconnect electrical supply.
- Dismantle and remove standby generators, cubicles, and associated equipment as per the detailed work package.
- Remove concrete pad down to grade.
- Final backfill, grading, and landscaping, as required for safe re-use of the area.

Work Package Closeout

- The standby power system will be removed down to grade and backfilled as required per the interim end state described for PE-A [R-3].

5.0 WASTE MANAGEMENT

5.1 Waste Management Plan

Most of the systems and structures within PE-A are not expected to be radiologically contaminated, except for the Sulzer A plant which is anticipated to generate LLW. Therefore, plans will be in place to manage both conventional, including hazardous, and radioactive waste. These preliminary waste classifications were arrived at based on expert knowledge of the system/structures' function, as well as a study of past incidents in the area that may have resulted in contamination. Further scoping and surveys will be completed to verify expected waste characteristics in accordance with the characterization strategy outlined in the Program Overview DDP [R-3].

Table 7 shows the estimated waste volumes associated with the decommissioning activities planned for PE-A.

Waste Stream	Conventional (m ³)	LLW (m ³)
Concrete	2,070	-
Metal	9,870	453
Hazardous	198	-

Table 7 Planning Envelope A Waste Volume Estimates

5.1.1 Waste Pathways

5.1.1.1 Conventional Waste

As can be seen in the table above, much of the waste generated is expected to be conventional waste and as such, dedicated in-situ laydown areas will be setup for Planning Envelope A activities. Refer to the Program Overview DDP [R-3] for further pathway details.

5.1.1.2 Conventional Hazardous Waste

Hazardous Waste is expected to be generated during decommissioning activities related to Volume 1 activities. Of the HBMA's completed to date, hazards identified include asbestos, lead, mercury, silica, and mould. Hazardous Building Material Assessments and sampling will be used to verify hazards prior to any dismantling activities in accordance with NMS. Refer to the Program Overview DDP [R-3] for further pathway details.

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5.1.1.3 Radiological Waste

According to the Table 7, a relatively small amount of LLW is expected to be generated during the dismantling activities related to the Sulzer A Plant. Radiological Waste is not expected during the dismantling of the outbuildings, however, due to the location of the outbuildings it is possible small amounts of contamination will be discovered during characterization or demolition activities. Refer to the Program Overview DDP [R-3] for further pathway details

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6.0 REFERENCES

- [R-1] OPG, Decommissioning, REGDOC-2.11.2
- [R-2] OPG, Off Gas Management System PNGS-A & B –Abandon System In-Place, P-CORR-00531-00693
- [R-3] OPG, Detailed Decommissioning Plan – Program Overview, NA44-PLAN-00960-00004
- [R-4] OPG, Radiation Protection Program, N-PROG-RA-0013
- [R-5] OPG, Fire Protection, N-PROG-RA-00012
- [R-6] OPG, Environment Health and Safety Managed Systems Program, OPG-PROG-0005
- [R-7] OPG, Management of Asbestos-Containing Material, OPG-PROC-0124
- [R-8] OPG, Management of Designated Substances Other Than Asbestos, OPG-PROC-0125
- [R-9] OPG, Working at Heights, OPG-PROC-0137
- [R-10] OPG, Falling Material Control, OPG-PROC-0136
- [R-11] OPG, Safe Work Planning and Pre-Job Briefing, OPG-PROC-0129
- [R-12] OPG, Confined Space Management, OPG-PROC-0122
- [R-13] OPG, Spill Management, OPG-STD-0152
- [R-14] OPG, Maintenance of Equipment Containing Hydrogen, N-STD-RA-0022
- [R-15] OPG, Ontario Power Generation Emergency Management Program, OPG-PROG-0030
- [R-16] OPG, Work Protection, N-PROG-MA-0015
- [R-17] OPG, Hoisting and Rigging, N-STD-MA-0018
- [R-18] OPG, Integrated Decommissioning Safety Assessment, NA44-REP-00960-00431
- [R-19] OPG, Pickering Site Overarching Document, P-PLAN-00960-00008
- [R-20] OPG, Control of Ignition Sources And Hot Work Activities, N-PROC-RA-0057

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7.0 ACRONYMS

Acronym	Definition
AIFB	Auxiliary Irradiated Fuel Bay
ALARA	As Low As Reasonably Achievable
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DDP	Detailed Decommissioning Plan
HPSW	High Pressure Service Water
IFB	Irradiated Fuel Bay
IFB-A	Irradiated Fuel Bay for Pickering A
ILW	Intermediate Level Waste
IR	Instrument Room
LLW	Low Level Waste
NMS	Nuclear Management System
OGMS	Off Gas Management System
OPG	Ontario Power Generation
PDP	Preliminary Decommissioning Plan
PE	Planning Envelope
PHT	Primary Heat Transport
PNGS	Pickering Nuclear Generating Station
PNGS-A	Pickering Nuclear Generating Station A
PNGS-B	Pickering Nuclear Generating Station B
PRD	Pressure Relief Duct
RAB	Reactor Auxiliary Building
REGDOC	Regulatory Document
RP	Radiation Protection

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Acronym	Definition
SDSE	Shutdown System Enhancement
SSC	System, Structure, or Component
U1	Unit 1
U2	Unit 2
U3	Unit 3
U4	Unit 4
U5	Unit 5
U8	Unit 8
UPP	Upgrading Plant Pickering
UPPA	Upgrading Plant Pickering A
WMP	Waste Management Plan

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Appendix A: Verification Matrix

REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 1	A description of, and diagram showing, the areas, components and structures to be decommissioned, grouped, where appropriate, into logical decommissioning planning envelopes	A)	A description of, and diagram showing, the areas, components, and structures to be decommissioned, grouped where appropriate into logical decommissioning planning envelopes	Section 2.0
Bullet 2	The operational history, including incidents or accidents that could affect decommissioning	B)	The operational history, including incidents or accidents that could affect decommissioning	See the Program Overview DDP [R-3]
Bullet 3	The storage with surveillance stage, as applicable, and requirements of the: functional building services monitoring and surveillance activities inspection activities usage boundaries during storage with surveillance	C)	The SWS stage and requirements: functional building services; monitoring and surveillance activities; inspection activities; and usage boundaries during SWS;	See the Program Overview DDP [R-3]
Bullet 4	The final radiological, physical and chemical end-state objectives, and interim end-state objectives, as applicable	D)	The final radiological, physical, and chemical end-state objectives. Where more than one DDP is required in a phased program, interim end-state objectives and monitoring programs for deferral periods shall be provided for each detailed plan.	See the Program Overview DDP [R-3]
Bullet 5	A description of the requirements for any institutional controls	E)	A description of the requirements for long-term institutional controls	See the Program Overview DDP [R-3]

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REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 6	Comprehensive and systematic survey results of radiological and other potentially hazardous conditions, including identification and description of the remaining significant gaps or uncertainties in the measurement or prediction of such conditions	F)	Comprehensive and systematic survey results of radiological and other potentially hazardous conditions, including identification and description of the remaining significant gaps or uncertainties in the measurement or prediction of such conditions	Section 4.3
Bullet 7	A decommissioning strategy for each planning envelope that highlights any significant changes from the strategy identified in the PDP	G)	A decommissioning strategy for each planning envelope that highlights any significant changes from the strategy in the PDP	See the Program Overview DDP [R-3]
Bullet 8	A description of the decommissioning work packages, including: a step-wise technical approach the nature and source of potential significant risks to workers, the public and the environment (including estimates of doses), as well as species at risk, the procedures or technologies proposed to mitigate risks the quantities, characteristics and disposition methods of waste.	H)	A description of the decommissioning work packages, including: a step-wise technical approach; the nature and source of potential significant risks to workers, the public, and the environment (including estimates of doses) as well as species at risk; procedures or technologies proposed to mitigate risks; and quantities, characteristics, and disposition methods of all wastes;	Section 4.3

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REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 9	A schedule of the execution of decommissioning activities showing: the start date of the proposed execution of decommissioning activities the approximate duration and sequence of work packages (and periods of storage with surveillance, if applicable) the anticipated date of completion of decommissioning activities	I)	A schedule showing the proposed start date; the approximate duration and sequence of work packages (and periods of SWS, if applicable); and the anticipated completion date;	See the Program Overview DDP [R-3]
Bullet 10	A waste management plan	J)	A waste management plan	Section 5.1
Bullet 11	A characterization of potential environmental effects and the measures to be employed to mitigate and monitor these effects	K)	A characterization of potential environmental effects and the measures that will be employed to mitigate and monitor the effects	See the Program Overview DDP [R-3]
Bullet 12	A conservative cost estimate (based on the work packages), as described in REGDOC-3.3.1, <i>Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities</i> , for labour, materials, equipment, waste management, environmental assessment, monitoring and administration (e.g., training, safety, licensing, project management, government and public liaison)	L)	An itemized conservative cost estimate	See the Program Overview DDP [R-3]
Bullet 13	Financial guarantee arrangements	M)	Financial guarantee arrangements	See the Program Overview DDP [R-3]

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REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 14	A summary report of any public and Indigenous consultations undertaken in preparing the plan, including issues raised and how they were considered and dispositioned	N)	A summary report of any public and Indigenous engagement undertaken in preparing the plan, including issues raised and how they were considered and dispositioned	See the Program Overview DDP [R-3]
Bullet 15	The project management structure	O)	The project management structure	See the Program Overview DDP [R-3]
Bullet 16	Applicable programs (e.g., management system, emergency response, site security, radiation protection, environmental protection, fire, and personnel training) (Note: this includes programs applicable during storage with surveillance and decommissioning)	P)	Applicable programs (e.g., management system, emergency response, site security, radiation protection, environmental protection and monitoring, fire protection, personnel training)	See the Program Overview DDP [R-3]
Bullet 17	A human factors program that includes: human factors analysis training provisions use of contractors procedural development ergonomic issues	Q)	A human factors program that includes human factors analysis; training provisions; use of contractors; procedural development; and ergonomic issues;	See the Program Overview DDP [R-3]
Bullet 18	Conventional occupational health and safety issues and associated training and protection programs	R)	Conventional occupational health and safety issues and associated training and protection programs;	See the Program Overview DDP [R-3]
Bullet 19	A list of federal and provincial regulatory agencies involved in the project	S)	AHJs involved in the project;	See the Program Overview DDP [R-3]

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REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 20	The final survey program with interpretation criteria	T)	The final survey program with interpretation criteria	See the Program Overview DDP [R-3]
Bullet 21	The operating and decommissioning records that will be retained, and the method of retention	U)	The operating and decommissioning records required for long-term retention and the method of retention	See the Program Overview DDP [R-3]
Bullet 22	A table of contents for the final end-state report, outlining the topics to be covered	V)	A table of contents for the final end-state report that outlines the topics to be covered	See the Program Overview DDP [R-3]
Bullet 23	Operational experience and lessons learned from the decommissioning of similar nuclear facilities	W)	Operational experience and lessons learned of the decommissioning of similar nuclear facilities.	See the Program Overview DDP [R-3]
Bullet 24	Criticality safety assessment, as required, and planned actions involving fissile material	N/A	N/A	See the Program Overview DDP [R-3]

ATTACHMENT 3

OPG Letter, P. Seguin to R. Richardson, "Pickering NGS, Units 1 to 4 – Submission of the Detailed Decommissioning Plan and Storage with Surveillance Plan".

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PNGS-A Detailed Decommissioning Plan Volume 2 - Non-Nuclear Component Removal

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1.0 INTRODUCTION

This Detailed Decommissioning Plan (DDP) focuses on Planning Envelope B (PE-B) and includes the dismantling and removal of Systems, Structures and Components (SSCs) considered to be non-nuclear that are located within the Turbine Hall (TH) and Turbine Auxiliary Bay (TAB). Within 5 years of submission, the scope and contents of this volume will be reviewed and revised as required.

PE-B consists of systems and components that are designated for end-stating, abandonment, or retirement. While many of these systems will no longer support PNGS-A SWS or the planned refurbishment or extended operations of PNGS-B (U5 - U8), some components will remain operational until station separation is completed. Refer to the Program Overview DDP [R-1] for details on the separation strategy.

This PE has been preliminarily sub-categorized into two groups based on the location and type of systems to be decommissioned. The specific timing and sequence of decommissioning activities within PE-B will be coordinated with the station separation schedule to maintain required operational dependencies.

- Group B-1: SSCs such as the turbine and generator, located within the Turbine Hall of PNGS-A U1 – U4.
- Group B-2: SSCs such as the electrical supply and controls, located within PNGS-A U1 – U4 TAB.

The components included in this envelope are not anticipated to be radiologically contaminated. A general description of the SSCs is provided in Section 2.0.

NOTE

As decommissioning planning and execution progresses, some non-nuclear systems may be available earlier than originally contemplated in the preliminary sub-categorization. In these instances, approved OPG processes and procedures will be used to advance the work, including consultation with the CNSC as required.

In accordance with REGDOC-2.11.2 [R-16], any work activities that fall within PE-B, even if not explicitly detailed, will undergo all mandatory preparatory activities. This ensures comprehensive decommissioning planning and preparation as required by the regulatory framework.

2.0 GENERAL DESCRIPTION & BREAKDOWN OF PLANNING ENVELOPE SYSTEM, STRUCTURE & COMPONENTS

This section includes a description of all the non-nuclear components that have been included in the scope for decommissioning of PNGS-A.

2.1 Turbine Hall

The main components in the TH are the turbine and auxiliary equipment and the generator and auxiliary equipment.



Figure 1 Turbine Hall 294' Elevation

2.1.1 41100 Turbine

The Turbine System, located in the turbine hall, consists of high pressure and low-pressure turbine units, rotor assemblies, casings, bearings, and steam flow path components constructed mainly of high-grade steel alloys.

2.1.2 41120 Moisture Separation System

The Moisture Separation System consists of moisture separator vessels, drain tanks, piping, and associated valves constructed mainly of carbon steel.

2.1.3 41130 Live Steam Reheat System

The Live Steam Reheat System consists of reheater vessels, steam piping, isolation valves, and associated instrumentation constructed mainly of carbon steel.

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2.1.4 41140 Turning Gear

The Turbine Generator Turning Gear System consists of an AC motor, self-shifting clutch mechanism, drive gearing, and associated control components constructed mainly of steel and copper electrical components.

2.1.5 41160 Turbine Lubricating Oil System

The Turbine Lubricating Oil System consists of oil storage tanks, pumps, filters, coolers, supply/return piping, and distribution headers constructed mainly of carbon steel with copper-alloy heat exchanger components.

2.1.6 41150 Turbine Gland Steam System

The Turbine Gland Steam System consists of steam supply headers, distribution piping, pressure control valves, and sealing components constructed mainly of carbon steel.

2.1.7 41170 Turbine Governing System

The Turbine Governing System consists of hydraulic actuators, control valves, speed sensors, electronic controllers, and associated instrumentation constructed mainly of steel and electronic components.

2.1.8 41180 Turbine Supervisory System

The Turbine Supervisory System consists of instrumentation and control equipment, constructed mainly of electronic components designed for turbine-generator protection service.

2.1.9 41190 LP Exhaust Cooling System

The LP Turbine Exhaust Cooling System consists of cooling equipment and monitoring instruments, constructed mainly of steel components designed for exhaust temperature control service.

2.1.10 43110 Extraction Steam System

The Extraction Steam System consists of steam piping and control equipment, constructed mainly of steel components designed for steam distribution service.

2.1.11 41200/41210 Generator

The Main Generator System consists of a large rotating electrical machine, constructed mainly of steel and copper components designed for electrical power generation service.

2.1.12 41220 Excitation

The Generator Excitation System consists of static pilot exciter, Automatic Voltage Regulator, a main exciter, and associated control equipment, constructed mainly of electrical and electronic components designed for generator field excitation control service.

2.1.13 41230 Hydrogen Cooling System

The Generator Hydrogen Cooling System consists of hydrogen coolers, seals, and auxiliary components, constructed mainly of steel and specialized materials designed for hydrogen gas cooling service.

2.1.14 41240 Stator Cooling System

The Stator Cooling System consists of a closed-loop demineralized water circulation system, constructed mainly of copper piping and heat exchange components designed for generator stator cooling service.

2.1.15 41250 Seal Oil System

The Generator Seal Oil System consists of oil pumps, filters, tanks, and regulating equipment, constructed mainly of steel components designed for hydrogen sealing and shaft lubrication service.

2.1.16 42110 Main Condenser

The Main Condenser System consists of shell and tube heat exchangers, constructed mainly of copper and stainless-steel components designed for steam condensing service. The system serves as the primary heat rejection component for the steam cycle, installed at the exhaust of the LP turbines.

2.1.17 42120 Extraction Air System

The Condenser Air Extraction System consists of three Condenser Air Extraction Pumps (CAEPs) and associated exhaust piping to the turbine hall roof, constructed mainly of steel components designed for vacuum service.

2.1.18 42130 Condenser Tube Cleaning System

The Condenser Tube Cleaning System (CTCS) consists of sponge rubber ball circulation equipment, ball collection and injection components, and associated piping, constructed mainly of stainless steel and rubber components designed for continuous mechanical tube cleaning service.

2.1.19 42140 Debris Filter Assembly

The Debris Filter System consists of filter assemblies installed upstream of the main condensers, constructed mainly of metal screening components designed for debris removal service.

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2.1.20 71210 Condenser Cooling Water (CCW) Supply System

The Condenser Cooling Water (CCW) System consists of two parallel pumps per unit discharging into a 9 ft diameter common header, six 6 ft diameter inlet pipes to the condensers, three 9 ft diameter discharge pipes, and a concrete discharge duct (10 ft wide by 15 ft high), constructed mainly of large-diameter steel piping and concrete components designed for lake water cooling service. The system includes stop logs for isolation at the CCW pump intake and lake discharge points.

2.1.21 71240 Vacuum Priming System

The Vacuum Priming System consists of three vacuum priming pumps per unit, control tank, level controller, unloader valve, pressure relief valve, and shut-off valves, constructed mainly of steel components designed for air removal service. The system is mounted above the condenser water boxes with top and bottom tank connections, which facilitated air collection and removal through siphon action.

2.1.22 43100 Feedwater Heating System

The Feedwater Heating System consists of LP and HP feedwater heaters arranged in a regenerative heating cycle, extraction steam piping, drain cascading lines, and venting system components, constructed mainly of steel components designed for high-pressure feedwater and extraction steam service.

2.1.23 43200 Condensate and Boiler Feed System

The Condensate System consists of condensate pumps, deaerator storage tank, and associated piping to the Boiler Feed (BF) System, Main Boiler Feed (MBF) pump glands, and LP Cylinder Exhaust Cooling System, constructed mainly of mild steel components designed for treated water service. The Boiler Feed System consists of feed pumps and associated piping from the deaerator storage tank to the boilers, constructed mainly of steel components designed for high-pressure feedwater service.

2.1.24 71640 Chemical Feed System

The Boiler Chemical Feed System consists of three subsystems:

- Amine (Morpholine) Feed System consists of four sets (one per unit) of 250-gallon mixing tanks, portable motor-driven agitators, metering pumps, and associated piping, constructed mainly of chemical-resistant materials designed for pH control chemical service.
- Hydrazine Feed System consists of four sets (one per unit) of mixing tanks, portable motor-driven agitators, metering pumps, and associated piping, constructed mainly of chemical-resistant materials designed for oxygen scavenging chemical service.
- Phosphate Feed System (currently abandoned) consists of two sets of dual mixing tanks, portable motor-driven agitators, metering pumps, and associated piping,

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constructed mainly of chemical-resistant materials designed for phosphate chemical service.

2.1.25 77000 Oil Services

The Turbine and Generator Oil System consists of oil storage tanks, oil purification equipment, pumps, and waste disposal components, constructed mainly of steel components designed for lubricating oil service. The system was designed to provide essential lubrication and cooling for turbine and generator bearings, with oil treatment capabilities to maintain oil quality and proper system function.

2.1.26 58200 Compressed Air

The compressed air system consists primarily of stainless-steel piping and provides pneumatic power to operate air blast circuit breakers located in the switchyard.

2.2 Turbine Auxiliary Bay

The TAB is where the Turbine & Generator (TG) Auxiliary Systems and Electrical Distribution Buses were used to support the operation of the turbine-generator system during reactor operation. The following sections will provide more details on the associated systems.



Figure 2 Turbine Auxiliary Bay

2.2.1 45110 Sampling Circuit

The Steam and Water Sampling (SAWS) System consists of stainless-steel sampling tubing from the reheater drains, reheater drain pumps, and main steam boiler headers, with service water heat exchangers for sample cooling, constructed mainly of stainless-steel components designed for high-temperature sampling service.

2.2.2 45200 Drain Systems

The Turbine & Extraction Steam Drain System consists of drain lines and steam traps located at the turbine casing, steam lines, and associated equipment, constructed mainly of steel piping and components designed for condensate collection and removal service.

2.2.3 75100 Service Air Systems

The Service Air (SA) System, common to U1 - U4, consists of two air-cooled rotary screw compressors, four air receivers, and a main distribution header with valves for pneumatic tool

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connections, constructed mainly of galvanised steel piping and pressure vessels designed for compressed air service.

2.2.4 71000 Cooling Water Systems

2.2.4.1 71200 Condenser Cooling Water and 71240 Vacuum Priming System

The Condenser Cooling Water (CCW) System consists of dual parallel pumps per unit feeding a header, six condenser supply pipes, three discharge pipes, and a discharge duct, with associated vacuum priming system (three pumps, control tank and valves) constructed mainly of concrete and steel components designed for lake water service.

2.2.4.2 71310 Low Pressure Service Water System

The Low-Pressure Service Water (LPSW) System consists of three 30,000 USGPM (1,893 L/s) vertically mounted pumps, automatic backwashing strainers, distribution headers, and interconnecting piping constructed mainly of corrosion-resistant materials designed for lake water service.

2.2.4.3 71320 Recirculated Cooling Water

The Recirculated Cooling Water System consists of pumps, tanks and heat exchangers which provide cooling water to heat exchangers, pump bearings and continuous user equipment. The system is constructed primarily of steel components.

2.2.4.4 71340 High Pressure Service Water System

The High-Pressure Service Water (HPSW) System consists of two 100% capacity vertical centrifugal pumps (9,000 USGPM or 0.59L/s each), distribution headers, and associated piping constructed mainly of corrosion-resistant materials designed for lake water service.

2.2.4.5 71620 Demineralized Water Distribution System

The Demineralized Water Storage and Distribution System consists of storage tanks, centrifugal pumps, head tanks, and distribution piping constructed mainly of stainless steel and corrosion-resistant materials.

2.2.5 73010 Electric Boiler

The Electric Boiler System consists of boiler chemical feed pump, boiler recirc pumps, heating steam condensate and blowdown tanks and associated piping. The components in this system are constructed mainly of aluminum and copper.

2.2.6 64323 BFLP trip Instrumentation

The Boiler Feedline Low Pressure Instrumentation is used to monitor and detect the boiler level and pressure and is constructed mainly of steel.

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2.2.7 34130 Biological Shield Cooling

The expansion tank is located in the TAB and is connected to a common point on the return lines close to the pump suction header. This tank is constructed mainly of steel.

2.2.8 34110 Calandria End Shield Cooling

The expansion tank is located in the TAB since it is the closest point to the reactor building that provides a mounting location at an elevation above the top of the end shield return headers. This tank is constructed mainly of steel.

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3.0 CURRENT STATUS

Initial surveys and inventories have been completed, providing a detailed understanding of the structures, systems, and components within these buildings. This information forms the foundation for developing targeted decommissioning strategies.

This projected start date aligns with the decommissioning timeline discussed in the Program Overview DDP [R-1] and is contingent upon securing the necessary authorizations from regulatory bodies to ensure compliance with all applicable safety and environmental regulations. In preparation for the upcoming decommissioning activities, scoping surveys and Hazardous Building Material Assessments (HBMA's) are currently in progress.

4.0 DECOMMISSIONING WORK PACKAGES AND SAFETY ASSESSMENT

The PE-B scope is broken down into several work packages detailed below. Work package development is ongoing and will progress into work plans to support execution of the work. The development of work packages will follow the established procedures detailed in the Work Package Management section of the Program Overview [R-1].

The equipment and structures within the Turbine Hall (TH) and Turbine Auxiliary Bay (TAB) have been grouped into work packages based on location and elevation. The goal of each work package is to document the plan to remove all equipment from the work area and reach an interim end state. This includes any tanks, valves, pumps, motors, heat exchangers, instrumentation, and pipework. All material and equipment are planned to be processed and removed for recycling or disposal as waste. The interim and final-end state objectives are set out in the Program Overview DDP [R-1].

4.1 Occupational Dose Assessment

Anticipated occupational dose assessments have been conducted by Ontario Power Generation's (OPG) Responsible Health Physicist (RHP) for Planning Envelope B. Based on historical surveys and available data, the structures, systems, and components (SSCs) within this planning envelope are expected to present minimal radiological hazards.

4.2 Decommissioning Safety Assessment

A decommissioning safety assessment was performed in accordance with the methodology detailed in the Program Overview DDP [R-1] for each work package scope to systematically identify potential hazards and evaluate associated risks. The identified hazards and their corresponding mitigation measures have been discussed in the Safety Assessment Report [R-15]. The identified hazards and corresponding mitigation measures are summarized in the table below:

Hazard Category	Hazard/Events Description	Mitigation Measures
Radiological	Radiological hazard associated with tritium and contaminated crud in the tanks.	Compliance with OPG's Radiation Protection Program [R-3].
Environmental	None Identified	
Non-Radiological	Hot work hazards from cutting pipes and equipment	Compliance with OPG's Control of Ignition Sources And Hot Work Activities [R-17] and adequate Safe Work Planning and Pre-Job Briefing [R-10].
	Asbestos in gaskets, tiles, and insulation	Compliance with OPG's Asbestos management procedure [R-6].

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Hazard Category	Hazard/Events Description	Mitigation Measures
	Lead paint	Compliance with OPG's Management of Designated Substances procedure [R-7]
	Mercury in switches and sensors	Compliance with OPG's Management of Designated Substances procedure [R-7]
	Working at heights	Compliance with OPG's Working at Heights procedure [R-8] and adequate Safe Work Planning and Pre-Job Briefing [R-10].
	Falling objects	Compliance with OPG's Falling Material Control procedure [R-9] and adequate Safe Work Planning and Pre-Job Briefing [R-10].
	Heavy equipment traffic	Adequate Safe Work Planning and Pre-Job Briefing [R-10].
	Overhead hazards	Adequate Safe Work Planning and Pre-Job Briefing [R-10].
	Noise	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-5].
	Dust	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-5].
	Dangerous or faulty equipment	Adequate Safe Work Planning and Pre-Job Briefing [R-10].
	Adjacent steam lines from building heating	Adequate Safe Work Planning and Pre-Job Briefing [R-10].
	Algae, zebra mussels, decaying organic material	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-4] and adequate Safe Work Planning and Pre-Job Briefing [R-10]
	Adjacent sewage and mold	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-5] and adequate Safe Work Planning and Pre-Job Briefing [R-10]
	High voltages from working around live systems and cable trays	Adequate Safe Work Planning and Pre-Job Briefing [R-10].

Hazard Category	Hazard/Events Description	Mitigation Measures
	Pinch points	Adequate Safe Work Planning and Pre-Job Briefing [R-10].
	Flammable materials (e.g., residual oil in compressors and receivers)	Compliance with the Fire Protection Program [R-4].
Unexpected Event	Surveys find radiological material	Characterize the material as needed, cut out and remove following OPG Radiation Protection Program [R-3].

Table 1 Hazard Assessment with Mitigation Measures

4.3 Scoping and Characterization

A Historical Site Assessment (HSA) has been completed for PNGS. The HSA documents construction activities, historical operations, current use of the site, and potential, likely, and known sources of radioactive material and hazardous constituents. The HSA identifies the suspected or known contaminants, the site buildings and areas that are known or most likely to be impacted and the media most likely to be contaminated.

The turbine hall is divided into 3 elevations with a total of 108 Survey Units with a preliminary MARSSIM Classification of 1, and 19 Survey Units with a preliminary MARSSIM Classification of 2.

MARSSIM Class 1 indicates potential areas impacted with concentrations of residual radioactivity that may exceed the preliminary clearance levels.

MARSSIM Class 2 indicates potential impacted areas where concentrations of residual radioactivity are not expected to exceed the preliminary clearance levels.

The HSA identified that Pickering A leakage across the steam generator boundary has been slight and typically due to manufacturing defects. Additionally, the HSA concluded that it is unlikely to find fission products in the secondary side systems, due to their design.

Due to system classification and use, non-nuclear systems are assumed not to be contaminated, unless otherwise proven contaminated during scoping activities.

Radiological Scoping Survey: No scoping surveys have been completed for these systems.

Hazardous Materials Assessments: No hazardous materials assessments (HBMA) have been completed for these systems. However, OPG's Hazardous Materials Information System (HMIS) lists all known hazardous materials for a given area/system and will be referred to when planning turbine system hazardous material assessments and for identifying outstanding information.

Outstanding Activities: Outstanding scoping surveys and HBMA will be performed following the guidance discussed in the Program Overview DDP [R-1]. Any remaining gaps and

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uncertainty observed will have tailored mitigation plans developed as required. These activities are deliberately scheduled to coincide with the timing of execution utilizing a graded approach based-on complexity of the Work Package. Once completed, the reports will be filed in accordance with the records retention arrangements detailed in the Program Overview DDP [R-1].

4.4 Pre-Req Activities

Before any equipment is removed from the TH and TAB, the following activities shall be completed:

- Verification that the equipment is not required to support PNGS-A stabilization, safe storage, or decommissioning.
- Verification that the equipment is not required to support PNGS operations, including PNGS-B, IFB, or D2O storage at the time of removal.
- Verification that equipment has been end stated/separated and abandoned/retired.
- Confirmation of the As-Left condition and the work area has been turned over for decommissioning.
- If applicable, construction islands are setup around equipment to be removed.

NOTE

A standardized nomenclature system has been developed to uniquely identify and organize work packages throughout the decommissioning project. This system ensures consistent identification of work locations, groups, and sequences across all planning envelopes. For example, a Work Package ID of PE-B-1-225-1 is interpreted as follows:

- PE: Planning Envelope – Indicates that the work package is associated with a specific planning envelope within the decommissioning project.
- B: Planning Envelope B – Specifies the planning envelope to which the work package belongs.
- 1: Group 1 – Denotes the group or subcategory within the planning envelope, organizing work packages into manageable segments.
- 225: Elevation 225 – Identifies the floor/elevation where the work is to be performed within the station.
- 1: Work Package 1 – Identifies the sequence number of the work package within the group.

So, *PE-B-1-225-1* means: Planning Envelope: B, Group: 1, Elevation:225, Work Package: 1

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4.5 Group B-1: Turbine Hall

Any SSC needed to support SWS activities are detailed in the SWS plan [R-2] and will not be removed at this time. Systems such as fire protection, service water, and electrical are needed to be in operations and will be retired when no longer required.

Table 2 summarizes the work packages in the TH and the associated equipment in each one.

Group	Elevation	ID	Work Package Description	List of Equipment
B-1	225	1	Service Air System Area	Switchyard Service Air Dryers
				Service Air Compressors
				Service Air Receivers
				Switchyard Service Air Compressors
				Switchyard Service Air Receivers
		2	CCW Lines	CCW Lines
		3	Reheat / Return Area	Emergency Hotwell Make-up Valves
				Transformer Oil Water Separator
		4	Heater Drains Pump Area	Reheat Return Pumps and Pipework
	254	1	Lube and Seal Oil Pump Area	Lube Oil HX and Filter
				Oil Purifier
				Seal Oil Heat Exchangers
				Condenser Air Extraction Accumulators
				Condenser Air Extraction Silencers/Separator
				Condenser Air Extraction Vacuum Pumps
				Vacuum Priming Pump

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Group	Elevation	ID	Work Package Description	List of Equipment
				Vacuum Priming Pump Silencer
				Condensate Extraction Pumps Just below 254'
		2	Condensate Pump Area - Lower Half	Feed Train (Cond and Boiler Feed) Isolating Valves 254'
		3	Steam Release Valve Area	Feed Train (Cond and Boiler Feed) Isolating Valves 254'
				LP Feed Heaters 254'
				Release Valve
				Feed Train (Boiler Feed) Isolating Valves 254'
		4	Hydrogen and Stator Cooling	Generator H2 Cooling Dryer
				Jacking Oil Pump
				Feed Train (Condensate extraction) Isolating Valves 254'
				Stator Cooling Detraining Tank
				Stator Cooling Filters and Strainers
				Stator Cooling Heat Exchangers
				Stator Cooling Pumps
		5	Reheater Drain Tank Area	Reheater Drains Tank
				Feed Train (Cond and Boiler Feed) Isolating Valves 254'
		6	Boiler Feed Pump Area	Boiler Feed Pumps
				Instrument Air Compressors
				Instrument Air Dryers
				Instrument Air Receivers
		7	HP Feed Heaters	HP Feed Heaters 254

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Group	Elevation	ID	Work Package Description	List of Equipment
	274			Feed Train (Cond and Boiler Feed) Isolating Valves 254'
		1	Isolate Phase Bus Cooling Area	Isolated Phase Bus cooling fan
				Isolated phase bus cooling HX/ACU
		2	Heater Withdrawal Area	Isolated phase Bus
				Vacuum Priming Tank
		3	LP Feed heaters	Feed Train (Cond and Boiler Feed) Isolating Valves 274'
				LP Feed heaters 274
				Shutdown Air Circulation Fans
		4	Boiler Feed Pump Valve Area	Boiler Stop Valves
		5	Separator Tank Area	No Major Equipment
		6	Steam Reheaters	Reheaters
		7	Condensate Pump Area - Upper half	Gland Condenser
		8	Moisture Separators	Moisture Separators
		9	Condensers	Turbine Condenser Tube Cleaning Tanks/feeder/soaker
				CCW Water Box Isolators
				Condensers (and water boxes)
				Turbine Condenser Tube Cleaning Tanks/feeder/soaker
	294	1	Lube and Seal Oil Pump Area	Shaft Driven Oil Pump
				Lube Oil AC, DC and booster Pump and Seal Oil Pumps
				Main Lube Oil Tank (In pit below floor level)

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Group	Elevation	ID	Work Package Description	List of Equipment
		2	Exciter and Generator	Exciter (Including Brush Gear)
				Generator
		3	LP Turbines	LP Turbine
				Intercept Valves
				Steam Lines
		4	HP Turbine	HP Turbine
		5	Steam Chest	Steam Chest

Table 2 TH Work Packages and Associated Equipment

Building lighting, ventilation, firewater and communication systems and structural foundations will not be removed to support SWS activities as the TH building will not be demolished immediately.

Cable trays were not included in the scope of work due to the extensive effort required to separate inactive and active cables. These cable trays will be addressed during the demolition of the powerhouse structure as part of Planning Envelope E (PE-E).

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4.5.1 Elevation 225 Work Package Details



Figure 3 TH 225 Elevation

4.5.1.1 PE-B-1-225-1 Work Package #1 Switch Yard Air System

This work package details the steps needed to remove 58200 Compressed Air equipment from the 225 ft elevation. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Complete characterization of the work area to identify and document any hazards.
- Remediate any identified hazards.
- Disconnect all equipment.
- Transport equipment to the loading bay at the 254 ft elevation.
- Survey equipment and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

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Electrical connections will be cut and removed back to the nearest cable tray or access point and abandoned in place, ensuring all electrical isolations are performed safely per the interim end state described for PE-B [R-1].

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4.5.1.2 PE-B-1-225-2 Work Package #2 Condenser Cooling Water Lines

This work package details the steps needed to remove cooling water lines from the 71210 Condenser Cooling Water (CCW) Supply System at 225 ft elevation. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Complete characterization of the work area to identify and document any hazards.
- Remediate any identified hazards.
- Support CCW lines from the existing structure.
- Segment CCW lines and lower to the floor.
- Further segment into smaller pieces for transport to the hatchway.
- Lift segmented pieces to the 254 ft elevation.
- Survey equipment and place into appropriate waste containers or load onto trucks for disposal.

Work Package Closeout

CCW pipework removed to access points and capped per interim end state described for PE-B [R-1].

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4.5.1.3 PE-B-1-225-3 Work Package #3 Reheat Return Pumps and Pipework

This work package details the steps needed to remove components of the 41130 Live Steam Reheat System, including reheat return pumps, drain tanks, and associated pipework from the east side of the 225 ft elevation, including disconnection, transport, and disposal. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Complete characterization of the work area to identify and document any hazards.
- Remediate any identified hazards.
- Remove temporary scaffolding surrounding the equipment.
- Disconnect pumps from existing connections.
- Load pumps onto an interim cart for transportation to the 225 ft access hatchway.
- Lift pumps to the 254 ft elevation.
- Survey equipment and place into appropriate waste containers or load onto trucks for disposal.

Work Package Closeout

Remove any remaining pipework and existing electrical supply to the access point per the interim end state described for PE-B [R-1].

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4.5.1.4 PE-B-1-225-4 Work Package #4 Heater Drains Pumps

The heater drains pumps, which are part of the 43100 Feedwater Heating System, are located south of the condenser inlet pipes on the 225 ft elevation.

Equipment Removal

- Complete characterization of the work area to identify and document any hazards.
- Remediate any identified hazards.
- Disconnect pumps from existing connections.
- Load pumps onto an interim cart for transportation to the 225 ft access hatchway.
- Lift pumps to the 254 ft elevation.
- Survey equipment and place into appropriate waste containers or load onto trucks for disposal.

Work Package Closeout

Remove any remaining pipework and existing electrical supply to the access point per the interim end state described for PE-B [R-1].

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4.5.2 Elevation 254 Work Package Details



Figure 4 TH 254 Elevation

4.5.2.1 PE-B-1-254-1 Work Package #1 Lube and Seal Oil Pump Area

This work package details the steps needed to remove equipment from the 77000 Oil Services and 41250 Seal Oil System pump area. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- (a) Complete characterization of the work area to identify and document any hazards.
- (b) Remediate any identified hazards.
- (c) Seal Oil Heat Exchangers:
 - Clear work area by removing miscellaneous piping and access platforms.
 - Hoist heat exchangers using temporary lifting equipment (e.g., grove crane).
 - Disconnect heat exchangers from remaining connections.
 - Transport heat exchangers to loading bay for final survey and disposal.

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(d) Vacuum Priming Pumps:

- Remove connections to pumps and silencers via segmentation.
- Disconnect pumps and silencers from floor mounts.
- Hoist equipment onto interim cart/buggy for transport to loading bay doors.
- Survey equipment and place onto truck bed for disposal.

(e) Lube Oil Heat Exchangers/Filters:

- Remove connections and surrounding pipework from heat exchangers.
- Remove interfering steel work.
- Hoist and remove heat exchangers one at a time, placing on cart for transport to turbine loading bay.
- Survey equipment and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

Clear work area of peripheral piping via segmentation per the interim end state described for PE-B [R-1].

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4.5.2.2 PE-B-1-254-2 Work Package #2 Condensate Extraction Pump Area

This work package details the steps needed to remove condensate extraction pumps and associated equipment from the 43200 Condensate and Boiler Feed System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(a) Condensate Extraction Pumps

- Clear work area by removing miscellaneous piping (e.g., common service cooling lines) via segmentation.
- Disconnect/segment pipework and valves from remaining connections.
- Hoist or lift equipment onto carts for transport.
- Transport valves and pipework to loading bay for final survey and disposal.

(b) Equipment Below Grating

- Remove equipment above grating.
- Create removal area by increasing existing access points, removing grating above pumps at 254 ft elevation.
- Isolate connection points via segmentation.
- Hoist equipment with temporary lifting equipment or portable crane.
- Separate motor from pump (5000lbs each) and lift to 254 ft elevation, place on cart for transport.
- Lift motor pump bowl out of well (large 4-stage pumps) and place on cart.
- Segment pipework and remaining equipment around pumps and hoist to 254 ft elevation for transport.
- Transport equipment to loading bay doors on interim cart/buggy.
- Survey equipment and place onto truck bed for disposal.

Work Package Closeout

Segment and remove any remaining pipework and peripheral equipment per the interim end state described for PE-B [R-1].

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4.5.2.3 PE-B-1-254-3 Work Package #3 Steam Release Valve Area

This work package details the steps needed to remove steam release valves and associated equipment from the 43110 Extraction Steam System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Clear work area by removing miscellaneous piping (e.g., common service cooling lines) via segmentation.
- Disconnect valves from remaining connections.
- Set up scaffolding to begin segmentation of pipework.
- Provide temporary support for extraction steam lines during segmentation and lower to floor level.
- Transport valves and segmented pipework on cart/buggy to loading bay doors.
- Disconnect pipework from LP feed heaters.
- Lift feed heaters from pedestals and attach wheels or place on cart for transport to turbine loading bay.

Work Package Closeout

Survey all removed equipment per the interim end state described for PE-B [R-1].

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4.5.2.4 PE-B-1-254-4 Work Package #4 Hydrogen Cooling and Stator Cooling

This work package details the steps needed to remove 41230 Hydrogen Cooling System and 41240 Stator Cooling System equipment. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Disconnect major equipment from remaining instrumentation.
- Systematically remove larger equipment such as valves, instrumentation, control panels, etc.
- Remove remaining pipework in segments to the access point to the next elevation.
- Roll back any electrical supplies or signals to the nearest cable tray.

Work Package Closeout

Transport waste to the loading bay for final survey and disposal and clean up work area per the interim end state described for PE-B [R-1].

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4.5.2.5 PE-B-1-254-5 Work Package #5 Re-heater Drain Tank

This work package details the steps needed to remove the re-heater drain tank and associated equipment from the 41130 Live Steam Reheat System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Clear work area by removing miscellaneous piping via segmentation.
- Disconnect tank from any remaining connections.
- Set up scaffolding to begin segmentation of pipework.
- Transport tank and segmented pipework on cart/buggy to loading bay doors.

Work Package Closeout

Survey all removed equipment per the interim end state described for PE-B [R-1].

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4.5.2.6 PE-B-1-254-6 Work Package #6 Boiler Feed Pumps Area

Location

This work package details the steps needed to remove boiler feed pumps and associated equipment from the 43200 Condensate and Boiler Feed System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Clear work area by removing miscellaneous piping via segmentation.
- Disconnect pumps from any remaining connections.
- Set up scaffolding to begin segmentation of pipework.
- Disassemble Boiler Feed Pumps into components:
 - Top casing (approximately 2000 lb)
 - Rotating element (approximately 1400 lb)
 - Bottom casing (estimated 3000 lb due to pipework connections)
 - Transport disassembled pump components and segmented pipework on cart/buggy to loading bay doors.

Work Package Closeout

Survey all removed equipment per the interim end state described for PE-B [R-1].

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4.5.2.7 PE-B-1-254-7 Work Package #7 High Pressure Feed Heaters

This work package details the steps needed to remove HP heat exchangers and associated equipment from the 43100 Feedwater Heating System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(c) Heat Exchangers

- Clear work area of existing scaffolding or obstructions.
- Sever all connections from the heat exchangers.
- Hoist heat exchangers from existing mounting pedestals using floor jacks.
- Push or tow heat exchangers to the main corridor for internal transport to the TH loading bay.
- Survey heat exchangers for surface/internal contamination.
- Survey equipment and place into appropriate waste containers or load onto truck beds for disposal.

(d) Piping and Miscellaneous Equipment

- Rig, lift, and segment existing piping into pieces.
- Transport segmented piping using interim cart, dolly, or forklift to the loading bay.
- Remove pipework up to the point where it can no longer be accessed via the 254 ft elevation.
- Roll back existing cables to originating cable trays (cable trays to be left abandoned in place).
- Remove miscellaneous instrumentation lines, smaller valves, and pumps in bulk.
- Remove non-structural scaffolding or temporary platforms.
- Survey piping and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

Remove miscellaneous inactive equipment, cover floor openings, and temporarily cap open pipework per the interim end state described for PE-B [R-1].

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4.5.3 Elevation 274 Work Package Details

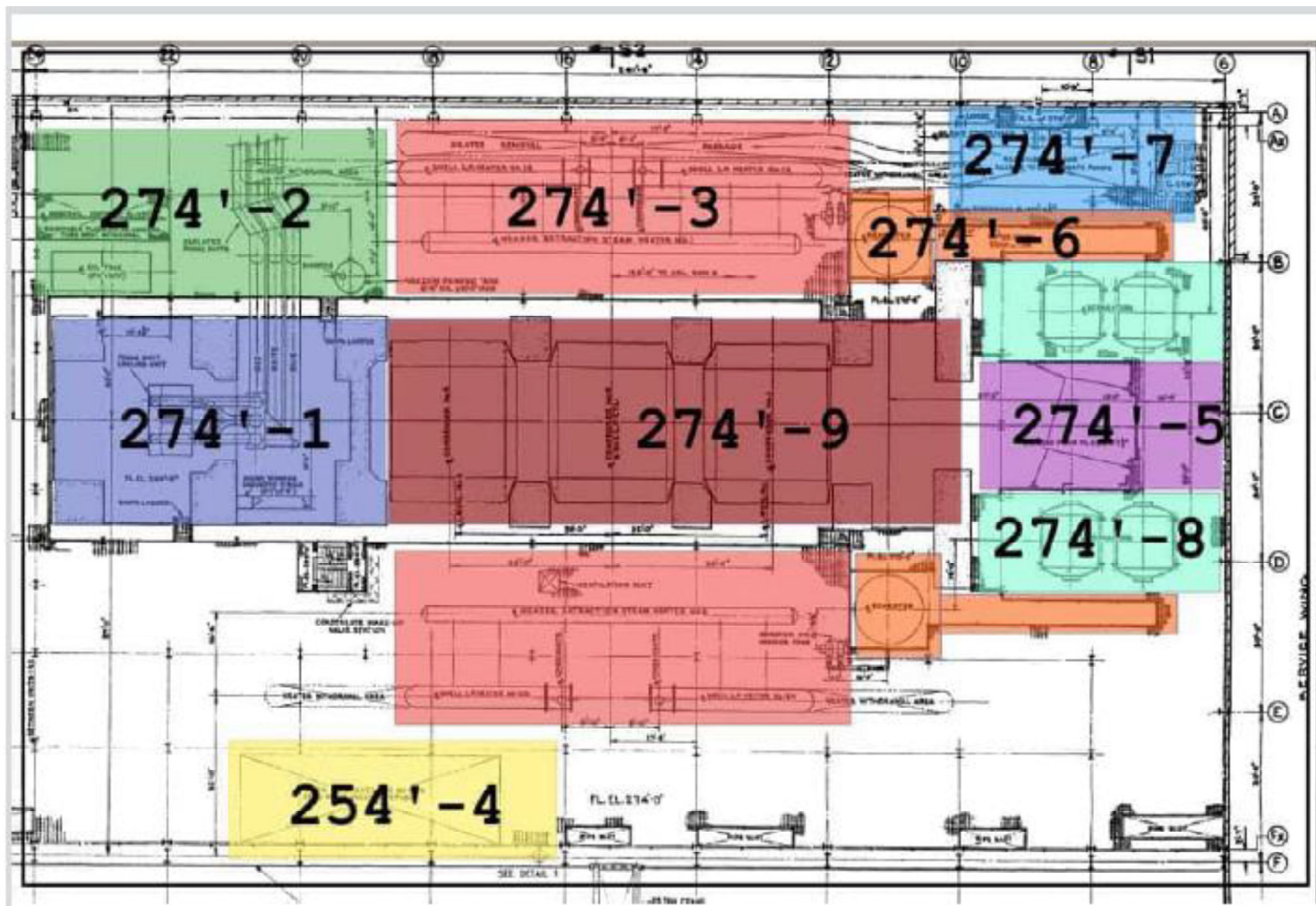


Figure 5 TH 274 Elevation

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4.5.3.1 PE-B-1-274-1 Work Package #1 Isolated Phase Bus Cooling Area

This work package details the steps needed to remove fans and cooling units that support the Isolated Phase Bus (IPB), which in turn links the 41200/41210 Generator to both the main and generator service transformers. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Disconnect fans and heaters from dampers and MCC connections.
- Roll back inactive electrical connections to nearest cable tray or access point.
- Remove miscellaneous instrumentation as bulk waste.
- Remove connections to common service water and other peripheral pipework up to access point and temporarily cap.
- Disconnect and lift equipment located below the generator on the turbine pedestal to the 274 ft elevation.
- Lower equipment through opened hatchway to the 254 ft elevation for transport to turbine loading bay.
- Survey equipment and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

Clean work area per the interim end state described for PE-B [R-1].

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4.5.3.2 PE-B-1-274-2 Work Package #2 Heater Withdrawal Area

This work package details the steps needed to remove the 71240 Vacuum Priming System tank, IPBs and associated equipment. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(e) Vacuum Priming Tank

- Segment and remove insulation from the tank.
- Isolate and disconnect all connections to valves and the main connection between the tank and Condenser (CD1).
- Disconnect and remove all pump connections and associated piping.
- Suspend the tank (weight: 3419 lbs) and remove supports.
- Lower the tank through 274 ft elevation to 254 ft elevation using a crane.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(f) Isolated Phase Buses:

- Segment and remove isolated phase buses extending through this zone.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(g) Miscellaneous Equipment

- Roll back inactive electrical connections to nearest cable tray or access point.
- Remove miscellaneous instrumentation as bulk waste.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

Transport all disconnected equipment through the hatchway to the 254 ft loading bay and clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.3.3 PE-B-1-274-3 Work Package #3 LP Feed Heaters Area

This work package details the steps needed to remove LP feed heaters and steam equipment from the 43100 Feedwater Heating System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(a) LP Feed Heaters

- Disconnect connections to extraction steam, condensate/feed water, drains, and instrumentation.
- Move feed heaters on wheels along the track to the removable floor area.
- Lower feed heaters to 254 ft elevation for transport to the turbine loading bay.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(b) Extraction Steam Headers

- Segment extraction steam headers.
- Lower segmented parts to 254 ft elevation.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(c) Steam Supply to LP Turbine

- Support and segment steam supply from the re-heater.
- Lower segmented parts to 254 ft elevation for transport to the turbine loading bay.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(d) Miscellaneous Equipment

- Roll back inactive electrical connections to nearest cable tray or access point.
- Remove miscellaneous instrumentation as bulk waste.
- Remove and temporarily cap connections to common service water and other peripheral pipework.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

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Work Package Closeout

Transport all disconnected equipment through the hatchway to the 254 ft loading bay and clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.3.4 PE-B-1-274-4 Work Package #4 Boiler feed Pump Valve Area

This work package details the steps needed to remove boiler feed pump valves and associated equipment from the 43200 Condensate and Boiler Feed System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(a) Boiler Feed Pump Discharge Pipework

- Segment connections to valves and lines as required.
- Remove sufficient grating and lower components.
- Lower segmented parts to 254 ft elevation for transport to the turbine loading bay.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(b) Motorized Valves and Suction Pipework

- Disconnect and segment as necessary.
- Lower to 254 ft elevation through openings in the grating.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(c) Miscellaneous Equipment

- Roll back inactive electrical connections to nearest cable tray or access point.
- Remove miscellaneous instrumentation as bulk waste.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

Transport all disconnected equipment through the hatchway to the 254 ft loading bay and clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.3.5 PE-B-1-274-5 Work Package #5 Ladder Area between Separators

This work package details the steps needed to remove boiler stop valves and steam header equipment located between the separators, part of the 41120 Moisture Separation System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(a) Boiler Stop Valves and Other Valves

- Support the equipment.
- Perform disconnections.
- Lower equipment to cart on 254 ft elevation for transport.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(b) Main Steam Balance Header and Connecting Pipework

- Support the equipment.
- Disconnect and segment as necessary.
- Lower to 254 ft elevation through the hatchway.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(c) Miscellaneous Equipment

- Roll back inactive electrical connections to nearest cable tray or access point.
- Remove miscellaneous instrumentation as bulk waste.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

Transport all disconnected equipment through the hatchway to the 254 ft loading bay and clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.3.6 PE-B-1-274-6 Work Package #6 Re-heaters Area

This work package details the steps needed to remove re-heaters and associated equipment from the 41120 Moisture Separation System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(a) Reheaters and Separators

- Disconnect all connections to valves and separators.
- Remove flooring up to the reheaters.
- Lift reheaters through the opening in 294 ft elevation for transport to loading bay.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(b) Steam Lines and Associated Pipework

- Cut steam line connections, providing temporary support as needed.
- Segment associated pipework prior to transfer to the hatchway.
- Lift steam lines from reheater to separators through the same opening as reheaters.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(c) Miscellaneous Equipment

- Remove miscellaneous instrumentation as bulk waste.
- Lower smaller equipment to 254 ft elevation for transport to the loading bay.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

Survey smaller equipment and place into waste containers or load onto truck bed for disposal per the interim end state described for PE-B [R-1].

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4.5.3.7 PE-B-1-274-7 Work Package #7 Condenser Area

This work package details the steps needed to remove condenser equipment from 42110 Main Condenser. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(a) Gland Condenser and Large Equipment

- Disconnect all connections.
- Segment equipment into smaller pieces for transportation.
- Lower segmented pieces through the hatchway to the 254 ft elevation.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(b) Condensate Pumps

- Remove floor sections to access the condensate pumps.
- Disconnect and remove pumps, potentially using the floor openings for removal.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(c) Miscellaneous Equipment

- Roll back inactive electrical connections to nearest cable tray or access point.
- Remove miscellaneous instrumentation as bulk waste.
- Remove and temporarily cap connections to common service water and other peripheral pipework up to the access point.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

Transport all disconnected equipment through the hatchway to the 254 ft loading bay and clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.3.8 PE-B-1-274-8 Work Package #8 Moisture Separator Area

This work package details the steps needed to remove moisture separators and associated equipment from the 41120 Moisture Separation System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(a) Moisture Separators (4)

- Remove floor gratings to access the moisture separators.
- Support and disconnect steam lines in and out of the moisture separators.
- Lift separators (approximately 54,000 lbs each) using the TH crane.
- Transport separators to the loading bay via crane and place on trailer for offsite transport.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(b) Large Steam Lines

- Lift large steam lines through the opening used for the separators.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

(c) Miscellaneous Equipment

- Roll back inactive electrical connections to nearest cable tray or access point.
- Remove miscellaneous instrumentation as bulk waste.
- Remove and temporarily cap connections to common service water and other peripheral pipework up to the access point.
- Perform surveys and place into appropriate waste containers or load onto truck beds for disposal.

Work Package Closeout

Survey tanks and place into waste containers or load onto truck bed for disposal and clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.3.9 PE-B-1-274-9 Work Package #9 Condensers

This work package details the steps needed to remove 42110 Main Condenser. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Remove instrumentation.
 - Disconnect and remove peripheral piping (CCW Lines, Boiler Steam Lines, Steam Release Lines).
 - Roll back inactive electrical connections to nearest cable tray or access point.
 - Remove and temporarily cap peripheral pipework up to the access point.
- (a) Condenser Removal Options
- (1) Large Section Removal
- Cut condensers into 4 sections (as originally installed).
 - Use the main crane to lift out sections.
 - Transport sections to loading bay for final survey and disposal.
- (2) Piece-by-Piece Removal
- Cut out inside supports for the condensers.
 - Cut condensers into smaller pieces, allowing them to drop into the center of the hot-well.
 - Use portable crane or forklift from 254 ft elevation to lift pieces onto a cart.
 - Transport sections to loading bay for final survey and disposal.
- (b) Water Boxes, Condenser Components, and Cleaning Ball Collector/Tanks
- Hoist equipment using overhead lifting rail.
 - Disconnect from remaining supports and connections.
 - Lift components for final survey and disposal.

Work Package Closeout

Clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.4 Elevation 294 Work Package Details

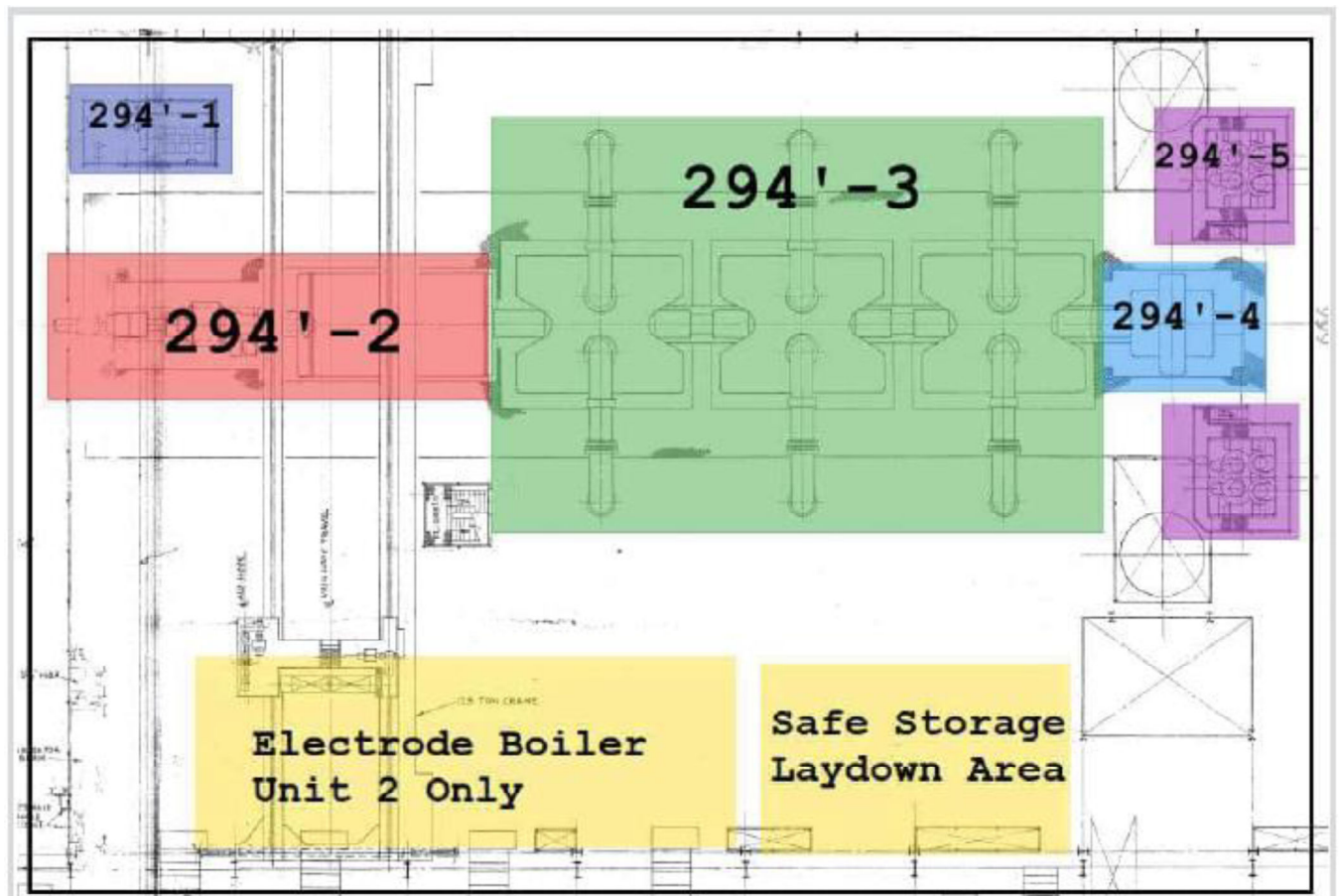


Figure 6 TH 294 Elevation

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4.5.4.1 PE-B-1-294-1 Work Package #1 Lube and Seal Oil Pump Area

This work package details the steps needed to remove lube and seal oil pump equipment from the 77000 Oil Services and 41250 Seal Oil System respectively. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Separate work area from electrical equipment and ventilation units on the north side of the station.
- Roll back inactive electrical connections to nearest cable tray or access point.
- Remove miscellaneous instrumentation as bulk waste.
- Remove and temporarily cap peripheral pipework up to the access point.
- Hoist pumps from the pit using the TH Crane or a portable crane.
- Disconnect pumps from mountings on top of the turbine lube oil tank.
- Lower equipment to the 254 ft loading bay using the appropriate crane.
- Disconnect connections to the main lube oil tank.
- Use the TH crane to lift out the tank.
- Lower the tank to the turbine loading bay for transport.
- Move smaller equipment via trolley to the access hatchway, perform final surveys.

Work Package Closeout

Clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.4.2 PE-B-1-294-2 Work Package #2 Generator and Exciter

This work package details the steps needed to remove the 41200/41210 Generator and 41220 Excitation equipment. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(a) Exciter Removal

- Remove main exciter coolers and associated piping (approx. 5000 lbs each).
- Remove turning gear cover (approx. 4000 lbs, offset center of gravity).
- Remove top half of bearing and exciter brush gear.
- Disassemble and remove main exciter (rotor approx. 7 tons, stator casing + rotor approx. 17 tons).

(b) Generator Rotor Removal

- Remove generator rotor (approx. 143 tons) following the established procedure for generator rotor removal [R-14].

(c) Generator Stator and Casing Removal

- Remove hydrogen coolers from generator casing.
- Remove hold down bolts, covering steel floor plates, and resistance columns (12).
- Remove all electrical and mechanical connections.
- Lift generator using series of alternating lifts (max 1" offset at any point).
- Install support stools onto stator core.
- Jack out stator core approx. 4 ft.
- Hoist stator core (approx. 225 tons) using both TH cranes and transport to laydown area.
- Hoist and transport generator casing to laydown area and perform surveys.

Work Package Closeout

Clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.4.3 PE-B-1-294-3 Work Package #3 Lower Pressure Turbines and Steam Lines

This work package details the steps needed to remove LP turbines and steam lines from the 41100 Turbine. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

(a) Main Intercept Valves

- Remove insulation and instrumentation.
- Hoist valves using TH crane.
- Segment valves from main steam lines.
- Lift and lower valves to 254 ft loading bay for final survey and disposal.

(b) Main Steam Lines

- Systematically hoist, segment, and lift main steam lines.
- Use TH crane to lower segments to 254 ft loading bay for survey and disposal.

(c) LP Turbine

- Remove instrumentation and obstructions.
- Remove LP top half outer shell (exhaust hood in 3 pieces) and miscellaneous housing and turbine casings.
- Remove LP Rotor.
- Remove LP lower half turbine casing, outer shell remaining housing, and deck plates.
- Separate the lower half of the turbine exhaust cover from the condensers.
- Use TH crane to lower segments to 254 ft loading bay for survey and disposal.

Work Package Closeout

Clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.4.4 PE-B-1-294-4 Work Package #4 High Pressure Turbine

This work package details the steps needed to remove the HP turbine from the 41100 Turbine system. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- (a) HP Turbine Outer Cylinder Removal
 - Remove HP turbine cladding.
 - Remove HP joint insulation.
 - Remove inlet pipe support.
 - Remove HP four outer covers access doors.
 - Remove HP half joints.
 - Lift HP outer cylinder using TH crane.
- (b) HP Turbine Internal Components
 - Systematically remove internal components.
 - Transport removed components to the loading bay for disposal.
- (c) HP Turbine Bottom Half
 - Remove remaining bottom half of the HP turbine casing.
 - Transport to loading bay for disposal.

Work Package Closeout

Clean work area and clearly mark any identified hazards per the interim end state described for PE-B [R-1].

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4.5.4.5 PE-B-1-294-5 Work Package #5 Steam Chest

This work package details the steps needed to remove the steam chest and associated equipment from 41150 Turbine Gland Steam System. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Remove any steel work that will interfere with removal.
- Remove instrumentation and isolation components.
- Hoist main valves using TH Crane.
- Disconnect valves from main steam lines.
- Lift valves using TH Crane and transport to the loading bay for survey and disposal.
- Disconnect steam chest from remaining connections.
- Lift steam chest using TH Crane and transport to the loading bay for survey and disposal.

Work Package Closeout

Clean up area and make safe per the interim end state described for PE-B [R-1].

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4.6 Group B-2: Turbine Auxiliary Bay

The layout of the SSCs contained in group B-2 varies slightly from group B-1 as illustrated in Figure 8 - Figure 12 below and Table 3 summarizes the work packages and the associated equipment in each one.

Group	Elevation	ID	Work Package Description	List of Equipment
B-2	254	1	Service Water Pumps	LP Service Water Pumps including strainers, valves, and discharge headers
	278	1	Piping from Electric Boiler Condensate Pumps	Piping Electric Boiler Condensate Pumps
	294	1	Condensate and steam equipment	Electric Boiler air compressors
				Electric Boiler chemical feed pump
				Electric Boiler recirc pump
				Service water to Heating Steam Condensate tank
				Misc. Piping
				Heat Exchanger Relief Valve
				Heater Drains
				Cascade drains
		2	Heating steam tanks	Heating Steam Boiler Condensate tank
				Heating Steam Boiler Blowdown tank
	317	1	Heat exchangers, piping, and tanks	Feedwater Sampling Station
				Stator Cooling Head tank
				LP Heaters including piping and vent lines
				Misc. Piping
		2	Head Tanks (potentially contaminated)	Biological Shield Head Tank
				End Shield Cooling Head tank

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Group	Elevation	ID	Work Package Description	List of Equipment
	339	3	Chemical Addition Tanks	Chemical Addition Tanks
		1	Deaerator and associated equipment	Condensate Storage tank including all inlet and outlet piping reject and make up valves, de-aerator, DA storage tank, and associated piping
				Recirc Cooling Head Tank
				Boiler Feed Lines and valve station
		2	Instrumentation	BFLP Trip Instrumentation

Table 3 TAB Work Packages and Associated Equipment

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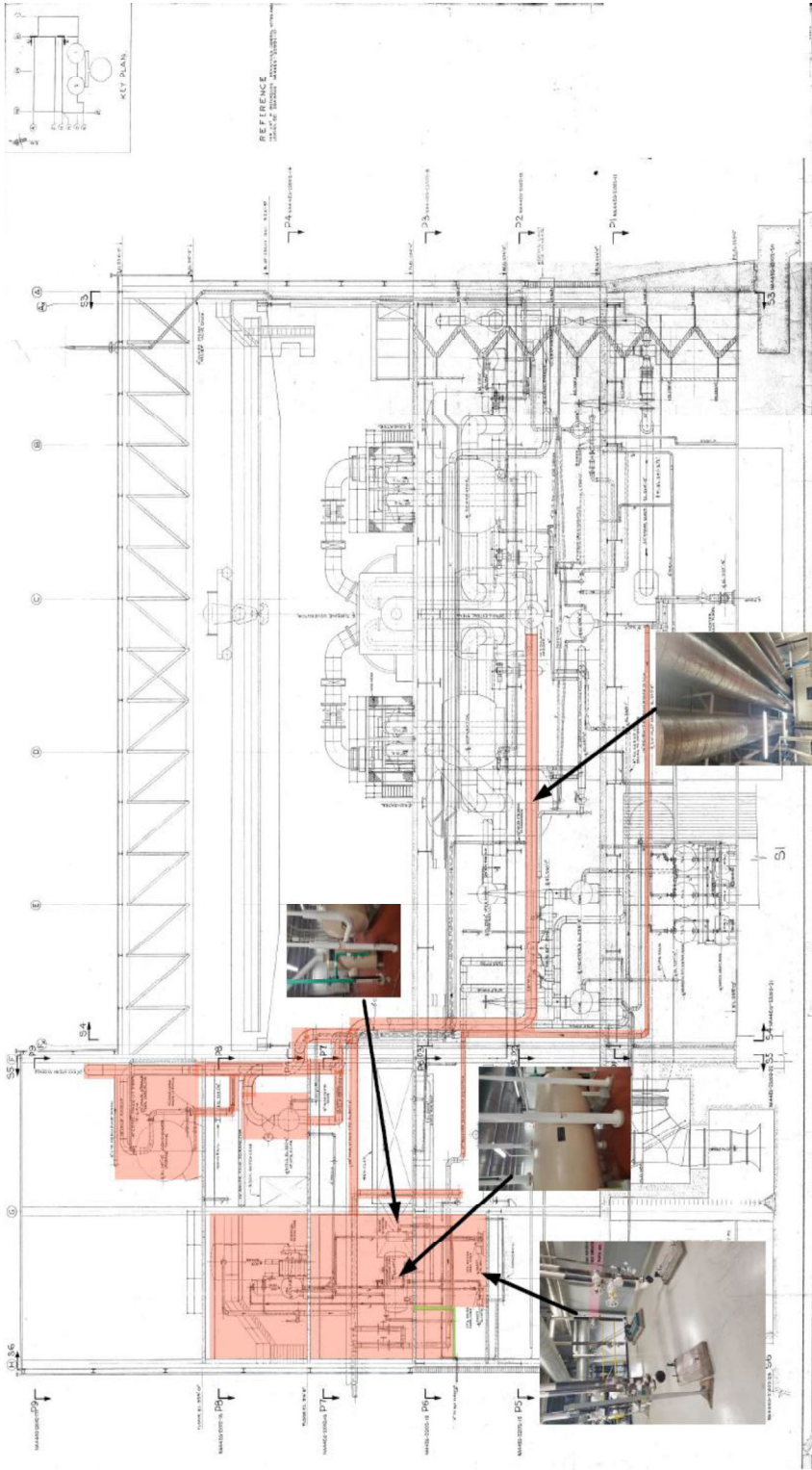


Figure 7 TAB Unit 1 Plant Arrangement - Elevations 254 to 339

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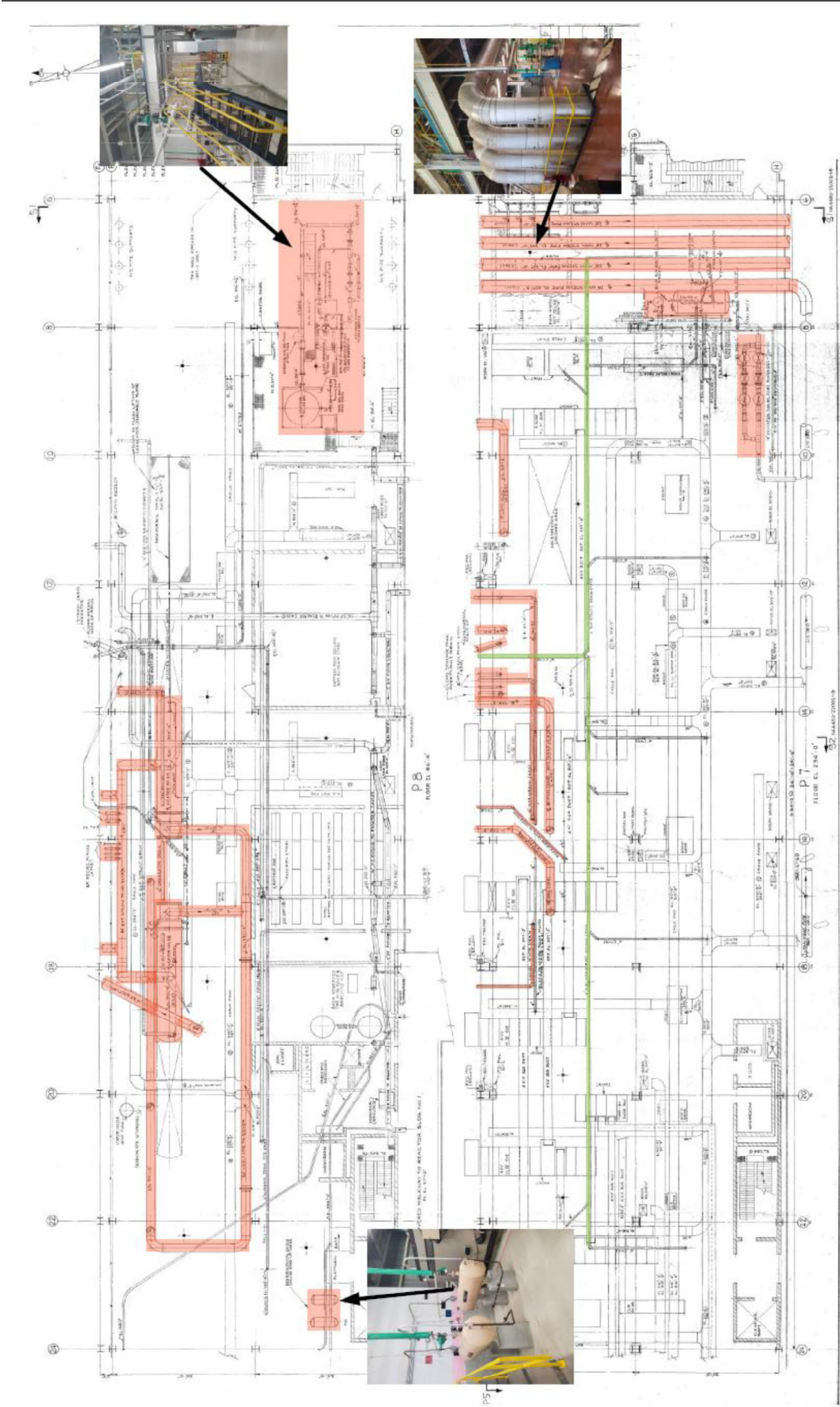


Figure 9 TAB Elevation 294 and 317

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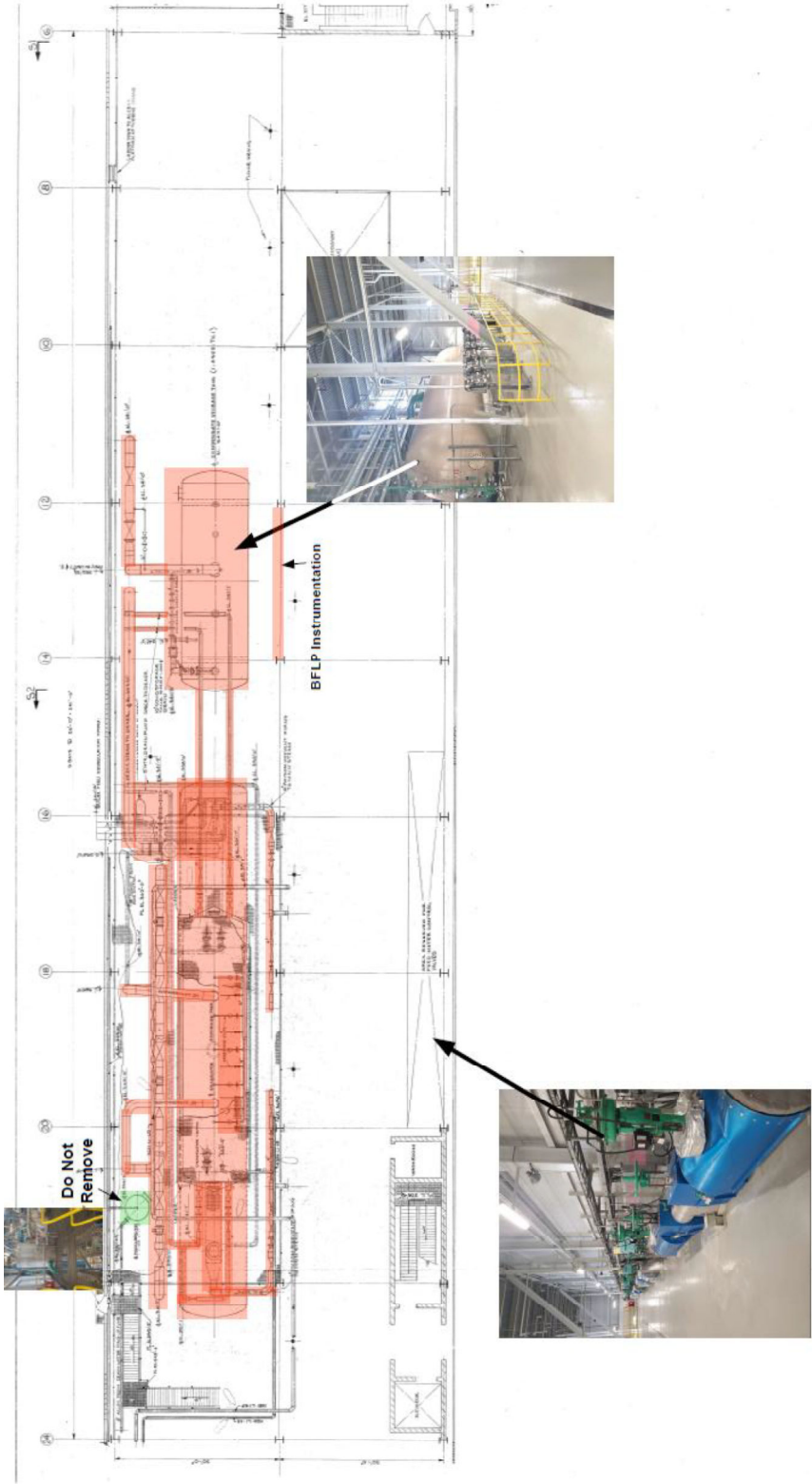


Figure 11 TAB Unit 1 Elevation 339

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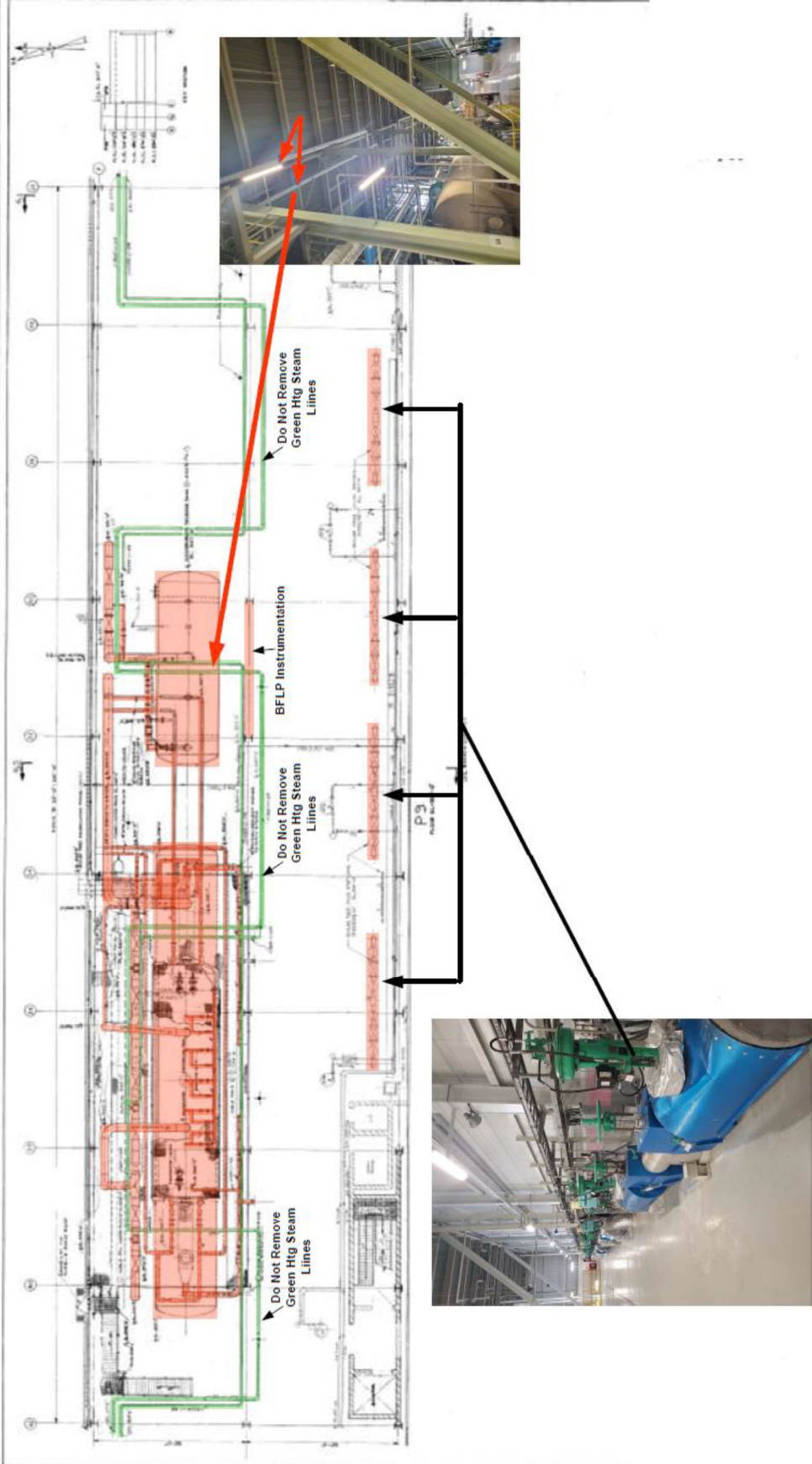


Figure 12 TAB Unit 2 Elevation 339

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Building lighting, ventilation, firewater and communication systems and structural foundations will not be removed to support day-to-day operations as the TH building will not be demolished. Cable trays were not included in the scope of work and thus will not be removed due to the extensive effort required to separate inactive and active cables.

4.6.1 Elevation 278 Work Package Details

4.6.1.1 PE-B-2-278-1 Work Package #1 Piping from Electric Boiler Condensate Pumps

This work package details the steps needed to remove components of the 73010 Electric Boiler System, including pipework and valves from the electric boiler condensate pumps. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Disconnect and segment pipework and valves from all remaining connections, ensuring all systems are properly isolated and de-energized.
- Transport valves and pipework to the loading bay for final survey and disposal.
- Survey equipment in accordance with established procedures to confirm the absence of radiological contamination.
- Place equipment onto truck beds for disposal, following all waste management protocols and transportation regulations.

Work Package Closeout

- Electrical connections will be cut and removed back to the nearest cable tray or access point and abandoned in place, ensuring compliance with electrical safety procedures per the interim end state described for PE-B [R-1].
- Temporarily cap all open pipe ends as necessary to maintain safety and environmental controls per the interim end state described for PE-B [R-1].

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4.6.2 Elevation 294 Work Package Details

4.6.2.1 PE-B-2-294-1 Work Package #1 Condensate and Steam Equipment

This work package details the steps needed to remove components of the 43200 Condensate and Boiler Feed System, including pumps, compressors, and associated pipework from the 294 ft elevation. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Clear the work area to access the pumps and compressors by removing any obstructing miscellaneous piping.
- Disconnect and segment pipework and valves from any remaining connections, ensuring all systems are properly isolated.
- Hoist or lift equipment onto carts or buggies for transport using appropriate lifting equipment and techniques.
- Transport valves and pipework to the loading bay for final survey and disposal.
- Hoist pumps and compressors onto interim carts or buggies for transport to the loading bay doors.
- Survey equipment in accordance with established procedures to confirm the absence of radiological contamination.
- Place equipment onto truck beds for disposal, following all waste management protocols and transportation regulations.

Work Package Closeout

Temporarily cap all open pipe ends as necessary to maintain safety and environmental controls per the interim end state described for PE-B [R-1].

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4.6.2.2 PE-B-2-294-2 Work Package #2 Heating Steam Tanks

This work package details the steps needed to remove components of the 73010 Electric Boiler System, including heating steam tanks and associated pipework from the 294 ft elevation. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Clear the work area to access the tanks by removing any obstructing miscellaneous piping.
- Disconnect and segment pipework and valves from any remaining connections, ensuring all systems are properly isolated.
- Roll back existing inactive electrical connections to the nearest cable tray or access point.
- Segment the tanks into manageable pieces suitable for transport.
- Transport tank segments to the TH floor using carts.
- Crane down the tank segments from the TH floor to the loading bay utilizing appropriate lifting equipment and techniques.
- Survey the equipment in accordance with established procedures to confirm the absence of radiological contamination.
- Place equipment into waste containers or load onto truck beds for disposal, following all waste management protocols and transportation regulations.

Work Package Closeout

Temporarily cap all open pipe ends as necessary to maintain safety and environmental controls per the interim end state described for PE-B [R-1].

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4.6.3 Elevation 317 Work Package Details

4.6.3.1 PE-B-2-317-1 Work Package #1 Heat Exchangers, Piping, And Tanks

This work package details the steps needed to remove components of the 43100 Feedwater Heating System, including LP feed heaters, tanks, and associated pipework from the 317 ft elevation. Equipment removal will utilize the existing hatchway for systematic lowering of large equipment to lower elevations. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Disconnect connections to extraction steam, condensate/feed water, drains, and instrumentation from the LP feed heaters.
- Roll back existing inactive electrical connections to the nearest cable tray or access point.
- Remove miscellaneous instrumentation as bulk waste.
- Move the feed heaters along their tracks in either an east or west direction to align with the removable floor area adjacent to the hatchway.
- Lower the feed heaters through the hatchway to elevation 254 using appropriate lifting equipment.
- Transport the feed heaters to the TH loading bay for final survey and disposal.
- Segment and place tanks on carts, lower them through the hatchway, and transport them to the loading bay.
- Segment and support large piping, then remove it via carts and the hatchway.

Work Package Closeout

Temporarily cap all open pipe ends as necessary to maintain safety and environmental controls per the interim end state described for PE-B [R-1].

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4.6.3.2 PE-B-2-317-2 Work Package #2 Head Tanks

This work package details the steps needed to remove contaminated head tanks associated with systems 34110 Calandria End Shield Cooling and 34130 Biological Shield Cooling from the 317 ft elevation. Due to potential contamination, special characterization and handling procedures will be implemented. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- The head tanks will be characterized, and the radiological hazard quantified prior to removal.
- Existing inactive electrical connections will be rolled back to the nearest cable tray or access point.
- Miscellaneous instrumentation will be removed as bulk waste.
- Connections to common service water and other peripheral pipework will be removed up to the access point and temporarily capped.
- The tanks will be segmented, placed on a cart, lowered through the hatchway to the 254 ft elevation, and brought to the loading bay.
- The work area will be cleaned, and any hazards identified and clearly marked.
- The equipment will be surveyed and placed into a waste container or loaded onto a truck bed for disposal.

Work Package Closeout

Remove any remaining connections and services associated with the tanks and ensure all open pipe ends are capped to maintain safety and environmental controls per the interim end state described for PE-B [R-1].

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4.6.3.3 PE-B-2-317-3 Work Package #3 Chemical Addition Tanks

This work package details the steps needed to remove components of the 71640 Chemical Feed System, including tanks and associated equipment from the 317 ft elevation. Equipment removal will utilize the existing hatchway for systematic lowering to lower elevations. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Existing inactive electrical connections will be rolled back to the nearest cable tray or access point.
- Miscellaneous instrumentation will be removed as bulk waste.
- Connections to common service water and other peripheral pipework will be removed up to the access point and temporarily capped.
- The tanks will be segmented, placed on a cart, lowered through the hatchway to the 254 ft elevation, and brought to the loading bay.
- The work area will be cleaned, and any hazards identified and clearly marked.
- The equipment will be surveyed and placed into a waste container or loaded onto a truck bed for disposal.

Work Package Closeout

Remove any remaining connections and services associated with the tanks and ensure all open pipe ends are temporarily capped to maintain safety and environmental controls per the interim end state described for PE-B [R-1].

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4.6.4 Elevation 339 Work Package Details

4.6.4.1 PE-B-2-339-1 Work Package #1 Deaerator and Associated Equipment

This work package details the steps needed to remove the deaerator and associated components from multiple systems (43100 Feedwater Heating System, 71320 Recirculated Cooling Water, and 43200 Condensate and Boiler Feed System) from the 339 ft elevation. The deaerator is used for removing dissolved gases from the feedwater for steam-generating boilers. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Existing inactive electrical connections will be rolled back to the nearest cable tray or access point.
- Miscellaneous instrumentation will be removed as bulk waste.
- Connections to common service water and other pipework will be removed up to the access point and temporarily capped.
- The tanks will be segmented, placed on a cart, lowered through the hatchway to the 254 ft elevation and brought to the loading bay.
- Work area will be cleaned, and any hazards identified and clearly marked.
- The equipment will be surveyed and placed into a waste container or loaded onto a truck bed for disposal.

Work Package Closeout

Remove any remaining connections and services associated with the tanks and ensure all open pipe ends are temporarily capped to maintain safety and environmental controls per the interim end state described for PE-B [R-1].

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4.6.4.2 PE-B-2-339-2 Work Package #2 Instrumentation

This work package details the steps needed to remove components of the 64323 BFLP trip Instrumentation from the 339 ft elevation. The following is a listing of all work to be completed as part of this work package:

Equipment Removal

- Existing inactive electrical connections will be rolled back to the nearest cable tray or access point.
- Miscellaneous instrumentation will be removed as bulk waste.
- Connections to common service water and other pipework will be removed up to the access point and temporarily capped.
- Work area will be cleaned, and any hazards identified and clearly marked.
- The equipment will be surveyed and placed into a waste container or loaded onto a truck bed for disposal.

Work Package Closeout

Remove any remaining connections and services associated with the tanks and ensure all open pipe ends are temporarily capped to maintain safety and environmental controls per the interim end state described for PE-B [R-1].

5.0 WASTE MANAGEMENT

5.1 Waste Management Plan

The TH is located inside the protected area however, it is on the conventional side of PNGS-A and the majority of SSCs are not expected to be contaminated apart from head tanks associated with systems 34110 Calandria End Shield Cooling and 34130 Biological Shield Cooling.

Most of the systems in the TH have not come into contact with contamination and will generate conventional wastes, however, the head tanks associated with work package PE-B-2-317-2 Work Package #2 Head Tanks will be considered contaminated due to interactions with End Shield Cooling, Biological Shield Cooling and past system history, generating Low Level Waste (LLW).

Further planned characterizations and surveying completed during the work planning and dismantling activities will be used to further verify the classification, as discussed in the characterization strategy section of the Program Overview DDP [R-1].

Table 4 shows the estimated waste volumes associated with the decommissioning activities of PE-B.

Waste Stream	Conventional (m ³)	LLW (m ³)
Metal	16,353	5
Hazardous	1,970	

Table 4 Planning Envelope B Waste Volume Estimates

5.1.1 Waste Pathways

5.1.1.1 Conventional Waste

As can be seen in the table above, much of the waste generated is expected to be conventional waste and as such, dedicated in-situ laydown areas will be setup for PE-B activities. Refer to the Program Overview DDP [R-1] for further pathway details.

5.1.1.2 Conventional Hazardous Waste

Hazardous Waste is expected to be generated during decommissioning activities. Most of the hazardous waste will be asbestos with the potential for some equipment to contain mercury. Hazardous Building Material Assessments will verify hazards prior to any dismantling activities. Refer to the Program Overview DDP [R-1] for further pathway details.

5.1.1.3 Radiological Waste

A relatively small amount of LLW is expected to be generated during the dismantling activities related to PE-B-2-317-2 Work Package #2 Head Tanks. Radiological Waste is not expected

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during the dismantling of remaining TH systems, however, due to the location of the systems it is possible small amounts of contamination will be discovered during scoping or demolition activities. Refer to the Program Overview DDP [R-1] for further pathway details.

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6.0 REFERENCES

- [R-1] OPG, Detailed Decommissioning Plan – Program Overview, NA44-PLAN-00960-00004
- [R-2] OPG, PNGS-A Storage with Surveillance Plan, NA44-PLAN-00960-00001
- [R-3] OPG, Radiation Protection Program, N-PROG-RA-0013
- [R-4] OPG, Fire Protection, N-PROG-RA-00012
- [R-5] OPG, Environment Health and Safety Managed Systems Program, OPG-PROG-0005
- [R-6] OPG, Management of Asbestos-Containing Material, OPG-PROC-0124
- [R-7] OPG, Management of Designated Substances Other Than Asbestos, OPG-PROC-0125
- [R-8] OPG, Working at Heights, OPG-PROC-0137
- [R-9] OPG, Falling Material Control, OPG-PROC-0136
- [R-10] OPG, Safe Work Planning and Pre-Job Briefing, OPG-PROC-0129
- [R-11] OPG, Confined Space Management, OPG-PROC-0122
- [R-12] OPG, Spill management, OPG-STD-0152
- [R-13] OPG, Maintenance of Equipment Containing Hydrogen, N-STD-RA-0022
- [R-14] OPG, Generator Rotor Removal, P-AB-MMP-41200.11
- [R-15] OPG, Integrated Decommissioning Safety Assessment, NA44-REP-00960-00431
- [R-16] OPG, Decommissioning, REGDOC-2.11.2
- [R-17] OPG, Control of Ignition Sources And Hot Work Activities, N-PROC-RA-0057

7.0 ACRONYMS

Acronym	Definition
AIFB	Auxiliary Irradiated Fuel Bay
ALARA	As Low As Reasonably Achievable
BF	Boiler Feed
CAEP's	Condenser Air Extraction Pumps
CCW	Circulating Cooling Water
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
CTCS	Condenser Tube Cleaning System
DDP	Detailed Decommissioning Plan
FP	Full Power
GV	Governor Valve
HP	High Pressure
HT	Heat Transport
I&C	Instrumentation and Control
ILW	Intermediate Level Waste
IPB	Isolated Phase Bus
IV	Intercept Valve
LLW	Low Level Waste
LP	Low Pressure
MBF	Main Boiler Feed
MW	Mega Watt
NMS	Nuclear Management System
OGMS	Off Gas Management System
OPG	Ontario Power Generation

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Acronym	Definition
PDP	Preliminary Decommissioning Plan
PE	Planning Envelope
PNGS	Pickering Nuclear Generating Station
PNGS-A	Pickering Nuclear Generating Station A
PNGS-B	Pickering Nuclear Generating Station B
REGDOC	Regulatory Document
RHP	Responsible Health Physicist
RP	Radiation Protection
RTD	Resistance Temperature Detector
RV	Release Valve
SAWS	Steam and Water Sampling
SSC	System, Structure, or Component
SWS	Storage with Surveillance
TAB	Turbine Auxiliary Bay
TH	Turbine Hall
U1	Unit 1
U2	Unit 2
U3	Unit 3
U4	Unit 4
U5	Unit 5
U8	Unit 8
USI	Uniform Subject Index
WMP	Waste Management Plan

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Appendix A: Verification Matrix

REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 1	A description of, and diagram showing, the areas, components and structures to be decommissioned, grouped, where appropriate, into logical decommissioning planning envelopes	A)	A description of, and diagram showing, the areas, components, and structures to be decommissioned, grouped where appropriate into logical decommissioning planning envelopes	Section 2.0
Bullet 2	The operational history, including incidents or accidents that could affect decommissioning	B)	The operational history, including incidents or accidents that could affect decommissioning	See the Program Overview DDP [R-1]
Bullet 3	The storage with surveillance stage, as applicable, and requirements of the: functional building services monitoring and surveillance activities inspection activities usage boundaries during storage with surveillance	C)	The SWS stage and requirements: functional building services; monitoring and surveillance activities; inspection activities; and usage boundaries during SWS;	See the Program Overview DDP [R-1]
Bullet 4	The final radiological, physical and chemical end-state objectives, and interim end-state objectives, as applicable	D)	The final radiological, physical, and chemical end-state objectives. Where more than one DDP is required in a phased program, interim end-state objectives and monitoring programs for deferral periods shall be provided for each detailed plan.	See the Program Overview DDP [R-1]
Bullet 5	A description of the requirements for any institutional controls	E)	A description of the requirements for long-term institutional controls	See the Program Overview DDP [R-1]

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REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 6	Comprehensive and systematic survey results of radiological and other potentially hazardous conditions, including identification and description of the remaining significant gaps or uncertainties in the measurement or prediction of such conditions	F)	Comprehensive and systematic survey results of radiological and other potentially hazardous conditions, including identification and description of the remaining significant gaps or uncertainties in the measurement or prediction of such conditions	Section 4.3
Bullet 7	A decommissioning strategy for each planning envelope that highlights any significant changes from the strategy identified in the PDP	G)	A decommissioning strategy for each planning envelope that highlights any significant changes from the strategy in the PDP	Section 2.0 and the Program Overview DDP [R-1]
Bullet 8	A description of the decommissioning work packages, including: a step-wise technical approach the nature and source of potential significant risks to workers, the public and the environment (including estimates of doses), as well as species at risk, the procedures or technologies proposed to mitigate risks the quantities, characteristics and disposition methods of waste.	H)	A description of the decommissioning work packages, including: a step-wise technical approach; the nature and source of potential significant risks to workers, the public, and the environment (including estimates of doses) as well as species at risk; procedures or technologies proposed to mitigate risks; and quantities, characteristics, and disposition methods of all wastes;	Section 4.5 and 4.6

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REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 9	A schedule of the execution of decommissioning activities showing: the start date of the proposed execution of decommissioning activities the approximate duration and sequence of work packages (and periods of storage with surveillance, if applicable) the anticipated date of completion of decommissioning activities	I)	A schedule showing the proposed start date; the approximate duration and sequence of work packages (and periods of SWS, if applicable); and the anticipated completion date;	See the Program Overview DDP [R-1]
Bullet 10	A waste management plan	J)	A waste management plan	Section 5.0
Bullet 11	A characterization of potential environmental effects and the measures to be employed to mitigate and monitor these effects	K)	A characterization of potential environmental effects and the measures that will be employed to mitigate and monitor the effects	See the Program Overview DDP [R-1]
Bullet 12	A conservative cost estimate (based on the work packages), as described in REGDOC-3.3.1, <i>Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities</i> , for labour, materials, equipment, waste management, environmental assessment, monitoring and administration (e.g., training, safety, licensing, project management, government and public liaison)	L)	An itemized conservative cost estimate	See the Program Overview DDP [R-1]
Bullet 13	Financial guarantee arrangements	M)	Financial guarantee arrangements	See the Program Overview DDP [R-1]

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REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 14	A summary report of any public and Indigenous consultations undertaken in preparing the plan, including issues raised and how they were considered and dispositioned	N)	A summary report of any public and Indigenous engagement undertaken in preparing the plan, including issues raised and how they were considered and dispositioned	See the Program Overview DDP [R-1]
Bullet 15	The project management structure	O)	The project management structure	See the Program Overview DDP [R-1]
Bullet 16	Applicable programs (e.g., management system, emergency response, site security, radiation protection, environmental protection, fire, and personnel training) (Note: this includes programs applicable during storage with surveillance and decommissioning)	P)	Applicable programs (e.g., management system, emergency response, site security, radiation protection, environmental protection and monitoring, fire protection, personnel training)	See the Program Overview DDP [R-1]
Bullet 17	A human factors program that includes: human factors analysis training provisions use of contractors procedural development ergonomic issues	Q)	A human factors program that includes human factors analysis; training provisions; use of contractors; procedural development; and ergonomic issues;	See the Program Overview DDP [R-1]
Bullet 18	Conventional occupational health and safety issues and associated training and protection programs	R)	Conventional occupational health and safety issues and associated training and protection programs;	See the Program Overview DDP [R-1]
Bullet 19	A list of federal and provincial regulatory agencies involved in the project	S)	AHJs involved in the project;	See the Program Overview DDP [R-1]

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REG DOC 2.11.2 Section 7.1.1	Requirement Description	CSA N294:19 App C.1	CSA Requirement Description	DDP Section Reference
Bullet 20	The final survey program with interpretation criteria	T)	The final survey program with interpretation criteria	See the Program Overview DDP [R-1]
Bullet 21	The operating and decommissioning records that will be retained, and the method of retention	U)	The operating and decommissioning records required for long-term retention and the method of retention	See the Program Overview DDP [R-1]
Bullet 22	A table of contents for the final end-state report, outlining the topics to be covered	V)	A table of contents for the final end-state report that outlines the topics to be covered	See the Program Overview DDP [R-1]
Bullet 23	Operational experience and lessons learned from the decommissioning of similar nuclear facilities	W)	Operational experience and lessons learned of the decommissioning of similar nuclear facilities.	See the Program Overview DDP [R-1]
Bullet 24	Criticality safety assessment, as required, and planned actions involving fissile material	N/A	N/A	See the Program Overview DDP [R-1]

ATTACHMENT 4

OPG Letter, P. Seguin to R. Richardson, "Pickering NGS, Units 1 to 4 – Submission of the Detailed Decommissioning Plan and Storage with Surveillance Plan".

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PNGS-A Storage with Surveillance Plan

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Revision Summary

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1.0 INTRODUCTION

The Ontario Power Generation (OPG) Pickering Nuclear Generating Station (PNGS) consists of PNGS-A, U1 - U4 and PNGS-B, U5 - U8. Within PNGS-A:

- U2 and U3 have been in Storage with Surveillance (SWS), part of the Execution of Decommissioning Stage, since 2010 [R-38], and
- In 2024, U1 was shut down and U4 is planned to be shut down and undergo transition activities from operations to Storage with Surveillance (SWS), currently planned from 2024 to 2028.

The SWS Plan is a subset of the Detailed Decommissioning Plan (DDP) for PNGS-A facilities [R-5]. The SWS Plan describes the requirements for care and maintenance of the facility equipment and substances until decontamination and dismantling actions are performed. Along with the DDP, within five years of submission, the SWS Plan will be reviewed and updated as required, per REGDOC-2.11.2 [R-3]. The current SWS Plan details systems that are expected to remain active or partially active post Stabilization, and are necessary for the SWS period, planned continued operation of PNGS-B, or anticipated to be required for decontamination and dismantling activities at PNGS.

Figure 1 details the stages for the entire lifecycle of a nuclear facility including the SWS, Dismantlement and Site Restoration phases as outlined in Canadian Nuclear Safety Commission (CNSC) REGDOC-3.5.1 [R-2].

This plan was prepared to meet the requirements of REGDOC-2.11.2 [R-3] and Canadian Standards Association (CSA) N294:19 [R-4] and is based on the safety assessment that was completed for activities occurring during the SWS period [R-28]. A regulatory compliance matrix is included in Appendix B.

1.1 Stabilization

Prior to reaching SWS, PNGS-A will go through a Stabilization period as detailed in Figure 1: Deferred Decommissioning Phases which is an excerpt from REGDOC-3.5.1 [R-2].

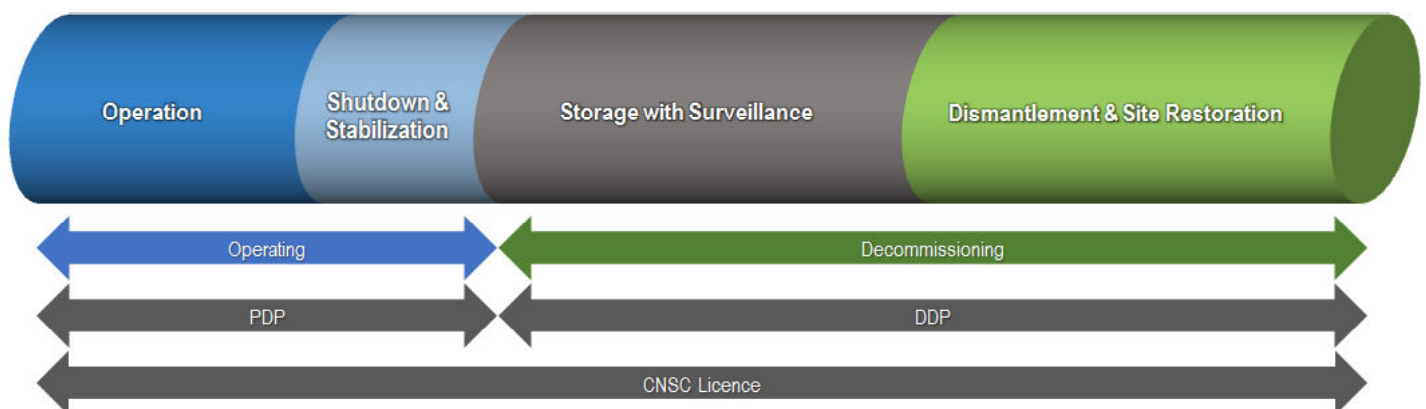


Figure 1: Deferred Decommissioning Phases

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This period of Stabilization is governed by the Stabilization Activity Plan (SAP) [R-1].

1.1.1 Stabilization Activity Plan

The purpose of the SAP [R-1] is to describe the arrangements and activities that ensure a safe and efficient transition (Stabilization) from the end of commercial operation of PNGS-A to the SWS state. The SAP addresses the following activities:

- (a) Assessing systems, structures or components (SSCs) to determine the following:
 - SSCs that are necessary to continue operating during the SWS period to protect the environment, workers and the public,
 - SSCs anticipated for future use in Decommissioning activities,
 - SSCs that will be required to support planned continued operation of PNGS-B, U5 - U8 facilities, and
 - SSCs that can be abandoned post Unit 1 and 4 shutdown.
- (b) Producing System End State Declarations for each SSC associated with U1 and U4.
- (c) Updating operational and maintenance procedures, including the Master Equipment List and Asset Suite 9, to reflect ongoing maintenance and monitoring requirements post Stabilization leading into SWS.

NOTE

U2 and U3 have already undergone the Stabilization process and have been in SWS since 2010.

1.1.2 End State Declarations

System End State Declarations (SESDs) document the as-left configuration of the system to ensure that the end state as defined in the End State Determination Report (ESDR) [R-6] has been accurately achieved. SESDs, once completed, will be submitted to the CNSC as the work progresses. SESDs document the final configuration of the SSC at the end of Stabilization and the beginning of SWS. See Appendix A for a list of SSCs that will remain active or partially active at the beginning of the SWS period.

1.2 Risk Reduction Activities During SWS

Consistent with REGDOC 2.11.2 [R-3], OPG may execute risk reduction activities during the SWS phase. Anticipated risk reduction activities are discussed in the Program Overview DDP Volume 0 [R-5]. Other risk reduction activities may be identified as the work progresses. Any

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emergent risk reduction activities will be planned and executed in accordance with the Pickering licence.

1.3 Irradiated Fuel Bays

The Irradiated Fuel Bay 'A' (IFB-A) and Auxiliary Irradiated Fuel Bay (AIFB) will remain in operation for portions of the SWS phase. Details of the ongoing activities to empty the Irradiated Fuel Bays (IFBs) are included in the Program Overview DDP Volume 0 [R-5]. The systems required to support the IFBs are discussed in Section 4.2 of this SWS Plan. Once the IFBs are emptied, drained and dried, some of the systems being maintained under this SWS plan can be end stated and made available for decommissioning. These details will be covered in future submissions of the DDP and SWS Plan.

The state of the irradiated fuel bays at the beginning of SWS is described in their respective ESDRs:

- Pickering A – Auxiliary Irradiated Fuel Bay Facility (P-ESR-29500-00001)
- Irradiated Fuel Storage Bay 'A' (P-ESR-34400-00001)
- Irradiated Fuel Bay Shipping Facility (P-ESR-35600-00001)
- Irradiated Fuel Bay Inspection and Storage (P-ESR-35500-00001)

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2.0 RESPONSIBILITIES

OPG's nuclear organizational structure have been described in the Program Overview DDP Volume 0 [R-5].

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3.0 FACILITY CHANGE OR MODIFICATION PROCESS

All facility modifications will follow OPG's existing Nuclear Management System (NMS) as outlined in Program Overview DDP Volume 0 [R-5]. This includes the process to place SSC into inactive/abandoned status as well as managing active SSCs during SWS.

4.0 FUNCTIONAL SYSTEMS

4.1 General

This section describes the functional systems at PNGS-A that will remain operational at the end of Stabilization and to support activities during the SWS phase.

In addition to ongoing maintenance and monitoring of operational SSCs within the station, the activities that are planned to continue during SWS are as follows:

- Ongoing fuel transfers from IFBs to dry storage as outlined in the Program Overview DDP Volume 0 [R-5],
- Stored resin removal (Section 4.2.24),
- Storage of heavy water during the planned refurbishment of PNGS-B (Section 0), and
- Risk reduction activities in accordance with section 8.1 of REGDOC 2.11.2 [R-3].

SSCs within PNGS-A will be subject to ongoing monitoring to ensure the safety of workers, the public and the environment. See Section 5.0 for more information about maintenance, inspection, and surveillance during SWS.

See Appendix A: ESDRs for Active Systems Supporting SWS.

4.1.1 Systems Required to Remain Functional During SWS Phase

The following systems will need to be maintained during the SWS phase:

- Fire Protection, Section 4.2.1,
- Common Water Systems, Section 4.2.2,
- Service Water Systems, Section 4.2.3,
- Demineralized Water, Section 4.2.4,
- Domestic Water and Sewer, Section 4.2.5,
- Heating and Ventilation, Section 4.2.6,
- Instrument Air, Section 4.2.7,
- Service Air, Section 4.2.8,
- Breathing Air, Section 4.2.9,
- Drainage, Section 4.2.10,

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- Liquid Effluent Monitoring and Sampling System, Section 4.2.11,
- Electrical Power Distribution System, Section 4.2.12,
- Monitoring and Control, Section 4.2.13,
- Site Instrumentation Systems, Section 4.2.14,
- Stack Monitoring, Section 4.2.15,
- Communication Systems, Section 4.2.16,
- IAEA Safeguards Equipment, Section 4.2.17,
- Control Centre Equipment (MCR & CER), Section 4.2.18,
- Cranes, Hoists and Associated Equipment, Section 4.2.19,
- Emergency Mitigating Equipment, Section 4.2.20,
- Radioactive Liquid Waste Management System, Section 4.2.21,
- Heavy Water Storage, Section 4.2.23, and
- Resin Handling System and Radioactive Waste Management, Section 4.2.24.

4.1.2 Planned PNGS-B Refurbishment

There are several common systems that are interconnected between PNGS-A and PNGS-B which will retain some interconnection during SWS. See section 4.2 for more details:

- Electrical / Standby Power / Site Electrical System (SES), including Class IV power,
- Breathing Air,
- Service Water,
- Domestic Water,
- Demineralized Water,
- Fire Protection,
- Instrument Air,
- Heating System,
- Radioactive Liquid Waste Management System, and

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- Liquid Effluent Monitoring and Sampling System.

There are several common systems that will be separated and limited to PNGS-B to allow independent decommissioning activities to continue at PNGS-A following the planned refurbishment of PNGS-B. Plant modifications associated with the separation activities are currently being assessed during stabilization [R-1], and are not part of DDP/SWS scope. The state of the systems at the beginning of SWS are described in their respective ESDRs:

- Reactor Building Containment (P-ESR-21100-00001)
- Emergency Coolant Injection System (P-ESR-33350-00001)
- Vacuum Building and Ducts (P-ESR-25000-00001)

Several common systems located within the PNGS-A powerhouse will be transferred fully to Common Services operations following the planned refurbishment of PNGS-B. The state of the systems at the beginning of SWS are described in their respective ESDRs:

- Heavy water (D₂O) Ion Exchange Cleanup System(P-ESR-34970-00001)
- Nitrogen System (P-ESR-75700-00001)

The boundary between PNGS-A for SWS and PNGS-B for operations will be defined by the AB Gate (see Section 4.1.3).

4.1.3 AB Gate: Defining Usage Boundaries during Storage with Surveillance

Should there be a decision to refurbish PNGS-B, there is a need to define the boundary between PNGS-A (U1 to U4) and PNGS-B (U5 to U8). It is expected that there will be different lifecycle phases occurring at PNGS:

- PNGS-A will enter the decommissioning phase of the lifecycle after Stabilization, and will initially be put into a period of SWS prior to demolition; and
- PNGS-B is planned for refurbished (pending regulatory approval) and continue to be in the operational phase of the lifecycle.

The separation of PNGS-A and PNGS-B is denoted by the concept of an AB Gate, which is illustrated in Figure 2 and has been defined for planning purposes, denoting the separation between the operational side and the decommissioning side. See the Program Overview DDP Volume 0 [R-5] for additional details on the criteria that is being used to guide the location of the gate and the extent of physical modifications required. The planned engineering and physical modifications are addressed in the SAP and are excluded from the scope of this DDP/SWS Plan.

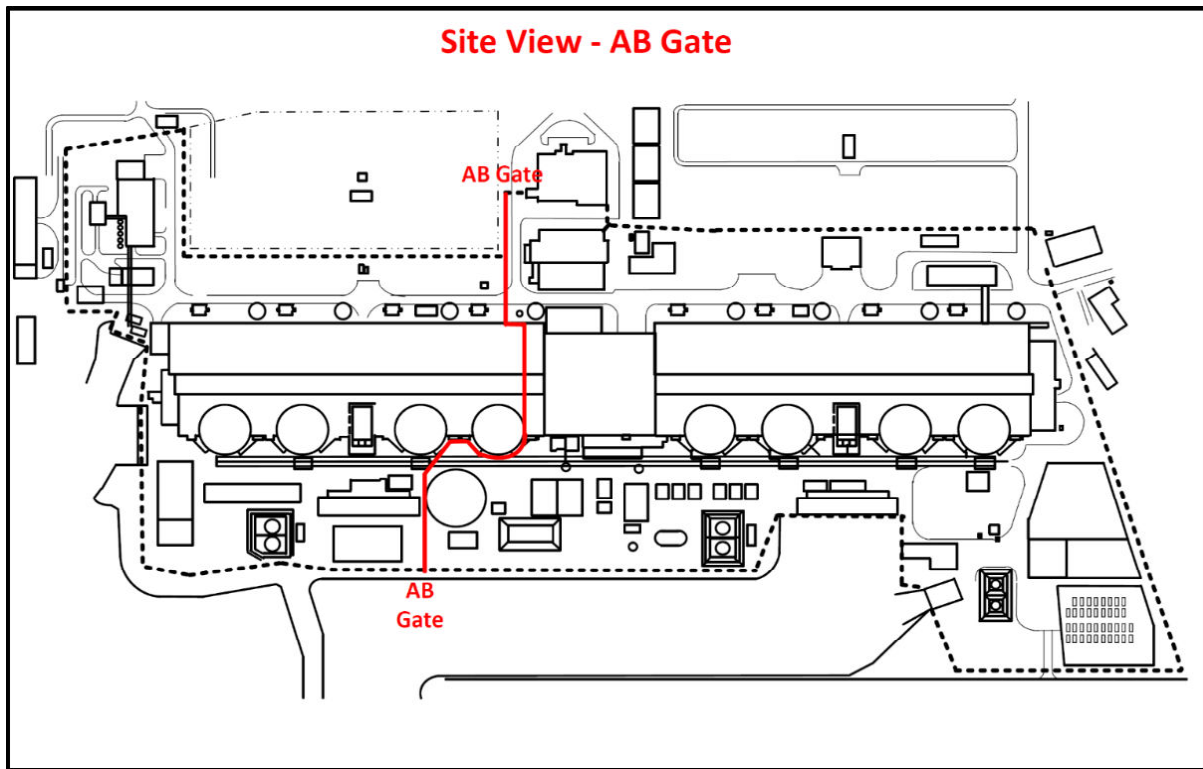


Figure 2: AB Gate to Differentiate between PNGS-A and PNGS-B

4.2 Detailed Description of SSCs Remaining Functional to Support SWS

The following sections provide a brief description of SSCs necessary for the SWS period and anticipated for decontamination and dismantling activities. These systems will remain active or partially active during SWS phase. The end state of an SSC is outlined in its most current ESDR and reflected here. Any required system modifications during the SWS period will be executed in accordance with approved OPG Nuclear Management System (NMS) procedures as outlined in the Program Overview DDP Volume 0 [R-5].

4.2.1 Fire Protection Systems

The PNGS-A fire protection system, consisting of the Fire Detection and Alarm, and Fire Suppression systems, provides equipment for detection and suppression of fires to comply with the requirements of the National Fire Code (NFC) [R-7], the National Building Code of Canada (NBCC) [R-8], and CSA N293 [R-9].

During SWS, design modifications will be completed for new fire detection and alarm equipment where new detection is required based on the results of the SWS Fire Hazard Assessment and Code Compliance Review. Similarly, existing equipment will be removed from service if it is no longer required based on the results of the SWS Fire Hazard Assessment and Code Compliance Review.

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The Fire Protection Assessment documents are made up of Code Compliance Review (CCR) [R-11] and Fire Hazard Assessment (FHA) [R-10] and will be maintained during SWS. These documents are required to confirm the fire protection requirements based on facility end-state configuration, including hazard levels, staffing, and fire response strategies. During SWS, these documents will be reviewed and revised as required by CSA N293 [R-9].

4.2.1.1 Fire Detection and Alarm Systems (67140)

The state of the Fire Detection and Alarm systems at the beginning of SWS is described in P-ESR-67140-00001 [Appendix A].

The PNGS-A Fire Detection and Alarm Systems provide central and local fire alarms, including control room annunciation, for personnel and equipment protection throughout the station. The system will remain active during the SWS phase.

As a result of activities during SWS, the fire load will be reduced within the station, and consideration can be given to isolating portions of the systems that are no longer required to support the FHA [R-10]. A future end-state could occur when the PNGS-A system can be disconnected from the PNGS fire system and removed from service. Any end-stating of fire detection within PNGS-A will be determined and validated by the FHA and CCR per CSA N293 requirements.

The PNGS-A Fire Detection and Alarm System annunciations that are currently routed to the control rooms will be routed to the centralized Pickering A Monitoring Centre once it is in service, see section 4.2.13.

Existing monitoring, inspection, and maintenance activities will continue during the SWS period. A system or portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.1.2 Fire Water Supply (71410)

The state of the Fire Water Supply system at the beginning of SWS is described in P-ESR-71400-00001 [Appendix A].

The Fire Protection Water supply circuit distributes water throughout the station. The system will remain active during SWS to provide fire protection in areas of the station that may be occupied or contain combustible materials.

As a result of activities during SWS, the fire load will be reduced within the station, and consideration can be given to isolating portions of the systems that are no longer required to support the FHA [R-10]. A potential future modification may involve using PNGS-B to supply fire water to PNGS-A, at which point the diesel fire water pumps in the PNGS-A greenhouse can be removed from service. Any proposed end-stating for specific areas of the station will be determined and validated by the FHA and CCR per CSA N293 requirements.

Existing monitoring, inspection, and maintenance activities will continue during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

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4.2.2 Common Water System (71100)

The state of the Common Water System at the beginning of SWS is described in P-ESR-71100-00001 [Appendix A].

The Common Water System (CWS) supplies screened lake water to PNGS-A. This water is used to supply the Condenser Cooling Water System (CCW) and the Service Water Systems. Through the common water system, the Screenhouse also supplies the Fire Water System (71410) to PNGS-A and PNGS-B and the PNGS-A Fire Protection System (71400).

The CWS screenhouse will remain partially in service to support the delivery of lake water to required loads during SWS, including:

- PNGS-A Service Water, including supply to IFB-A and AIFB,
- Unit 1 CCW pump operation (see 4.2.21), and
- Firewater diesel backup water supply for PNGS-A and PNGS-B.

Portions of the CWS can be end-stated once the systems they supply are removed from service and the entire system can be end-stated and abandoned once no systems requiring water from the CWS remain in service.

Monitoring, inspection, and maintenance will be required of the Screenhouse, service loads, and pump operations during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.3 Service Water System (71300)

The state of the Service Water System at the beginning of SWS is described in P-ESR-71300-00001 [Appendix A].

The Service Water system supplies cooling water and other service loads to PNGS-A. The system is made up of Low-Pressure service water (71310), High Pressure service water (71340), Lawn Water (71350), Emergency Water (71380), Emergency storage (71330), and Chlorination (71650).

Service Water will need to remain partially active to provide cooling water to required PNGS-A loads during SWS:

- IFB-A and AIFB operation,
- Heating, Ventilation, and Cooling (HVAC) system cooling,
- Unit 1 CCW pump cooling,
- Air systems compressor cooling, and

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- Station System Transformers (SSTs) oil cooling.

Service water will be provided to support the following functions that are shared with PNGS-B, until such time that the system is no longer required, or a separation modification is implemented to provide a supply from PNGS-B:

- Vacuum Building (VB) and associated systems,
- D₂O Upgrading Processing Plant (UPP) B and Sulzer B,
- Dilution of Liquid Active Waste Management System effluents,
- Service Wing HVAC, and
- Steam Supply System for Building Heating (electrode boiler) during planned PNGS-B refurbishment.

As modifications are implemented to supply PNGS-B systems, the associated service water loads on PNGS-A can be isolated from and removed from service. This is anticipated to occur early in the SWS phase.

Portions of the service water system can be end-stated once the systems they supply are removed from service, and the system can be end-stated and abandoned once no systems requiring service water remain in service.

Monitoring, inspection, and maintenance will be required of the chlorination system, service loads, and pump operations during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.4 Demineralized Water System (71620)

The state of the Demineralized Water System at the beginning of SWS is described in P-ESR-71620-00001 [Appendix A].

Demineralized water system supplies systems where the normally strained service water is not suitable. The system includes a high-pressure (HP) demineralized water system to supply systems where the pressure available from the low-pressure demineralized water system is limited.

The demineralized water system will remain active for the following systems during the SWS phase, and will only be a small fraction of the nominal station operating loads:

- AIFB for make-up water and for decontamination system spraying/flushing,
- IFB-A for make-up water to the bay,

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- Heating and Ventilation Systems for building heating through water-based heaters (including electrode boilers for the period of planned PNGS-B refurbishment),
- Resin Handling and Spent Resin Storage systems for spent resin transfer operations,
- Active Drainage System for dilution and flushing,
- Chemical Control Labs for performing lab activities,
- Class I & Class II Batteries for battery top-ups, and
- PNGS-B Demineralized Water supply via inter-station tie valve.

Power to the HP demineralized water pumps is supplied from PNGS-A, and modifications to transfer power supplies from PNGS-A to PNGS-B are part of the separation package to be implemented during the planned PNGS-B refurbishment.

Active portions of the demineralized water system can be end-stated once the systems they supply are removed from service, and the system can be end-stated and abandoned once no systems requiring demineralized water remain in service.

Monitoring, inspection, and maintenance will be required for the portions of the system that will remain in service during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.5 Domestic Water and Sewer System (71500/71730)

The state of the Domestic Water and Sewer System at the beginning of SWS is described in P-ESR-71500-00001 [Appendix A].

The domestic water system supplies the protected area with potable water from the municipality. The sewage system collects and transports sewage from domestic water sources to the municipal sewer main.

In areas of PNGS-A that will remain heated and inhabited during SWS, the domestic water system will continue to provide potable water to sinks, toilets, urinals, fountains, and emergency eyewash and shower stations, as well as to provide cooling water for equipment that will remain in service in SWS (e.g., breathing air compressors). The domestic sewer system will remain in service in areas of PNGS-A that will remain heated and inhabited during SWS.

The bulk of the domestic water supply system lies on PNGS-B (See Section 4.1.3) and will be operated and maintained by Common Services Operations until a modification is implemented to move these services to a new supply from PNGS-B. For the early stages of the SWS phase, the domestic water system will be a common system connected across the PNGS.

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Throughout SWS and as decommissioning progresses, portions of the distribution system will be end-stated as various outbuildings and plant equipment are removed from service. Once all service water and sewage supplies have been removed from service and end-stated, and a new supply to PNGS-B domestic water has been established, the remainder of the supply system on the PNGS-A can be end-stated and the system abandoned.

Monitoring, inspection, and maintenance will be required for the portions of the system that will remain in service during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.6 Heating and Ventilation (73000)

Steam, electricity, and hot water are used for station heating, and heating of facility outbuildings. These are supplied by separate systems, each with specific requirements during the SWS phase.

4.2.6.1 Powerhouse Steam Distribution and HVAC Systems

The state of the Powerhouse Steam Distribution and HVAC Systems at the beginning of SWS is described in P-ESR-73000-00001 [Appendix A].

The Powerhouse Ventilation and Steam and Condensate Return/Heating Steam systems provide heat and fresh air throughout the Turbine Auxiliary Bay (TAB), Turbine Hall (TH), and Powerhouse basement.

The Powerhouse Ventilation System will remain active and available for use on an as required basis for summer month air circulation and humidity control. The Powerhouse Steam & Condensate Return/Heating Steam systems will remain active to provide building heat throughout SWS. Early in the SWS phase, prior to completion of the planned PNGS-B refurbishment, building heating steam will be provided by electrode boilers installed in Unit 2 for this purpose [R-1]. After planned refurbishment, PNGS-B will provide heating steam and the electrode boilers will be decommissioned.

Existing monitoring, inspection, and maintenance will be maintained for the in-service heating and ventilation equipment during the SWS period. Portions of the system not in operation do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.6.2 RB & RAB Heating and Ventilation

The state of the RB & RAB Heating and Ventilation Systems at the beginning of SWS is described in P-ESR-71620-00002 [Appendix A].

All portions of the Reactor Building (RB) & Reactor Auxiliary Building (RAB) Heating and Ventilation system will remain active throughout SWS:

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- Reactor Vault Atmosphere System (73120) and RB Ventilation System (73130) will be de-powered and isolated, and available to be operated manually under local control prior to an RB entry by applying procedural controls,
- RAB Heating & Cooling (73140) and RAB Ventilation System (73150) will be in service to provide heating within the RAB,
- Spent Fuel Storage Bay Ventilation System (73170) will be in service, and
- RAB Air Conditioning Systems (73190 - F.A.D. Stack Monitoring Building) will be in service for planned PNGS-B extended operation.

Based on SWS needs, other portions of the system may be taken out of operation to reduce system operational loads. However, no part of the system is planned to be retired or abandoned.

Existing monitoring, inspection, and maintenance will be maintained for the in-service heating and ventilation equipment during the SWS period. Portions of the system not in operation do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.6.3 Class I / II Battery and Electrical Enclosure Room HVAC

The state of the Class I / II Battery and Electrical Enclosure Room HVAC Systems at the beginning of SWS is described in P-ESR-73000-00006 [Appendix A].

The Class I/II Battery and Electrical Enclosure Rooms HVAC system provides cooling for batteries and electrical equipment within each enclosure room. Most PNGS-A Class I and Class II batteries, rectifiers, and inverters will remain active during SWS, requiring the associated HVAC systems to remain in service.

Portions of the HVAC system can be end-stated and abandoned once the batteries and equipment in the rooms are removed from service and cooling is no longer required.

Existing monitoring, inspection, and maintenance will be maintained for the in-service HVAC equipment during the SWS period. Performance and status of heating and cooling circuits can be controlled via current monitoring systems (i.e. walkdowns). Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.6.4 Control Rooms and CERs HVAC

The state of the Control Rooms and Control Equipment Rooms (CERs) HVAC Systems at the beginning of SWS is described in P-ESR-73000-00004 [Appendix A].

The Control Room and CERs HVAC system provides ventilation and cooling to the personnel and computer systems within the control rooms. During SWS, several Air-Cooling Units and chiller trains will be left in service to maintain conditions in the Control Room and Control

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Equipment Rooms to allow monitoring of the IFB and AIFB as well as control of some environmental monitoring systems.

Once all system monitoring is end-stated or transferred to a common monitoring center (see Section 4.2.13), the remaining control room and CER HVAC equipment can be end-stated and abandoned.

Monitoring and inspection will be maintained for the portions of the system that remain in service or available for service, with repairs completed as needed for any failed equipment. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.6.5 Service Wing HVAC

The state of the Service Wing HVAC System at the beginning of SWS is described in P-ESR-73000-00005 [Appendix A].

The Service Wing HVAC will be maintained throughout SWS to keep all areas of the Service Wing habitable to support all PNGS activities.

4.2.6.6 Miscellaneous and Outside Buildings HVAC

The state of the Miscellaneous and Outside Buildings HVAC Systems at the beginning of SWS is described in P-ESR-73000-00009 [Appendix A].

HVAC systems are in place to provide climate control and ventilation in facilities and outbuildings outside the PNGS Powerhouse. During SWS, HVAC systems are expected to be maintained to support the PNGS-A Screenhouse, AIFB, Standby Generator Pumphouse, and West Annex for as long as those buildings and facilities are in operation. Areas used for chemical storage, or where risk of radon build-up exists, will require continued ventilation or their ventilation systems will be maintained as available to be reactivated prior to personnel entry until the hazard is no longer present.

HVAC systems in each facility and outbuilding can be end-stated and abandoned once climate control and ventilation are no longer required.

Existing monitoring, inspection, and maintenance will be maintained for the in-service HVAC equipment during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.7 Instrument Air (75100)

The state of the Instrument Air System at the beginning of SWS is described in P-ESR-75120-00001 [Appendix A].

The Instrument Air system supplies both low-pressure and high-pressure instrument air to systems throughout PNGS-A. Initially during SWS, instrument air will remain active to supply loads in the following areas:

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- Pickering A Screenhouse,
- IFB-A,
- AIFB,
- Vacuum Building/Relief Duct,
- Service Wing,
- Sulzer/D₂O Upgrading Plant,
- Ion Exchange Clean-up (IXCU),
- Administration Building,
- West Annex, and
- Helium Tank D₂O inlet valve.

Instrument air supplies for most other areas, including the RB and RAB, will be de-energized, drained, isolated, and abandoned in place prior to SWS. If instrument air is needed in these areas to support decommissioning activities, portable instrument air compressors may be used in place of the abandoned station systems.

Vacuum building instrument air is currently supplied via a tie-in to the PNGS-A system. To ensure PNGS-A separation from the VB prior to return to service of PNGS-B, a new instrument air line will be installed to re-route the VB supply from PNGS-B instrument air system. This will be implemented early in SWS, prior to planned return to service of the VB to support PNGS-B operation.

Reduced demand for air is anticipated with the units in SWS phase, and as load reduces due to systems that are no longer required, modifications may be undertaken to supply local loads with stand alone air supplies that can be routinely recharged as required.

A future end-state could occur when the fuel bays are emptied and end-stated, at which point portions of the delivery system supplying the IFB-A, AIFB, and PNGS-A Screenhouse can be isolated, and end stated.

Monitoring, inspection, and maintenance will be required of the parts of the instrument air system that remain in service during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.8 Service Air (75110)

The state of the Service Air System at the beginning of SWS is described in P-ESR-75110-00001 [Appendix A].

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The service air system is supplied by air-cooled compressors located in the powerhouse. Most service air supplies will remain available for use during all phases of decommissioning including SWS. Important loads continuing to require service air include:

- IFB-A,
- AIFB,
- Screenhouse,
- IXCU,
- Service Wing,
- UPP,
- West Annex,
- PNGS-B Service Air and Common Instrument Air, and
- PNGS-A RB, RAB, TH, and TAB.

Vacuum building service air is currently supplied from the PNGS-A system. To ensure PNGS-A separation from the VB prior to planned return to service of PNGS-B, a new service air line will be installed to transfer the VB supply to PNGS-B service air system. This will be implemented early in SWS, prior to return to service of the VB.

A future end-state could occur when the fuel bays are emptied and end-stated, at which point portions of the delivery system supplying the IFB-A, AIFB, and PNGS-A Screenhouse can be isolated. The service air supply pipework to these locations could remain available to support decommissioning activities if required.

Monitoring, inspection, and maintenance will be required of the parts of the service air system that remain in service during the SWS period, including parts of the system that are isolated and not in use but remain available to be put in service if needed. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.9 Breathing Air (75140)

The state of the Breathing Air System at the beginning of SWS is described in P-ESR-75140-00001 [Appendix A].

The breathing air system consists of compressors, receivers, and distribution network supplying personnel needing breathing air protection across PNGS-A. During SWS, breathing air will remain available for the following areas:

- IFB-A,

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- AIFB,
- Spent Resin Storage Tanks,
- Areas storing D₂O on site:
 - Heavy Water Addition and Transfer
 - UPP & UPP Expansion Feed Storage Area,
- Connection to PNGS-B Breathing Air,
- RB Airlocks,
- Main Control Room (MCR),
- Pressure Relief Duct (PRD), and
- Reactor Buildings.

A future end-state could occur when fuel is removed from the fuel bays and/or D₂O is no longer stored in PNGS-A, at which point portions of the delivery system supplying these locations can be isolated and breathing air compressors which are not being used can be end-stated. The breathing air supply pipework will remain available to support decommissioning activities if required.

Monitoring, inspection, and maintenance will be required of the parts of the breathing air system that remain in service during the SWS period, including parts of the system that are isolated and not in use but remain available to be put in service if needed. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.10 Drainage Systems (71700)

The station drainage system is subdivided into:

- Inactive drainage, and
- Active drainage.

4.2.10.1 Inactive Drainage (71710)

The state of the Inactive Drainage System at the beginning of SWS is described in P-ESR-71710-00001 [Appendix A].

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The Inactive Drainage system collects drainage throughout the station and surrounding yard. Most of the Inactive Drainage system will remain in service during SWS to cater to spills, ground water seepage and precipitation.

As plant conditions evolve through SWS, portions of the inactive drainage system in areas where water is no longer expected to collect will be end-stated to reduce the system footprint. Consideration will be given to reducing the number of pumps in station sumps and utilizing existing station procedures to plug TH/TAB floor drains where they are not required.

To aid in managing groundwater infiltration, the inactive drainage path in the TH basement will remain in service until structural demolition. Much of the current yard drainage system will remain in-service until site remediation is completed.

Effluent stream monitoring will continue for each drainage path until such time as that the release path is end-stated, and approval has been obtained to discontinue monitoring.

Monitoring, inspection, and maintenance will be required of the inactive drainage system pumps during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.10.2 Active Drainage (71720)

The state of the Active Drainage System at the beginning of SWS is described in P-ESR-71720-00001 [Appendix A].

The Active Drainage system collects potentially contaminated liquid waste and directs to the receiving tanks of the radioactive liquid waste management system. The Active Drainage system will remain in service to support SWS for the following plant locations:

- PNGS-A RABs,
- IFB-A and AIFB,
- West Annex, and
- Common facilities shared with PNGS-B (VB, Service Wing, D₂O Upgrader, Sulzer Plant, Laundry Facility).

As plant conditions evolve through SWS, portions of the active drainage system in areas where contaminated liquid is no longer expected to collect will be end-stated to reduce the system footprint. A future end-state could occur when all potential sources of active liquid wastes have been removed from PNGS-A, including from IFB-A and AIFB, at which time the PNGS-A active drainage system could be isolated from Radioactive Liquid Waste Management System (RLWMS), end-stated, and abandoned. See Section 4.2.21.

Monitoring, inspection, and maintenance will be required of the active drainage system pumps and tanks during the SWS period. Portions of the system in the abandoned state do not

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require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.11 Liquid Effluent Monitoring and Sampling System (71750)

The state of the Liquid Effluent Monitoring and Sampling System at the beginning of SWS is described in P-ESR-71750-00001 [Appendix A].

The Liquid Effluent Monitoring and Sampling (LEMS) system monitors discharges to the lake from PNGS-A. LEMS will remain in service in its current configuration during SWS (see Section 10.0).

As systems and equipment are phased out during SWS, the station's reconfigured footprint may allow for relaxed monitoring and sampling requirements. Once the drainage or flows and equipment in the associated drainage/flow areas have been end-stated and no longer contain monitored parameters, LEMS equipment can be made inactive for the remainder of SWS. Details for making the system inactive will be assessed closer to the time of removal from service, utilizing the appropriate process [R-21].

Current existing monitoring, inspection, and maintenance of LEMS will continue during the SWS period (see Section 5.0).

4.2.12 Electrical Power Distribution System (51000)

The state of the PNGS-A Electrical Power Distribution at the beginning of SWS is described in [Appendix A]:

- Main Power Output System: P-ESR-51000-00001
- Class III Electrical System: P-ESR-54100-00001
- Class I and Class II Electrical Systems: P-ESR-55100-00001
- Electrical Auxiliary Systems: P-ESR-58000-00001

The PNGS-A Electrical Power Distribution System provides electrical power throughout the station. During Stabilization of PNGS-A and preparation for the planned refurbishment of PNGS-B, detailed electrical load analyses will be completed based on which systems would be required to remain in service as well as planned system modifications. Distribution on each of the PNGS-A units will vary based on the remaining loads which may be amalgamated to reduce the switchgear requirements.

During SWS, the Main Power Output System will be partially active. The Main Output Transformer and the Generator Service Transformer on all PNGS-A units will be end-stated, and all four SSTs are expected to remain in service. The SSTs will remain operational to provide Class IV power to PNGS-A and to support PNGS-B planned refurbishment, as well as to provide power to the electrode boilers for building heating (see Section 4.2.6.1).

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Portions of the Class III Electrical Distribution System will be in service to supply Class III, Class II, and Class I loads to systems that are required to remain active. The grounding system will remain active for grounding electrical equipment during SWS.

Current monitoring, inspection, and maintenance will be required of the portions of the system that are operational during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.13 Digital Control System (66400) and Pickering A Monitoring Centre

The state of the Digital Control System at the beginning of SWS is described in P-ESR-66400-00001 [Appendix A].

The state of the Data Extraction System at the beginning of SWS is described in P-ESR-66450-00001 [Appendix A].

The Digital Control Computer (DCC) provides the MCR operators with the ability to monitor and control plant systems and respond to alarms. The DCC system and its subordinate systems will remain in service initially during SWS to provide required monitoring and control functions for plant systems that will be operation.

Due to the DCC components reaching end of life, a modification will be implemented to replace the DCC with a new system [R-1], the Pickering A Monitoring Centre (PAMC). The PAMC will replace the functionality of the existing MCRs and DCCs with one centralized monitoring centre located within the Protected Area, to continue to monitor SSCs remaining in service and transmit critical alarms both within the station and off-site. Once the PAMC has been installed and declared in service, the DCC and subordinate systems can be removed from service and abandoned.

The Unit 1 Data Extraction System (DES) will remain in service initially during SWS for monitoring of common station functions. After the PAMC has been installed and declared in-service, the DES can be removed from service and abandoned.

Current surveillance, inspection and maintenance programs will continue to apply to DCC systems that will remain in service. Once installed, the PAMC will require similar monitoring, inspection, and maintenance, which will be detailed in the design package for the new system.

4.2.14 Site Instrumentation Systems (61000)

The state of the Site Instrumentation Systems at the beginning of SWS is described in P-ESR-61000-00001 [Appendix A].

Components of the PNGS-A Seismic Monitoring System must remain in service in SWS for as long as there is a risk of an accidental radiological release originating from IFB-A and AIFB. All other Site Instrumentation System equipment is required for the planned continued operation of PNGS-B and must remain in service (i.e., Lake Current, Meteorological, and Pickering B Seismic and Radiological monitoring).

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Current monitoring, inspection, and maintenance requirements continue to apply for equipment that is remaining in service during the SWS period (see Section 5.0).

4.2.15 Stack Monitoring (67876)

The state of the Stack Monitoring System at the beginning of SWS is described in P-ESR-67876-00001 [Appendix A].

Stack Monitoring will continue to remain in service to support building locations that may contain radioactivity during SWS (see Section 10.0).

Stack Monitors will remain in service until the stack monitor shutdown is approved, as per the applicable process [R-19].

Current existing monitoring, inspection, and maintenance of the stack monitoring system will continue during the SWS period (see Section 5.0).

4.2.16 Communication Systems (60200)

The state of the Communication Systems at the beginning of SWS is described in P-ESR-60200-00001 [Appendix A].

The Communication Systems provides personnel with the ability to perform routine and emergency communications, through a Public Address System, Telephone System, Closed Circuit TV System, Wireless Systems, Suit Communications, Emergency Communications System, and Emergency Preparedness Portable & Mobile Radios. During SWS, these systems will remain in service in their existing configuration to continue to provide both site-wide and station-specific communications to personnel working within PNGS-A.

In the long term, PNGS-A communications systems will be end-stated in areas where the communications are no longer required or demolition activities require the removal of communications components.

Current existing monitoring, inspection, testing, and maintenance of the communication systems will continue during the SWS period (see Section 5.0).

4.2.17 IAEA Safeguards Equipment (35570)

The state of the IAEA Safeguards Equipment at the beginning of SWS is described in P-ESR-35570-00001 [Appendix A].

The Safeguards Equipment installed in PNGS-A belongs to the International Atomic Energy Agency (IAEA) and will remain active in a configuration to be determined by the IAEA and/or CNSC throughout SWS.

Based on OPEX from Units 2 and 3, it is assumed that the core discharge monitors, and fuel bundle counters will be removed from Units 1 and 4 after defueling and dewatering and that seals may be installed on end fittings and fuelling machine bridges, which will remain in place until dismantling and removal of the reactor components (after SWS).

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All PNGS-A safeguards will be maintained until IAEA concurrence that they are no longer required, including power supplies to the IAEA equipment and bay lighting.

Common Services Operations will provide required support for inspections and maintenance conducted by IAEA personnel, in accordance with the system Operating Manual [R-44].

4.2.18 Control Centre Equipment (MCR & CER) (66000)

The state of the Control Centre Equipment at the beginning of SWS is described in P-ESR-66000-00001 [Appendix A].

The Control Centre Equipment in the MCRs and CERs and subordinate systems will remain in service initially during SWS. Once all equipment associated with a given Control Centre panel is end stated and retired, the panel itself may be end stated.

Monitoring, inspection, and maintenance will be required for the panels that will remain in service during the SWS period. Panels in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.19 Cranes, Hoists and Associated Equipment (76100)

The state of the Cranes, Hoists, and Associated Equipment at the beginning of SWS is described in P-ESR-76100-00001 [Appendix A].

Cranes and hoists will be required well into the SWS phase to provide a means for routine handling of process equipment, maintenance equipment, and other material, as well as to execute decommissioning component removals, throughout PNGS-A. The requirements for each crane or hoist vary based on location and support function.

Several cranes have been identified as required frequently during the SWS phase to support activities such as:

- Loading and processing used fuel dry storage containers,
- Movement and inspection of fuel in the IFBs,
- Waste processing activities, including removal of resins and moving shipping containers,
- Maintenance work areas, and
- General SWS and decommissioning work within the work areas of the building support cranes, including Turbine Bay Crane, TAB Crane, and RAB Hatchway Cranes and Hoists.

The lifting equipment supporting these activities will be maintained in Active status, and their operating inspection requirements will be kept. Lifting equipment in areas where little work or maintenance is ongoing during SWS will be set to Conditional operational status, in which it is

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conditionally available pending an assessment and maintenance by qualified crane maintenance personnel.

In addition to the cranes and hoists, specialized equipment is required for the rigging, hoisting, and supporting of the heavy loads generally associated with turbines, generators, and transformers. These assets will remain available for use during SWS and maintained as per the requirements of each support function and piece of equipment.

All common services cranes and hoists that support PNGS-A and/or PNGS-B activities such as Service Wing cranes, Pickering In/Out Transfer System cranes, Maintenance shop cranes, and UPP cranes will be kept Active, as required.

Potential for changes to the crane strategy based on evolution of decommissioning planning will continue throughout the SWS phase, which could impact the long-term planning for cranes, hoists, and associated equipment. Any modification will be outlined in future revisions of the SWS plan.

4.2.20 Emergency Mitigating Equipment (09013)

The state of the Emergency Mitigating Equipment at the beginning of SWS is described in P-ESR-09013-00001 [Appendix A].

Emergency Mitigating Equipment (EME) includes portable equipment such as pumps, generators, support equipment, and telecommunications, and is used in conjunction with existing station systems via EME connection points in Beyond Design Basis Accidents.

The portion of the system that supports the IFB-A and AIFB will be active during SWS until all irradiated fuel is removed from the bays, after which the remaining EME can be removed from service and end-stated.

4.2.21 Radioactive Liquid Waste Management System (79200)

The state of the Radioactive Liquid Waste Management System at the beginning of SWS is described in P-ESR-79200-00001 [Appendix A].

The state of the Condensing System at the beginning of SWS is described in P-ESR-42000-00001 [Appendix A].

The Radioactive Liquid Waste Management System (RLWMS) is located in the Service Wing and handles liquid waste from both PNGS-A and PNGS-B. The RLWMS will remain fully in service during SWS to handle waste generated by PNGS-A as well as to support the planned continued operation of PNGS-B.

During the planned refurbishment of PNGS-B, the dilution flow for RLWMS will be provided by the Unit 1 Condensing System CCW pumps. Monitoring, inspection, and maintenance of these pumps will be required during this period (see Section 5.0).

The RWLMS is a common system located within the PNGS-B operating envelope; thus any monitoring, inspection, and maintenance of the system is outside the scope of SWS. PNGS-A

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will be separated from the RWLMS when no more radioactive liquid wastes are being generated by PNGS-A systems.

4.2.22 D₂O Upgrading Processing Plant

The state of the D₂O Upgrading Processing Plant for A and B Side at the beginning of SWS is described in P-ESR-34600-00001 [Appendix A].

The state of the D₂O Upgrading Plant Sulzer Process and Controls at the beginning of SWS is described in P-ESR-34930-00001 [Appendix A].

The D₂O Upgrading Processing Plant (UPP) is expected to remain in operation early in SWS. During operation, monitoring, inspection, maintenance will be the responsibility of Common Services Operations and is outside the scope of this SWS plan.

A future end-state of the UPP can occur once the facility is no longer required to process heavy water. The facility will be shut down and end-stated for the remainder of SWS. At that future point, monitoring, inspection, and maintenance will be required for the any equipment remaining in service. Equipment in the abandoned state does not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

4.2.23 Heavy Water Storage (38000)

The state of the Heavy Water Storage System at the beginning of SWS is described in P-ESR-38000-00001 [Appendix A].

The state of the D₂O Addition and Transfer System at the beginning of SWS is described in P-ESR-34960-00001 [Appendix A].

The Heavy Water Storage systems will remain active to receive, store, and transfer D₂O removed from PNGS-A during Stabilization prior to transfer to a heavy water management facility.

The common portion of the D₂O Addition and Transfer System will remain in service to support PNGS-B operation, including transfer lines that traverse PNGS-A connecting common systems.

A future end-state of the heavy water storage system can occur once all the D₂O has been removed from PNGS-A. The heavy water system would be shut down and end-stated for the remainder of SWS.

Monitoring, inspection, and maintenance will be required for the portions of the system that will remain in service during the SWS period. Portions of the system in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

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4.2.24 Resin Handling (34500/79000)

The state of the Resin Handling System at the beginning of SWS is described in P-ESR-34500-00001 [Appendix A].

The state of the Radioactive Waste Management System at the beginning of SWS is described in P-ESR-79000-00001 [Appendix A].

The Resin Handling System removes resin from station systems and transports it to resin storage tanks. The spent resin storage tanks will remain active, and transfer of resin from the spent resin tanks using the transfer skids is expected to continue during SWS.

A future end-state could exist during SWS where the spent resin storage tanks may be emptied and end-stated for the remainder of SWS. For Unit 2, the system should only be made inactive once the IFB-A has been end-stated and is no longer generating spent resin.

Existing monitoring, inspection, and maintenance will be required for as long as the spent resin storage tanks remain in service. Portions of the systems in the abandoned state do not require any special considerations except for routine operator rounds for general surveillance (see Section 5.0).

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5.0 MAINTENANCE INSPECTION AND SURVEILLANCE

Maintenance, inspection and surveillance activities during the SWS phase will continue to be planned and executed using the NMS described in the Program Overview DDP Volume 0 [R-5]. The established operations, maintenance, engineering and safety-related programs have the required processes and procedures to enable the safe management of Units 1 to 4 during this phase. This is demonstrated by the U2 and U3 SWS activities that have been in place since 2010.

During Stabilization of U1 and U4, operational and maintenance procedures, including the Master Equipment List (MEL) and Asset Suite 9, will be updated to reflect maintenance and monitoring requirements for the units during SWS. Any changes to requirements will be controlled using OPG's Nuclear Engineering Change Control program, where applicable. If required, changes to existing Programs and governing documents of the NMS will follow the established process. See the Program Overview DDP Volume 0 [R-5].

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6.0 QUALITY ASSURANCE

Quality assurance during SWS phase will follow OPG Nuclear Management System, see Program Overview DDP Volume 0 [R-5].

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7.0 QUALIFICATION AND TRAINING PROGRAM

Qualification and training programs during SWS phase will follow OPG Nuclear Management System, see Program Overview DDP Volume 0 [R-5].

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8.0 HAZARDS IDENTIFICATION AND MITIGATING MEASURES

8.1 Decommissioning Safety Assessment

A decommissioning safety assessment has been performed in accordance with the methodology detailed in the Program Overview DDP Volume 0 [R-5]. Each work package scope systematically identifies potential hazards and evaluate associated risks. The identified hazards and their corresponding mitigation measures have been discussed in the Safety Assessment Report [R-28]. The identified hazards and corresponding mitigation measures are summarized in the table below:

Hazard Category	Hazard/Events Description	Mitigation Measures
Radiological	Potential tritiated exit signs	Characterize the material as needed, remove following OPG Radiation Protection Program [R-18]
	Direct radiation sources from residual water in system	Compliance with OPG Radiation Protection Program [R-18]
	Radioactive liquid spill	Compliance with OPG Radiation Protection Program [R-18] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Loose beta-gamma contamination	Compliance with OPG Radiation Protection Program [R-18] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Fixed contamination in system piping	Compliance with OPG Radiation Protection Program [R-18]
	Failure of radioactive work ventilation during cutting operation	Compliance with OPG Radiation Protection Program [R-18] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
Environmental	Spills from residual oil in tanks and lines, during removal and due to incorrect capping/packaging during lifts and transport	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-21] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
Non-Radiological	Hot work hazards from cutting pipes and equipment	Compliance with OPG's Control Of Ignition Sources And Hot Work Activities [R-46] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Inadequately disconnected circuits from building power supply.	Adequate Safe Work Planning and Pre-Job Briefing [R-29]

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Hazard Category	Hazard/Events Description	Mitigation Measures
	PCBs from lights	Compliance with OPG's Management of Designated Substances procedure [R-31]
	Lead paint	Compliance with OPG's Management of Designated Substances procedure [R-31]
	Mercury in switches and light fixtures	Compliance with OPG's Management of Designated Substances procedure [R-31]
	Animal wastes, bird droppings	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-21] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Working at heights	Compliance with OPG's Working at Heights procedure [R-32] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Inadequate illumination and ventilation in the work area	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-21] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Degraded or degrading structures, systems, and components	Adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Falling objects	Compliance with OPG's Falling Material Control procedure [R-33] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Heavy equipment traffic	Adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Building Collapse	Adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Noise	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-21]
	Dust	Compliance with OPG's Environment Health and Safety Managed Systems Program [R-21]
	Dangerous or faulty equipment	Adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Pinch points	Adequate Safe Work Planning and Pre-Job Briefing [R-29]

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Hazard Category	Hazard/Events Description	Mitigation Measures
	Confined space work	Compliance with OPG's Confined Space Procedures [R-34]
	Fire and explosion hazards from flammable materials and compressed gasses	Compliance with OPG's Control Of Ignition Sources And Hot Work Activities [R-46] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Work area congestion, traffic, proximity to other work areas and facilities	Adequate Safe Work Planning and Pre-Job Briefing [R-29]
	Buried Services	Compliance with OPG's Identification of Buried Or Embedded Services [R-47] and adequate Safe Work Planning and Pre-Job Briefing [R-29]
Unexpected Event	PNGS-B Emergencies	Emergency Management plan [R-23]
	Surveys find radiological material	Characterize the material as needed, cut out and remove following OPG Radiation Protection Program [R-18]
	Asbestos found in insulation or other building materials	Compliance with OPG's Asbestos management procedure [R-45]
	Building collapse	Adequate Safe Work Planning and Pre-Job Briefing [R-29]

Table 1 Hazard Assessment with Mitigation Measures

For any emergent work identified during the DDP/SWS implementation period, the existing NMS change control process will be utilized to evaluate whether the work falls within the existing safety assessment envelope. If the emergent work presents new or different hazards not previously considered, or if risk levels exceed those analyzed in the current safety assessment, an update to the DDP/SWS Safety Assessment will be required prior to proceeding with the work.

8.2 Hazard Control Measures

During SWS, hazards and mitigating measures identified in the Safety Assessment will be managed using existing OPG programs and processes. In particular, the following Programs will continue to be implemented:

- Environmental Health & Safety Managed Systems [R-21] for the management of environmental and conventional hazards,
- Radiation Protection (RP) Program [R-18] for control of radioactive materials,

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- Fire Protection Program [R-30] to minimize the risks and consequences of fires, and
- Work Protection Program [R-36] to ensure worker safety and establishing appropriate barriers from energy sources when completing work.

8.2.1 Transient Hazardous Materials Tracking and Controls

OPG's Environmental Health and Safety Managed Systems [R-21] implements a rigorous process to identify, label, track, store and dispose of all hazardous materials [R-12]. This program will remain in effect throughout the SWS phase to manage any remaining transient hazardous material in the facility [R-12][R-13].

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9.0 ACCESS CONTROL AND ZONING

The RP Program [R-18] shall continue to be implemented during the SWS period. Any changes to radiological zones will be performed in accordance with the RP program and more specifically the process described in Radiological Zoning and Personnel/Material Monitoring [R-17][R-41][R-42][R-43].

RP Equipment will be required throughout the SWS for contamination control and monitoring purposes as radioactive hazards will remain on-site. The state of the RP Equipment at the beginning of SWS is described in P-ESR-78700-00001 [Appendix A].

During SWS, access control will continue to be executed in accordance with Access Control [R-15]. Entry into Unit 2 or Unit 3 Reactor Building [R-16] will be revised to include Unit 1 and 4 once they have been end-stated as part of the SAP [R-1]

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10.0 ENVIRONMENTAL MONITORING AND PROTECTION

The current Environmental Monitoring Program (EMP) [R-19] will continue to be implemented during the SWS period, per the Pickering Nuclear Radioactive & Hazardous Emissions Monitoring Plan [R-20]. As systems are isolated and end-stated and it has been determined that an effluent no longer meets the criteria for inclusion, an emissions monitoring modification will be submitted to remove the monitoring stream, as per the EMP.

Site groundwater monitoring at PNGS is guided by Environment Health and Safety Managed System [R-21] and adheres to Groundwater Protection and Monitoring Program [R-22], and will continue to be managed under this program for the SWS phase.

OPG is undertaking a Predictive Environmental Risk Assessment to determine the impact of the decommissioning of PNGS-A as well as the planned refurbishment of PNGS-B (see DDP Volume 0 [R-5]).

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11.0 EMERGENCY PLAN AND PROCEDURES

The current Consolidated Nuclear Emergency Plan (CNEP) [R-24] shall continue to be implemented during SWS. Its purpose is to provide a written basis to document the concepts, roles, and capability to protect the public, employees, and the environment in the event of a nuclear emergency. It provides a framework for interaction with external authorities and defines OPG commitments under the Provincial Nuclear Emergency Response Plan (PNERP) [R-25].

Site instructions to implement requirements of the CNEP are described in OPG Emergency Response Manual [R-23] for Pickering.

12.0 WASTE MANAGEMENT

Waste Management during SWS will be performed in accordance with OPG's Environment Health and Safety Managed System [R-21], Management of Waste and Other Environmentally Regulated Materials Standard [R-14], the Nuclear Waste Management Program [R-39], and the Radioactive Material Transportation Program [R-40]. The programs and standard outline the requirements for management of radiological and conventional waste streams, as well as other environmentally regulated materials within OPG ensuring compliance with all Federal and Provincial requirements.

DDP Volume 0 discusses the waste management plan including all activities necessary to remove waste generated or reduce hazards at the facility during the SWS period. DDP Volume 0 also covers the SWS IFB activities and the expected waste associated with that work is provided in Table 2 [R-37].

	LLW (m ³)	ILW (m ³)
IFB-A	1,559	22
A-FIB	369	14
Total	1,928	36

Table 2: Estimated LLW & ILW Volumes for Work Package 1-4 for IFBA and AFIB

Waste generated in maintaining the SSCs during SWS are estimated to be 15m³/ year of LLW consisting of personal protective equipment, replaced equipment, and other consumables generated from SWS activities.

During SWS, risk reduction activities may be undertaken to reduce risks and/or hazards at the facility; this includes activities in DDP Volume 1 [R-26] and Volume 2 [R-27]. The Program Overview DDP Volume 0 [R-5] includes details on risk reduction activities contemplated for this SWS period.

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13.0 RECORDS

See the Program Overview DDP Volume 0 [R-5] for the process used for records during the SWS period.

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15.0 ACRONYMS

Acronym	Definition
AIFB	Auxiliary Irradiated Fuel Bay
CCR	Code Compliance Review
CCW	Condenser Cooling Water
CER	Control Equipment Rooms
CNEP	Consolidated Nuclear Emergency Plan
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
CWS	Common Water System
D ₂ O	Heavy Water
DCC	Digital Control Computer
DDP	Detailed Decommissioning Plan
DES	Data Extraction System
EME	Emergency Mitigating Equipment
EMP	Environmental Monitoring Program
ESDR	End State Determination Report
ESR	End State Report
FHA	Fire Hazard Assessment
HP	High Pressure
HVAC	Heating, Ventilation and Cooling
IAEA	International Atomic Energy Agency
IFB	Irradiated Fuel Bay
IFB-A	Irradiated Fuel Bay for PNGS-A
ILW	Intermediate Level Waste
IXCU	Ion Exchange Clean-up
LEMS	Liquid Effluent Monitoring and Sampling

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Acronym	Definition
LLW	Low Level Waste
MCR	Main Control Room
MEL	Master Equipment List
NBCC	National Building Code of Canada
NFC	National Fire Code
NMS	Nuclear Management System
OPEX	Operating Experience
OPG	Ontario Power Generation
PAMC	Pickering A Monitoring Center
PNERP	Provincial Nuclear Emergency Response Plan
PNGS	Pickering Nuclear Generating Station
PNGS-A	Pickering Nuclear Generating Station A
PNGS-B	Pickering Nuclear Generating Station B
PRD	Pressure Relief Duct
RAB	Reactor Auxiliary Building
RB	Reactor Building
REGDOC	Regulatory Document
RLWMS	Radioactive Liquid Waste Management System
RP	Radiation Protection
SAP	Stabilization Activity Plan
SES	Site Electrical System
SESD	System End State Declaration
SSC	System, Structure or Component
SST	Station Service Transformers
SWS	Storage With Surveillance
TAB	Turbine Auxiliary Bay

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Acronym	Definition
TH	Turbine Hall
U1	Pickering Unit 1
U2	Pickering Unit 2
U3	Pickering Unit 3
U4	Pickering Unit 4
U5	Pickering Unit 5
U8	Pickering Unit 8
UPP	Upgrading Processing Plant
VB	Vacuum Building

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PNGS-A Storage with Surveillance Plan**Appendix A: ESDRs for Active Systems Supporting SWS**

Document Number	ESDR Title
P-ESR-09013-00001	Emergency Mitigating Equipment
P-ESR-25000-00001	Pickering End State Determination Report Vacuum Building and Ducts
P-ESR-29500-00001	Pickering A - Auxiliary Irradiated Fuel Bay End State Determination Report
P-ESR-32000-00001	Pickering End State Determination Report for Safe Storage. Moderator And Auxiliaries
P-ESR-33350-00001	Pickering End State Determination Report - Emergency Coolant Injection for All Units
P-ESR-34400-00001	Pickering A - Irradiated Fuel Storage Bay
P-ESR-34500-00001	Pickering A Resin Handling System End State Determination Report
P-ESR-34600-00001	D ₂ O Upgrading Processing Plant for A and B Side
P-ESR-34930-00001	D ₂ O Upgrading Plant Sulzer Process and Controls
P-ESR-34970-00001	D ₂ O Ion Exchange Cleanup System End State Determination Report
P-ESR-35500-00001	Irradiated Fuel Inspection and Storage
P-ESR-35570-00001	IAEA Safeguards Equipment
P-ESR-35600-00001	Irradiated Fuel Bay Shipping Facilities
P-ESR-38000-00001	Heavy Water
P-ESR-42000-00001	Pickering ESDR - Units 1 And 4 Condensing System
P-ESR-51000-00001	Main Power Output System
P-ESR-54100-00001	Class III Electrical System
P-ESR-55100-00002	Pickering A - Class I And Class II
P-ESR-58000-00001	Electrical Auxiliary Systems
P-ESR-60200-00001	Communication Systems
P-ESR-61000-00001	Pickering A And B Site Instrumentation Systems
P-ESR-66000-00001	Control Centre Equipment MCR-CER

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Document Number	ESDR Title
P-ESR-66450-00001	Pickering A - Data Extraction System ESDR
P-ESR-67140-00001	Pickering A - Fire Detection and Alarm System
P-ESR-67876-00001	Stack Monitoring
P-ESR-71100-00001	Pickering 018 - Common Water System
P-ESR-71300-00001	Service Water System
P-ESR-71400-00001	Fire Water Supply Configuration
P-ESR-71500-00001	Domestic Water and Sewer
P-ESR-71620-00001	Demineralized Water System
P-ESR-71710-00001	Inactive Drainage System
P-ESR-71720-00001	Pickering A and B Active Drainage
P-ESR-71750-00001	Liquid Effluent Monitoring and Sampling System for PNGS-A And PNGS-B
P-ESR-73000-00001	Powerhouse Steam Distribution and HVAC System (TH And TAB)
P-ESR-73000-00002	RB RAB Heating and Ventilation
P-ESR-73000-00004	Control Rooms and CERS HVAC
P-ESR-73000-00006	HVAC - Battery and Electrical Enclosure Rooms - Pickering End State Determination Report
P-ESR-73000-00009	Miscellaneous And Outside Buildings HVAC
P-ESR-75110-00001	Pickering A Service Air
P-ESR-75120-00001	Pickering 014 Low- and High-Pressure Instrument Air
P-ESR-75140-00001	Pickering 018 - Breathing Air System
P-ESR-75700-00001	Pickering - Nitrogen System End State Determination Report
P-ESR-76100-00001	Cranes and Hoists
P-ESR-78700-00001	Radiation Protection Equipment
P-ESR-79000-00001	Radioactive Waste Management
P-ESR-79200-00001	Radioactive Liquid Waste Management System

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Appendix B: Compliance Matrix

REG DOC 2.11.2 Section	REG DOC Section Requirement Description	CSA N294:19 Section	CSA Requirement Description	SWS Section
N/A	N/A	Annex B.1	Introduction	Section 1.0
N/A	N/A	Annex B.2	Responsibilities	Section 2.0
7.3 (1 st Bullet)	A description of the SSCs necessary for the storage with surveillance period, and anticipated for decontamination and dismantling activities	Annex B.3	Functional services and systems	Section 4.0
7.3 (2 nd Bullet)	The process to ensure that changes or modifications to SSCs are controlled	Annex B.10	Facility change or modification process	Section 3.0
7.3 (3 rd Bullet)	Maintenance, inspection, and surveillance activities	Annex B.4	Maintenance inspection and surveillance	Section 5.0
7.3 (4 th Bullet)	The identification (nature and source) of hazards, both radiological and non-radiological, and procedures or technologies proposed to mitigate them	Annex B.5	Hazard Identification	Section 8.0
		Annex B.6	Hazard Control Measures	Section 8.0
7.3 (5 th Bullet)	A description of the zoning, and means to ensure access control	Annex B.7	Access control and zoning	Section 9.0
7.3 (6 th Bullet)	Environmental protection measures that will be employed to mitigate and monitor environmental effects	Annex B.8	Environmental monitoring & protection	Section 10.0
7.3 (7 th Bullet)	Waste management activities necessary to remove waste from operations or to reduce hazards at the facility during the storage with surveillance period, including any secondary wastes	Annex B.11	Waste management	Section 12.0
7.3 (8 th Bullet)	Applicable programs (e.g., management system, training program, emergency preparedness program)	Annex B.9	Emergency plan and procedures Qualification and training program	Section 11.0

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REG DOC 2.11.2 Section	REG DOC Section Requirement Description	CSA N294:19 Section	CSA Requirement Description	SWS Section
		Annex B.12	Quality Assurance	Section 6.0
		Annex B.13	Qualification and Training Program	Section 7.0
7.3 (9 th Bullet)	A description of the records that will be maintained to periodically update the storage with surveillance plan	Annex B.14	Records	Section 13.0

Reference 3

**CNSC Letter, Dr. T. Berube to OPG, “Record of Decision DEC 22-H104 –
Application for
Acceptance of Ontario Power Generation’s Revised Consolidated Financial
Guarantee”,
December 6, 2022, e-Doc 6930798, CD# N-CORR-00531-23514.**



Record of Decision

DEC 22-H104

In the Matter of

Applicant Ontario Power Generation Inc.

Subject Application for Acceptance of Ontario Power
Generation's Revised Consolidated Financial
Guarantee

Date of
Decision December 6, 2022

RECORD OF DECISION – DEC 22-H104

Applicant: Ontario Power Generation

Address/Location: 700 University Avenue, Toronto, Ontario, M5G 1X6

Purpose: Application for Acceptance of Ontario Power
Generation's Revised Consolidated Financial Guarantee

Application received: August 2, 2022

Hearing: Public Hearing in Writing – Notice of Hearing in Writing
published on August 10, 2022

Date of decision: December 6, 2022

Panel of Commission: Dr. T. Berube, Presiding Member

Financial Guarantee: Accepted

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1.0 INTRODUCTION

1. On [August 2, 2022](#), Ontario Power Generation Inc. (OPG) submitted an application to the Canadian Nuclear Safety Commission¹ (CNSC) for the acceptance of its revised consolidated financial guarantee for the future decommissioning of OPG's nuclear facilities. OPG's current consolidated financial guarantee expires on December 31, 2022. OPG requested that the Commission accept the revised financial guarantee for the 2023-2027 period.
2. The facilities under OPG's consolidated financial guarantee, along with their current operating licences, are as follows:
 - Darlington Nuclear Generating Station (PROL 13.03/2025)
 - Darlington Waste Management Facility (WFOL-W4-355.01/2023)
 - Pickering A and B Nuclear Generating Station (PROL 48.01/2028)
 - Pickering Waste Management Facility (WFOL-W4-350.00/2028)
 - Bruce A and B Nuclear Generating Station² (PROL 18.02/2028)
 - Central Maintenance Facility (under PROL 18.02/2028)
 - Central Storage Facility³ (under PROL 18.02/2028)
 - Western Waste Management Facility (WFOL-W4-314.00/2027)
 - Radioactive Waste Operations Site-1 (WNSL-W1-320.05/2029)
3. OPG's nuclear facilities are located at various sites in the province of Ontario. The Pickering and Darlington Nuclear Generating Stations are located in the traditional territory of the Michi Saagiig Anishinaabe people. These lands are covered by the Williams Treaty between Canada and the Mississauga and Chippewa Nations. The Bruce Nuclear Generating Station location is in the traditional territory of the Anishinabek Nation: the peoples of the 3 fires known as Ojibway, Odawa and Pottawatomie Nations. Thanks are given to the Chippewas of Saugeen, and the Chippewas of Nawash, now known as the Saugeen Ojibway Nation, as the traditional keepers of this land. The Bruce region is also homeland to the Historic Saugeen Métis and to the Métis Nation of Ontario.
4. Subsection 24(5) of the [Nuclear Safety and Control Act](#)⁴ (NSCA) provides that a licence may contain any term or condition that the Commission considers necessary for the purposes of the NSCA, including a condition that an applicant provide a financial guarantee in a form that is acceptable to the Commission. The Commission has imposed such licence conditions requiring that OPG maintain an acceptable financial guarantee for the future decommissioning of its nuclear facilities. CNSC regulatory document

¹ The *Canadian Nuclear Safety Commission* is referred to as the "CNSC" when referring to the organization and its staff in general, and as the "Commission" when referring to the tribunal component.

² Although operated by Bruce Power, OPG retains ownership of and responsibility for the decommissioning costs associated with the Bruce A and B Nuclear Generating Stations.

³ The Central Storage Facility is also referred to as the Contaminated Tools Storage Facility or the Contaminated Tooling Storage Facility. The CSF is a newly constructed storage facility to support the Major Component Replacement outages at the Bruce A and B Nuclear Generating Stations.

⁴ Statutes of Canada (S.C.) 1997, c. 9.

[REGDOC 3.3.1 Financial guarantees for decommissioning of nuclear facilities and termination of licensed activities](#)⁵ provides guidance on the attributes of an acceptable financial guarantee in terms of liquidity, certainty of value, adequacy of value, and continuity.

5. OPG's current consolidated financial guarantee is satisfied by the "Nuclear Funds" which consist of Ontario Nuclear Funds Agreement (ONFA) Funds and the Nuclear Fuel Waste Act (NWFA) Trust. The Nuclear Funds are discussed further in Section 3.2 of this *Record of Decision*. OPG proposed that its financial guarantee continue to be satisfied by the Nuclear Funds for the 2023-2027 period.

Issue

6. OPG is required to maintain a financial guarantee for the decommissioning of the nuclear facilities listed in paragraph 2 of this *Record of Decision*, per the conditions of the facilities' respective licences. OPG is required to revise its financial guarantee and associated decommissioning plans at least every 5 years or when requested by the Commission. As such, OPG has revised the preliminary decommissioning plans, the associated cost estimates, and the financial guarantee for the 2023-2027 period. OPG is requesting that the Commission accept its revised financial guarantee.

Panel

7. Pursuant to section 22 of the NSCA, the President established a panel of the Commission consisting of Dr. Timothy Berube to consider the application. A [notice of hearing in writing](#) was published on August 10, 2022. The Commission, in conducting a public hearing based on written materials, considered written submissions from OPG ([CMD 22-H104.1](#)) and CNSC staff ([CMD 22-H104](#)). The Commission also considered a written intervention from the Nuclear Transparency Project ([CMD 22-H104.2](#)).

Participant Funding Program

8. Pursuant to paragraph 21(1)(b.1) of the NSCA, the Commission has established a [Participant Funding Program](#) (PFP) to facilitate the participation of Indigenous Nations and communities, members of the public and stakeholders in Commission Proceedings or in engagement activities with CNSC staff on matters of regulatory interest. Participant Funding was not made available for this hearing in writing, however, the CNSC received a request for funding from the Nuclear Transparency Project to facilitate their engagement with CNSC staff on this matter. In accordance with the PFP process, the CNSC subsequently provided the Nuclear Transparency Project with \$3,000 to meet with CNSC staff, review the CMDs on the record for this hearing, and to submit an intervention.

⁵ REGDOC-3.3.1 *Financial guarantees for decommissioning of nuclear facilities and termination of licensed activities*, CNSC, January 2021

2.0 DECISION

9. Based on its consideration of this matter, as described in more detail in the following sections of this *Record of Decision*, the Commission concludes that the proposed revised financial guarantee for the future decommissioning of OPG's nuclear facilities is acceptable.

Therefore,

the Commission, pursuant to licence conditions imposed on OPG under section 24(5) of the *Nuclear Safety and Control Act*, accepts the revised consolidated financial guarantee proposed by Ontario Power Generation Inc. for its nuclear facilities located in Ontario for the period from 2023-2027.

10. With this decision, the Commission accepts OPG's revised financial guarantee of \$20,480 million (January 1, 2023 present value dollars), increasing on a yearly basis to \$22,303 million in 2027, as described in Schedule B of the Fifth Amending Agreement.⁶ The Commission accepts OPG's proposed financial guarantee instruments in the form of the Nuclear Funds.
11. The Commission is satisfied that, with this decision, the CNSC Financial Security and ONFA Access Agreement shall be amended to reflect the revised financial guarantee amount in accordance with the Fifth Amending Agreement no later than December 31, 2022.

3.0 ISSUES AND COMMISSION FINDINGS

12. The Commission assessed the evidence submitted on the record for this hearing and considered the acceptability of OPG's proposed revised financial guarantee. The Commission considered whether the proposed financial guarantee met the criteria set out in REGDOC 3.3.1 and whether OPG would satisfy the applicable licence conditions for each facility. Each of the nuclear facility licences have a licence condition requiring the Commission's acceptance of its financial guarantee. With the exception of PROL 18.02/2028, each licence has a condition that states:

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

Bruce Power's licence for the Bruce A and B NGS licence, PROL 18.02/2028, contains licence condition 11.2 which states that:

"The licensee shall notify the Commission of any changes regarding the obligations of decommissioning and financial guarantees under the Lease Agreement with Ontario

⁶ Attachment 1, [CMD 22-H104.1](#)

Power Generation Inc., as described in 15.1”.

3.1 Decommissioning Plans and Cost Estimates

13. OPG submitted information on the revised preliminary decommissioning plans for its nuclear generating stations, nuclear waste management facilities, and other nuclear facilities, and provided information on its plans for the management of used nuclear fuel and low and intermediate level waste.⁷
14. OPG provided the Commission with the cost estimates for its various decommissioning programs from January 1, 2023 onwards and with information on the methodology used to calculate the cost estimates.^{8, 9} OPG reported that the total decommissioning cost estimate for 2023 is \$20,480 million (January 1, 2023 present value dollars¹⁰), increasing to \$22,303 million in 2027, as shown in Table 1.¹¹

Table 1: Proposed 2023-2027 Total Financial Guarantee Cost Estimate

Year	Total Cost Estimate (M\$)
2023	20,480
2024	21,149
2025	21,764
2026	22,140
2027	22,303

15. OPG submitted that the total revised cost estimate for January 1, 2023 had increased by \$919 million, to \$20,480 million, since the last review in 2017.¹² OPG explained that this increase was due to updated planning assumptions including: updated nuclear generating station end of life dates, cancellation of OPG’s proposed low and intermediate level waste deep geological repository project, and updated waste management costs.
16. CNSC staff assessed OPG’s preliminary decommissioning plans and found that the revised plans provide a basis for credible cost estimate for the future decommissioning of OPG’s nuclear facilities.¹³ CNSC staff confirmed that OPG’s cost estimation methodology is aligned with both international practices for decommissioning cost estimation and with REGDOC 3.3.1.¹⁴

⁷ Section 3.0, [CMD 22-H104.1](#)

⁸ Tables 2 to 6, [CMD 22-H104.1](#)

⁹ Section 4.0, [CMD 22-H104.1](#)

¹⁰ Dollar amounts in this *Record of Decision* are in 2023 present value dollars unless otherwise indicated.

¹¹ Table 7, [CMD 22-H104.1](#)

¹² Appendix D, [CMD 22-H104.1](#)

¹³ Section 3.1, [CMD 22-H104](#)

¹⁴ Section 2.2.3, [CMD 22-H104](#)

3.2 Financial Guarantee

17. OPG proposed that its financial guarantee continue to be satisfied by the Nuclear Funds. The Nuclear Funds consist of Ontario Nuclear Funds Agreement (ONFA) Funds, pursuant to [O. Reg. 53/05: PAYMENTS UNDER SECTION 78.1 OF THE ACT](#)¹⁵, and the Nuclear Fuel Waste Act (NWFA) Trust, pursuant to the [Nuclear Fuel Waste Act](#).¹⁶ CNSC staff provided detailed information on each of these funds in section 2.1 of CMD 22-H104.
18. OPG submitted that the Nuclear Funds are projected to have a fair market value in excess of the proposed cost estimate throughout the 2023-2027 period. The fair market value of the Nuclear Funds is projected to be \$25,148 million on January 1, 2023 and increase to \$28,250 million by January 1, 2027, as shown in Table 2.¹⁷

Table 2: 2023-2027 Forecasted Fair Market Value of the Nuclear Funds

Year	Nuclear Funds (M\$)
2023	25,148
2024	26,102
2025	27,011
2026	27,768
2027	28,250

19. CNSC staff provided the Commission with information on the Provincial Guarantee, a guarantee made payable to the CNSC by the Province of Ontario should OPG not meet its decommissioning obligations. CNSC staff noted that OPG met the financial guarantee requirement for the 2018-2022 period without provision of the Provincial Guarantee, and that, given that the value of the Nuclear Funds is projected to exceed the total financial guarantee, OPG anticipates that the Provincial Guarantee will not be required for the 2023-2027 period. CNSC staff assessed OPG's financial guarantee proposal and concurred with OPG that, at this time, a Provincial Guarantee is not required for the 2023-2027 period.¹⁸
20. OPG provided a draft of the Fifth Amending Agreement to the CNSC Financial Security and ONFA Access Agreement.¹⁹ The primary purpose of the amendment is to update the financial guarantee amount on a yearly basis from 2023-2027. CNSC staff confirmed that, should the Commission accept OPG's proposed financial guarantee, the Fifth Amending Agreement will be signed by the parties responsible for its execution.²⁰
21. CNSC staff assessed OPG's revised financial guarantee against the criteria set out in

¹⁵ O. Reg 53/05 under the [Ontario Energy Board Act](#), S.O. 1998, c.15, Sched B

¹⁶ S.C. 2002, c. 23

¹⁷ Table 8, [CMD 22-H104.1](#)

¹⁸ Section 2.2.5, [CMD 22-H104](#)

¹⁹ Attachment 1, [CMD 22-H104.1](#)

²⁰ Section 2.2.5, [CMD 22-H104](#)

REGDOC 3.3.1 and determined that the financial guarantee met the criteria pertaining to liquidity, certainty of value, adequacy of value, and continuity.²¹ CNSC staff reported that OPG's proposed financial guarantee for the 2023-2027 period is adequate for the decommissioning of the facilities and recommended that the Commission accept the revised consolidated financial guarantee.²²

22. CNSC staff confirmed that OPG is required to report annually to the CNSC on the status and adequacy of the financial guarantee. CNSC staff reported that OPG has satisfied this requirement throughout the current financial guarantee term through the submission of an annual written report and ONFA year-end statements.²³

3.3 Intervention

23. The intervention by the Nuclear Transparency Project ([CMD 22-H104.2](#)) provided several recommendations pertaining to transparency and accessibility of financial guarantee information. The Commission acknowledges the importance of transparency and encourages OPG and CNSC staff to continue to make relevant financial guarantee information available to the public and to consider the recommendations raised by this intervenor.

3.4 Commission Findings

24. Following the Commission's analysis of the evidence submitted on the record for this hearing, the Commission concludes that OPG's proposed financial guarantee instruments and revised financial guarantee amount are acceptable. The Commission is satisfied that OPG's revised preliminary decommissioning plans provide the basis for a credible cost estimate. The Commission is also satisfied that OPG continues to meet licensing requirements related to financial guarantees. The Commission comes to these conclusions on the basis that:
- The Commission agrees with CNSC staff's assessment that OPG's financial guarantee submission meets the criteria set out in REGDOC-3.3.1.
 - The Commission agrees with CNSC staff's assessment that OPG's revised preliminary decommissioning plans provide the basis for a credible cost estimate for the future decommissioning of the nuclear facilities covered under OPG's consolidated financial guarantee.
 - The Commission is satisfied that the Nuclear Funds are appropriate financial guarantee instruments per REGDOC 3.3.1.
 - The Commission agrees with CNSC staff's assessment that the proposed consolidated financial guarantee is adequate for the future decommissioning of the nuclear facilities covered under OPG's consolidated financial guarantee.

²¹ Executive Summary, [CMD 22-H104.1](#)

²² Section 3, [CMD 22-H104](#)

²³ Section 2.2.6, CMD 22-H104

25. The Commission notes that OPG is required to report annually to the CNSC on the status and adequacy of the financial guarantee. The Commission expects to be notified if CNSC staff identify any concerns with the adequacy of the financial guarantee in its review of the annual reports.
26. The Commission expects to be informed should there be an impact on decommissioning cost estimates due to revised decommissioning timelines, such as any future changes to the anticipated end of life dates of the nuclear facilities.

4.0 CONCLUSION

27. The Commission concludes that OPG's proposed revised financial guarantee will continue to provide for the future decommissioning of OPG's nuclear facilities. Therefore, the Commission accepts OPG's proposed revised financial guarantee for 2023-2027. The Commission is satisfied that, with this decision, the CNSC Financial Security and ONFA Access Agreement shall be amended to reflect the revised financial guarantee amount in accordance with the Fifth Amending Agreement.

**Timothy
Berube**

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Dr. Timothy Berube
Presiding Member,
Canadian Nuclear Safety Commission

Date