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Title:

PNGS-A Detailed Decommissioning Plan Volume 0 - Program Overview

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**PNGS-A Detailed Decommissioning
Plan Volume 0 - Program Overview****NA44-PLAN-00960-00004-00**

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Revision Summary

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R00	2024-12-02	Initial issue.

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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.

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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.

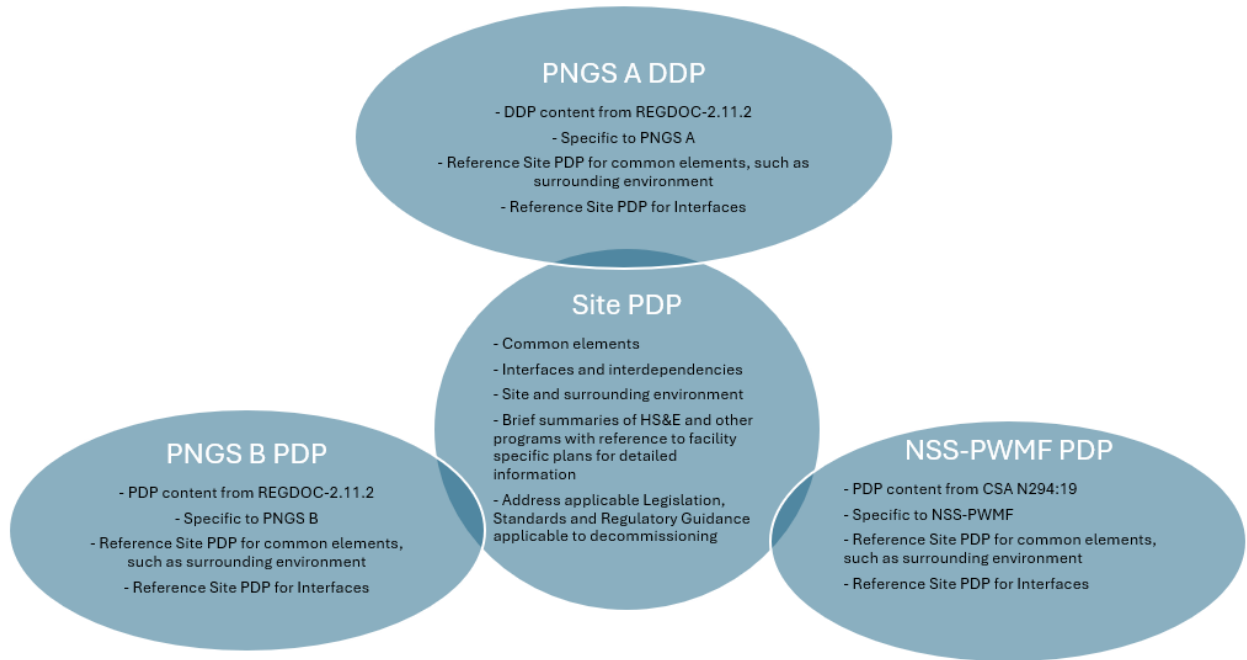


Figure 1 Pickering Decommissioning Plans Interface

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

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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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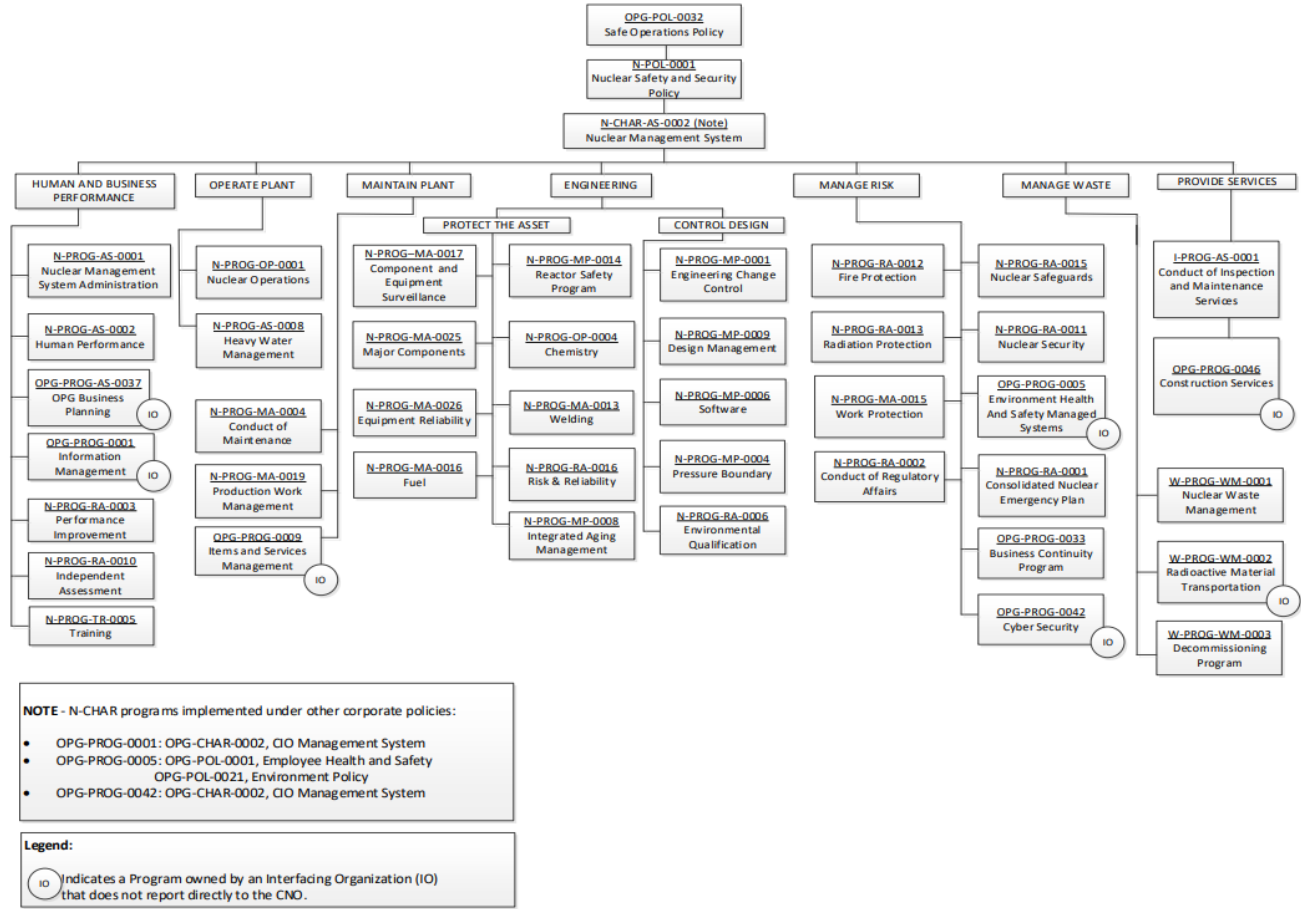


Figure 2 Management System Framework

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:

- (a) 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 Licences (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.

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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.

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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.

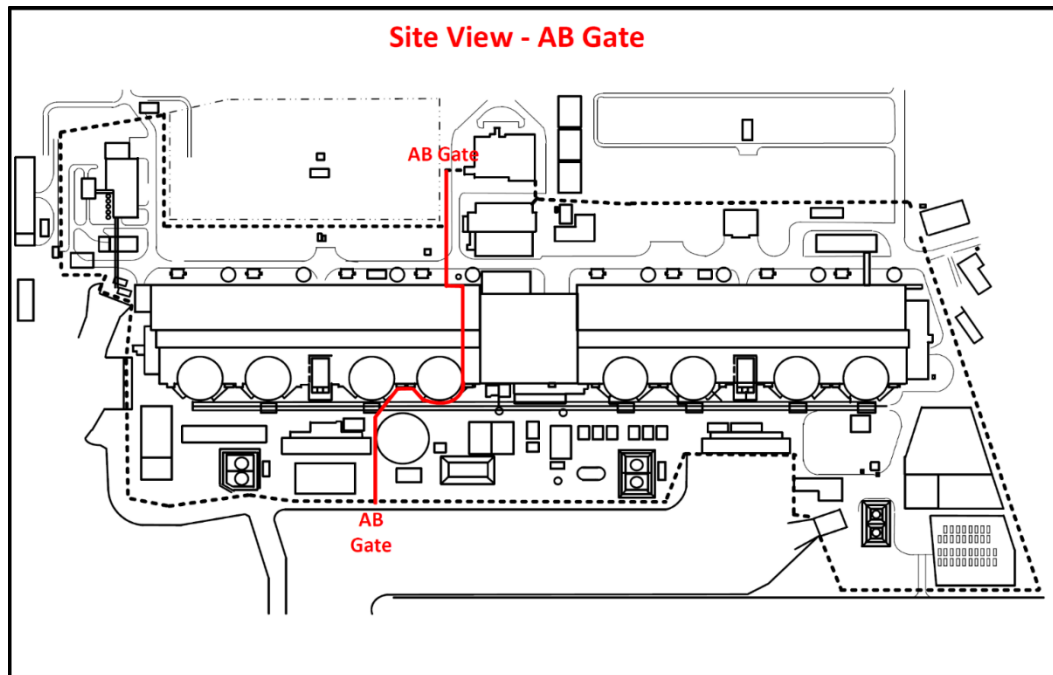


Figure 3 AB Gate

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].

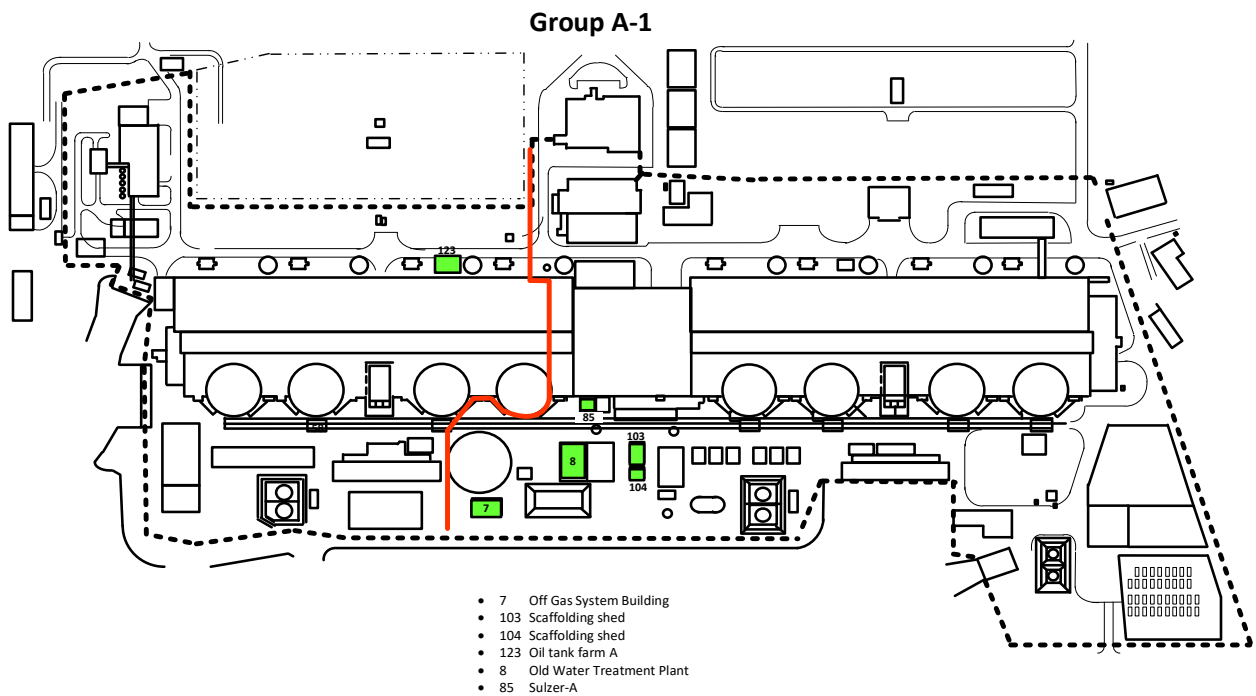


Figure 4 Planning Envelope A – Group A-1 Out Buildings Highlighted in Green

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Group A-2

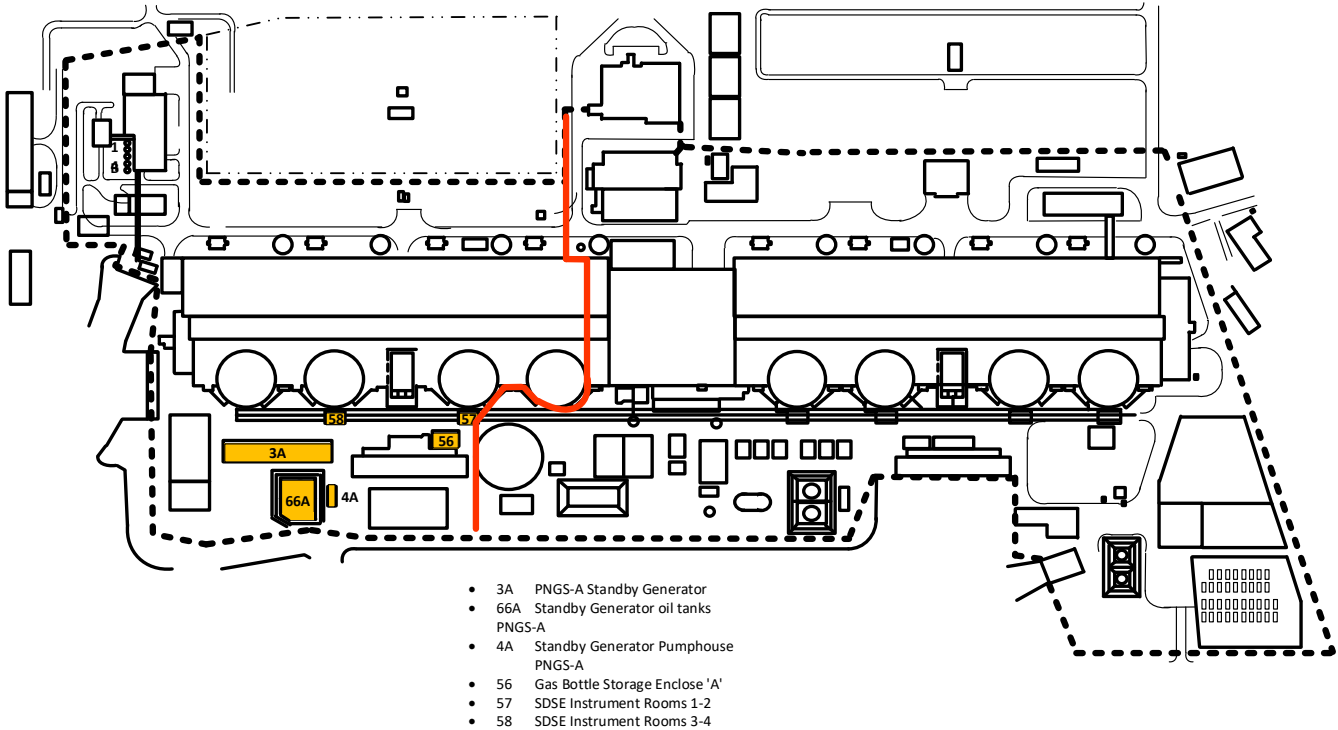


Figure 5 Planning Envelope A - Group A-2 Out Buildings Highlighted in Orange

Group A-3

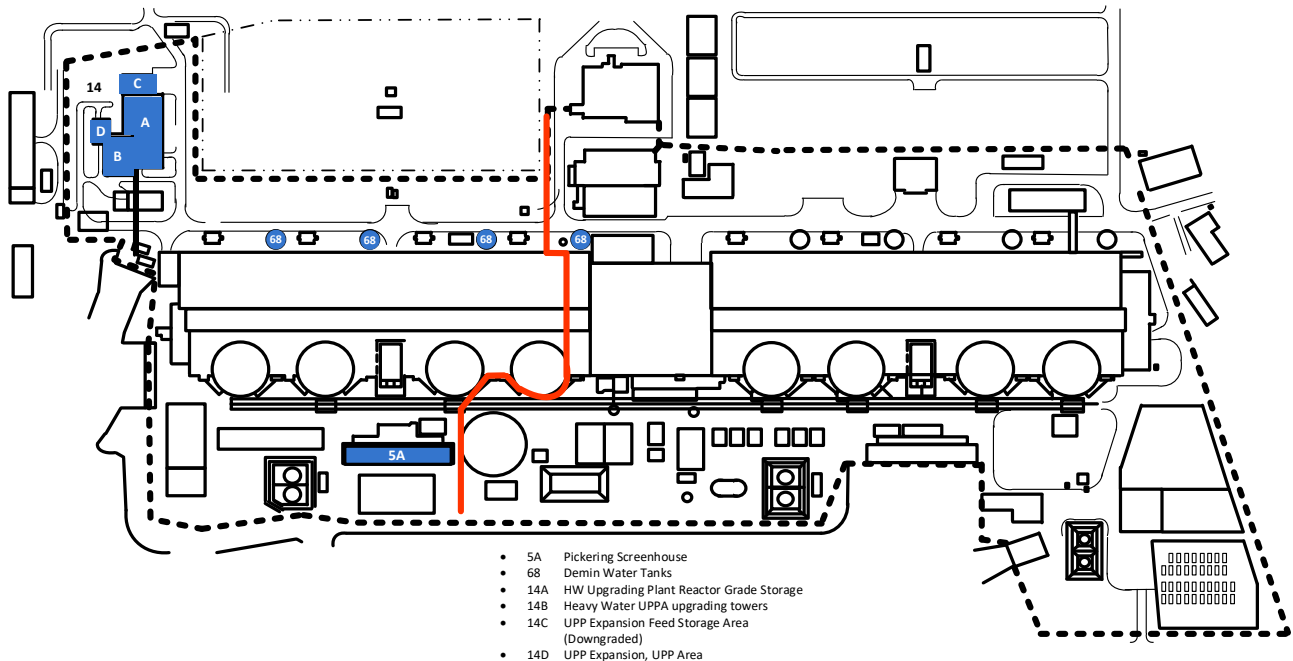


Figure 6 Planning Envelope A - Group A-3 Out Buildings Highlighted in Blue

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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.

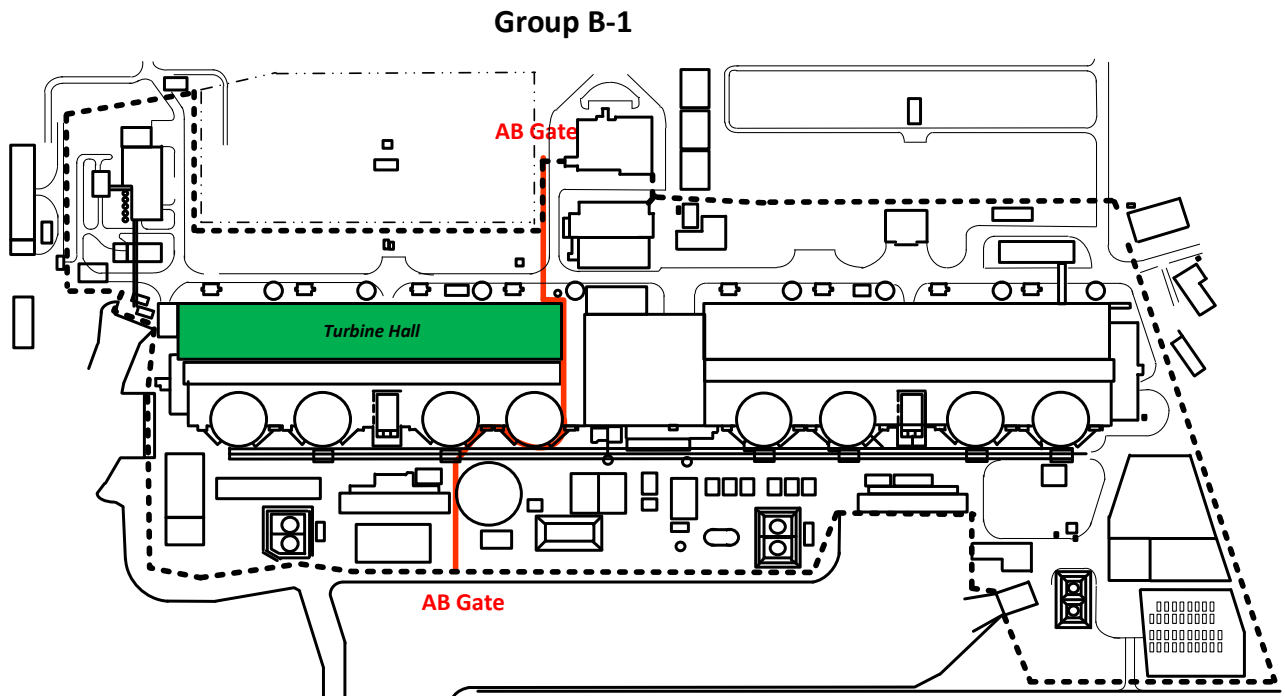


Figure 7 Planning Envelope B - Group B-1

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Group B-2

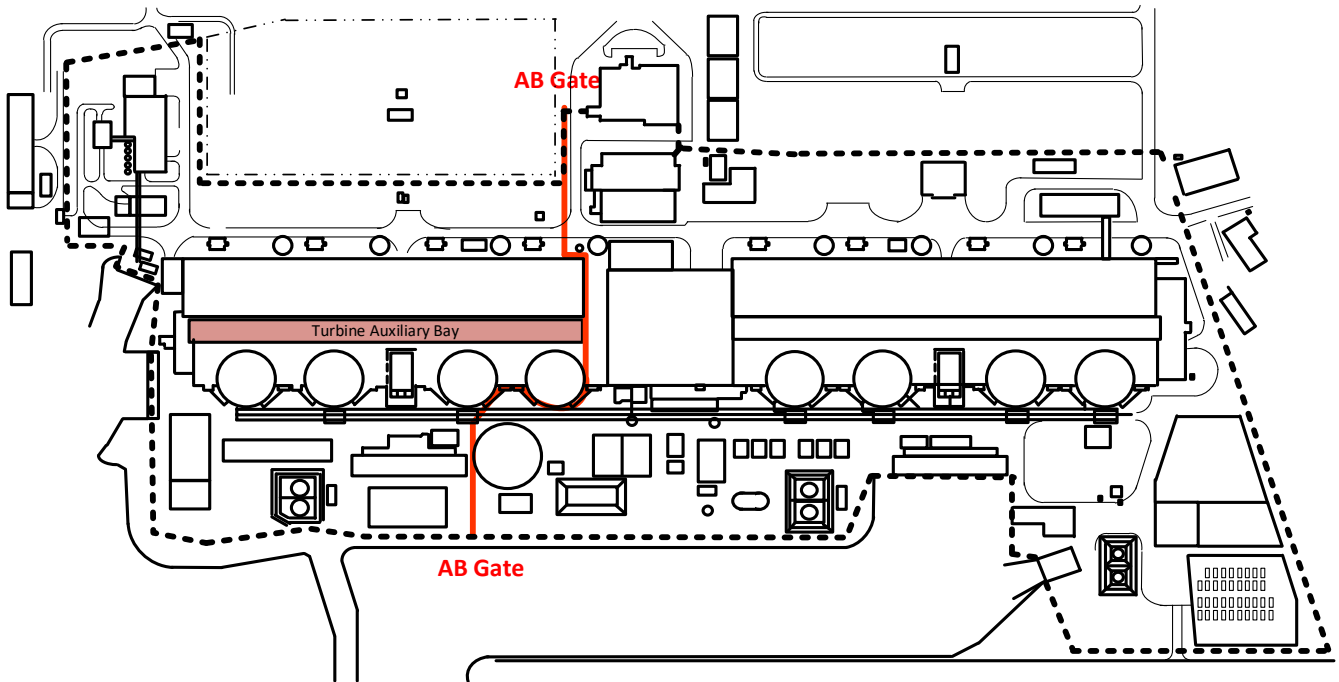


Figure 8 Planning Envelope B - Group B-2

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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

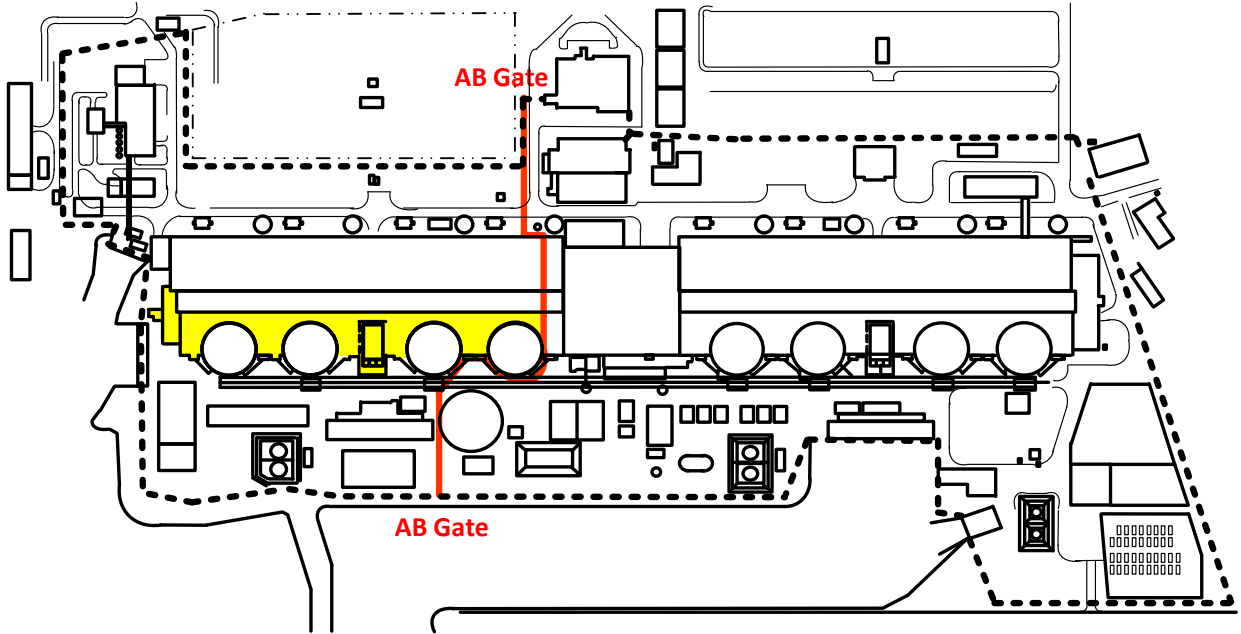


Figure 9 Planning Envelope C - Group C-1

Group C-2

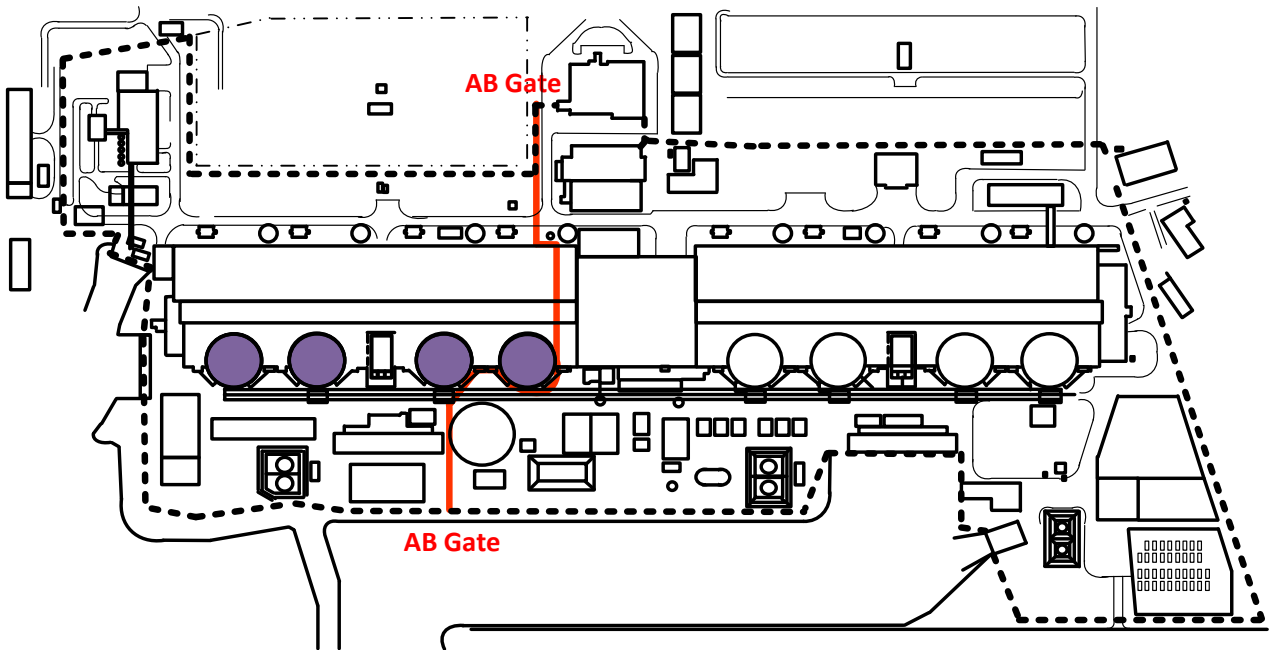


Figure 10 Planning Envelope C - Group C-2

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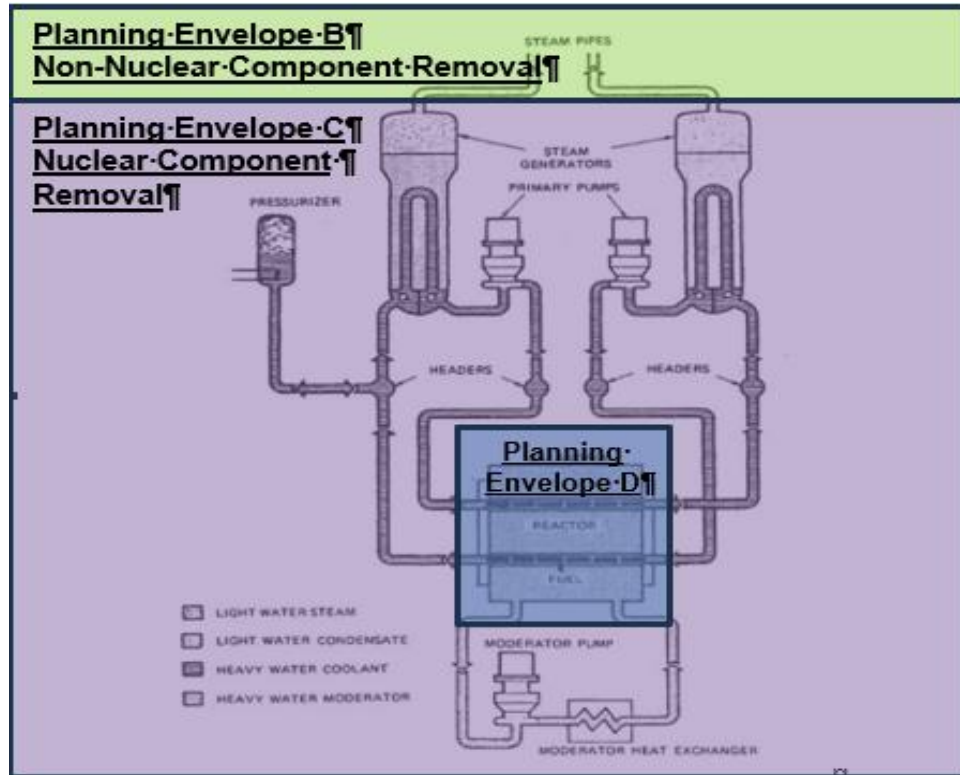


Figure 11 PNGS-A Primary Heat Transport System Breakdown Between Planning Envelopes B, C and D

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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,

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- 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.

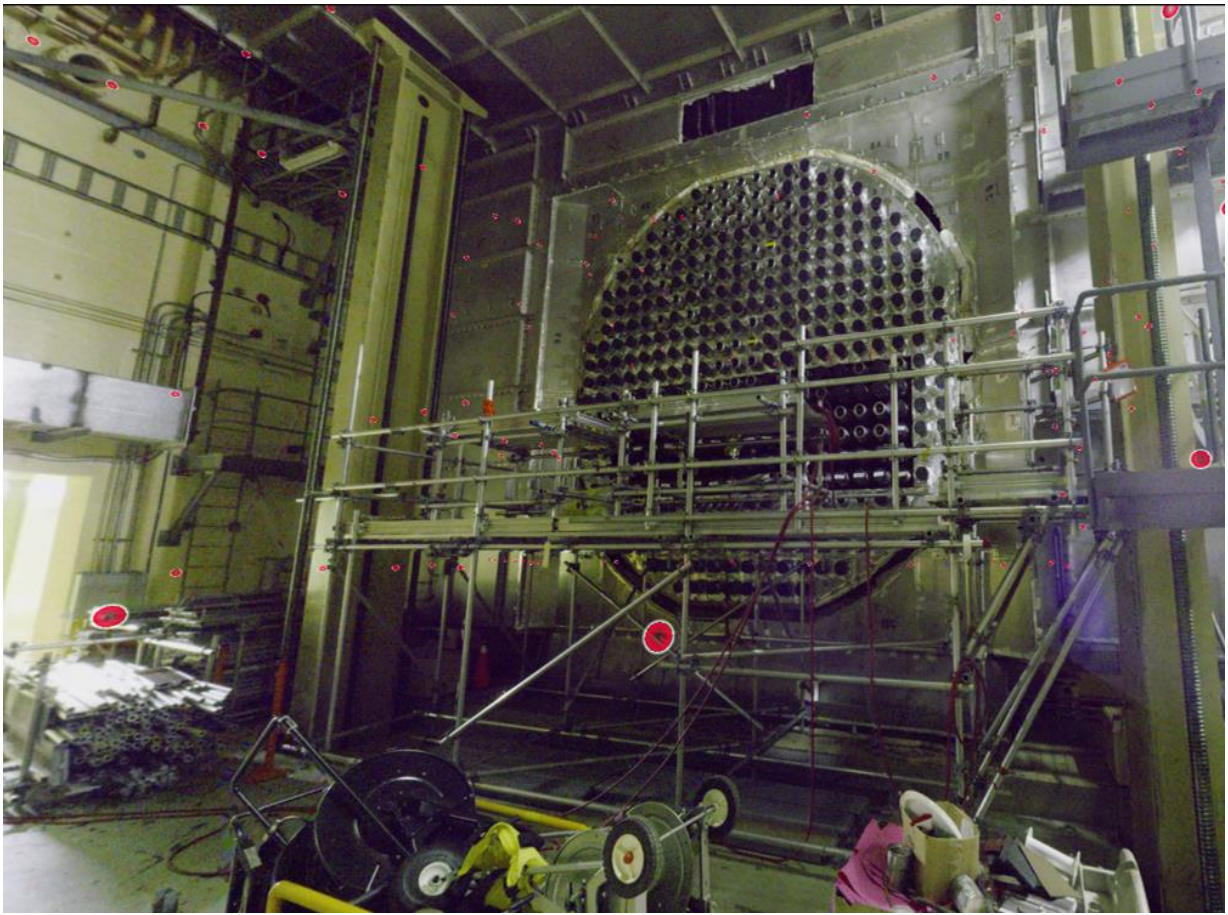
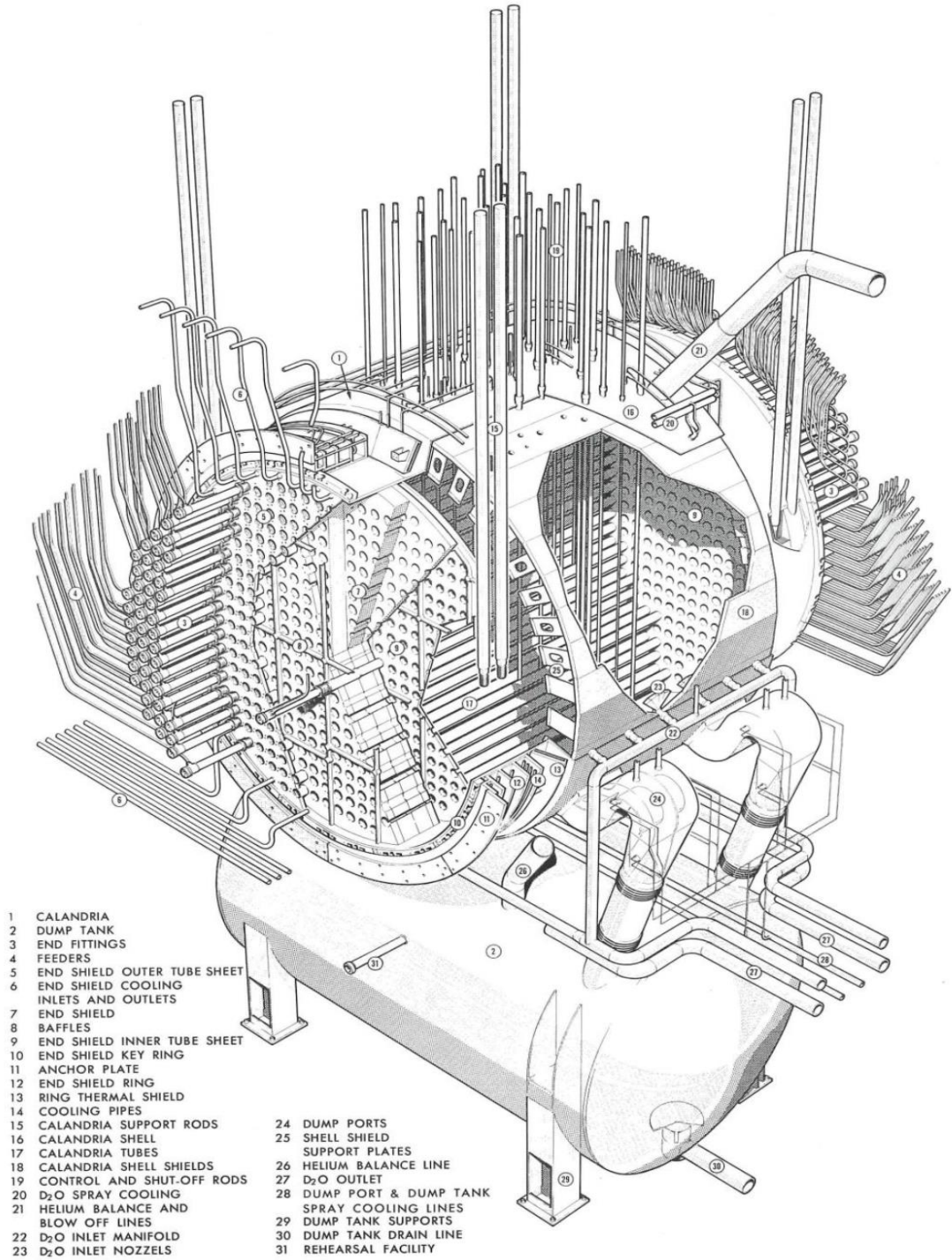


Figure 12 PNGS-A Reactor Face

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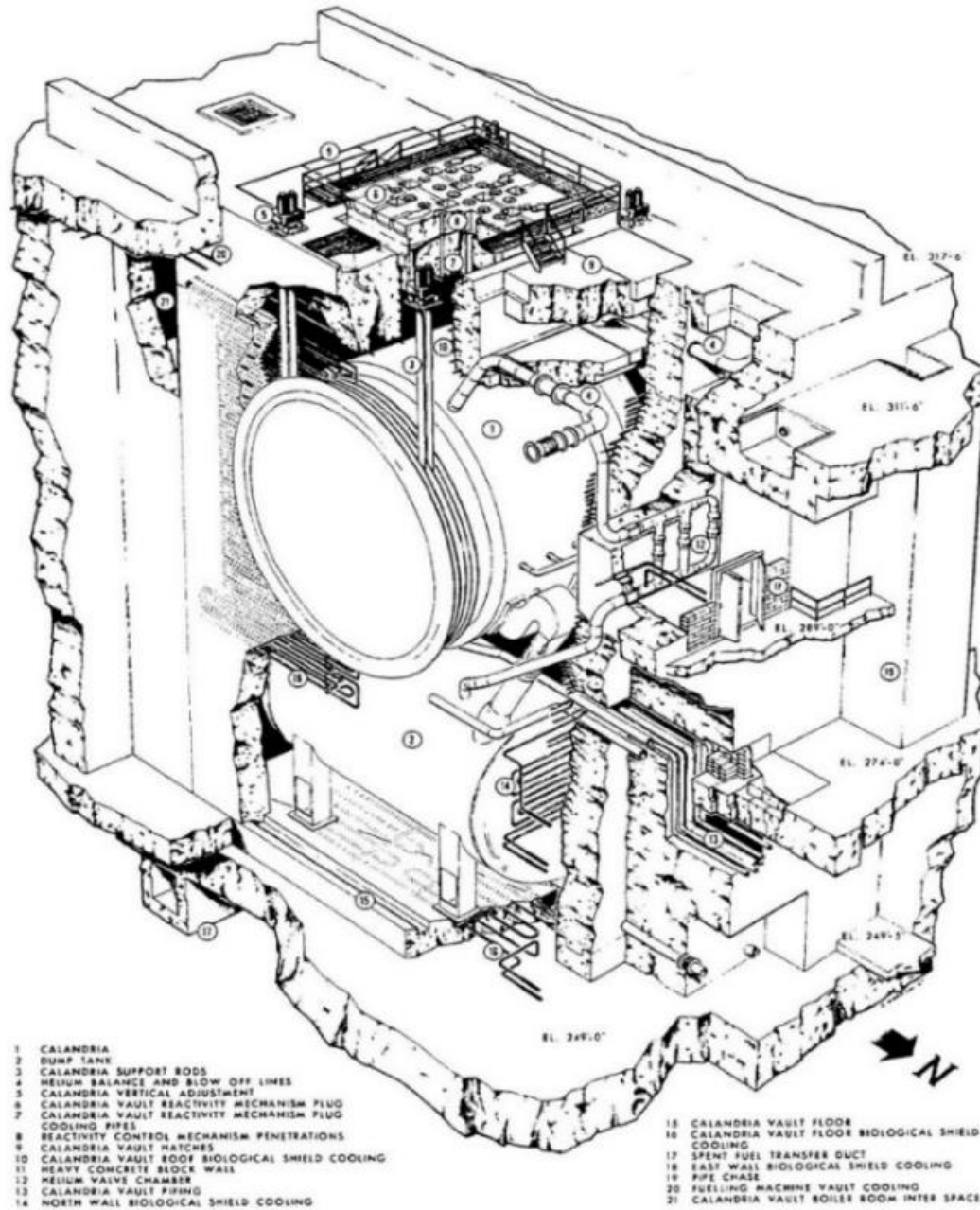
- | | |
|------------------------------------|----------------------------|
| 1 CALANDRIA | 24 DUMP PORTS |
| 2 DUMP TANK | 25 SHELL SHIELD |
| 3 END FITTINGS | SUPPORT PLATES |
| 4 FEEDERS | 26 HELIUM BALANCE LINE |
| 5 END SHIELD OUTER TUBE SHEET | 27 D ₂ O OUTLET |
| 6 END SHIELD COOLING | 28 DUMP PORT & DUMP TANK |
| INLETS AND OUTLETS | SPRAY COOLING LINES |
| 7 END SHIELD | 29 DUMP TANK SUPPORTS |
| 8 BAFFLES | 30 DUMP TANK DRAIN LINE |
| 9 END SHIELD INNER TUBE SHEET | 31 REHEARSAL FACILITY |
| 10 END SHIELD KEY RING | |
| 11 ANCHOR PLATE | |
| 12 END SHIELD RING | |
| 13 RING THERMAL SHIELD | |
| 14 COOLING PIPES | |
| 15 CALANDRIA SUPPORT RODS | |
| 16 CALANDRIA SHELL | |
| 17 CALANDRIA TUBES | |
| 18 CALANDRIA SHELL SHIELDS | |
| 19 CONTROL AND SHUT-OFF RODS | |
| 20 D ₂ O SPRAY COOLING | |
| 21 HELIUM BALANCE AND | |
| BLOW OFF LINES | |
| 22 D ₂ O INLET MANIFOLD | |
| 23 D ₂ O INLET NOZZELS | |

Figure 13 PNGS-A Calandria and Internals

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Figure 14 PNGS-A Calandria Vault

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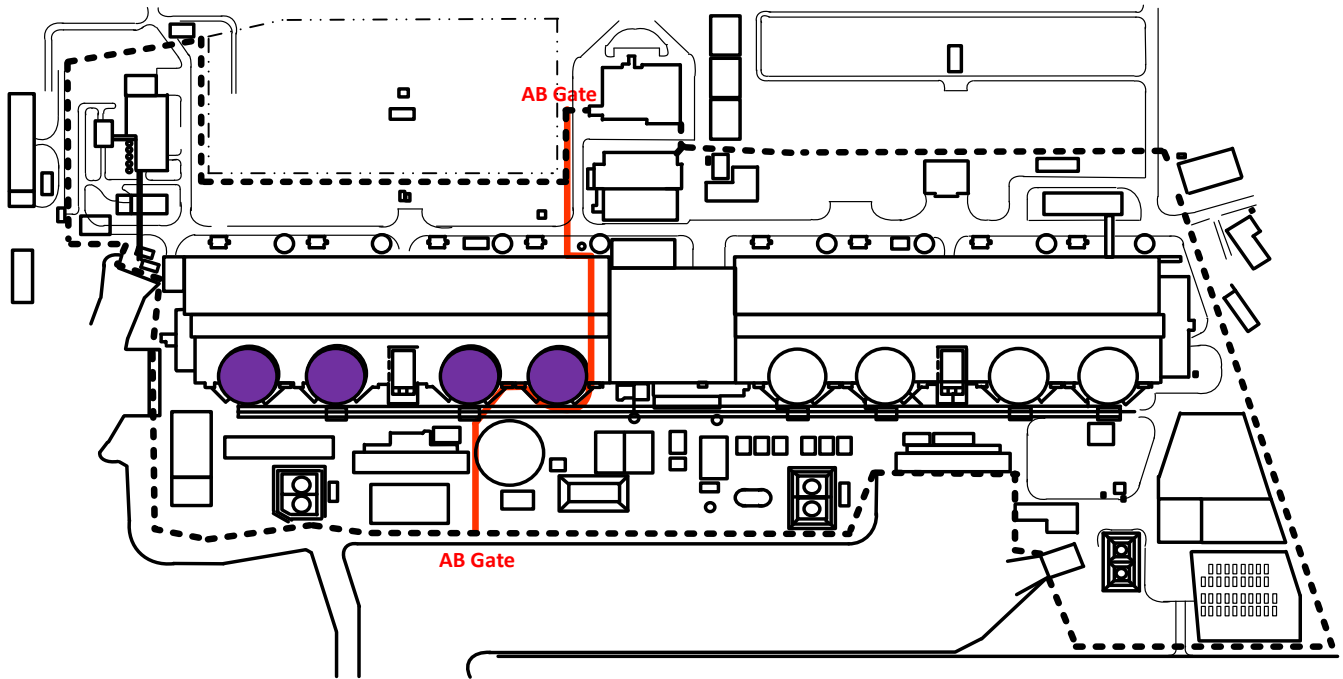


Figure 15 Planning Envelope D – Calandria Segmentation

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.

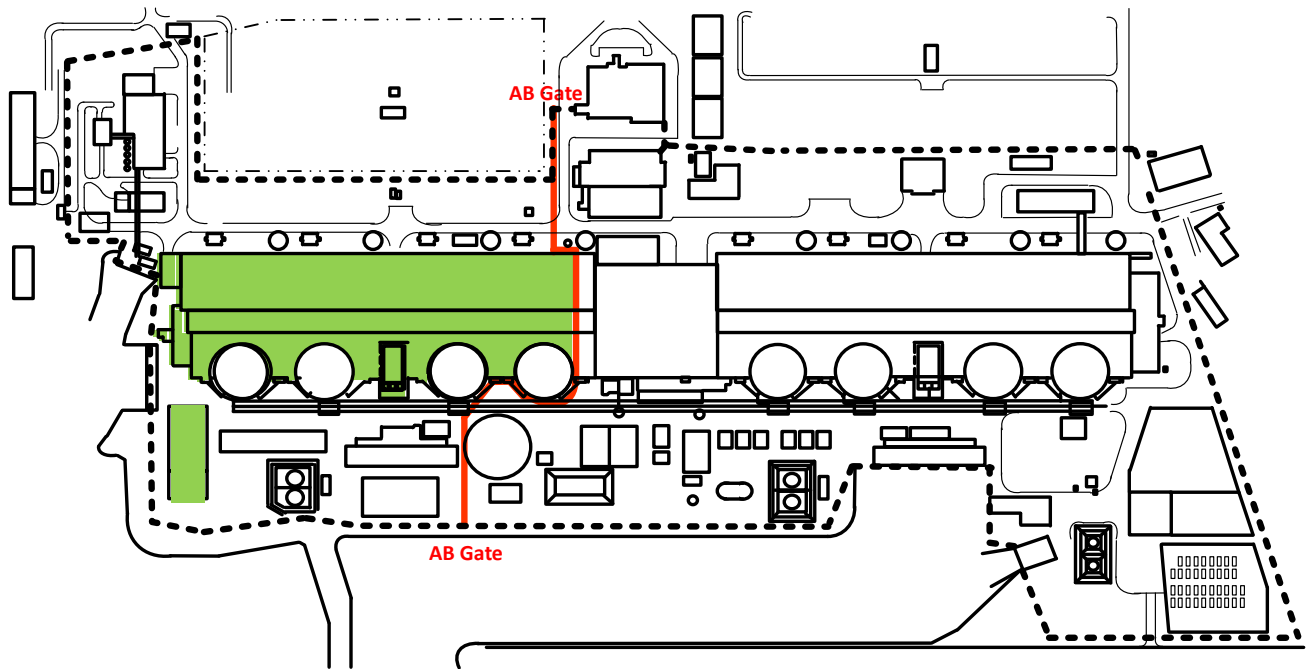


Figure 16 Planning Envelope E – Powerhouse and Reactor Auxiliary Bay Structural Removal

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.

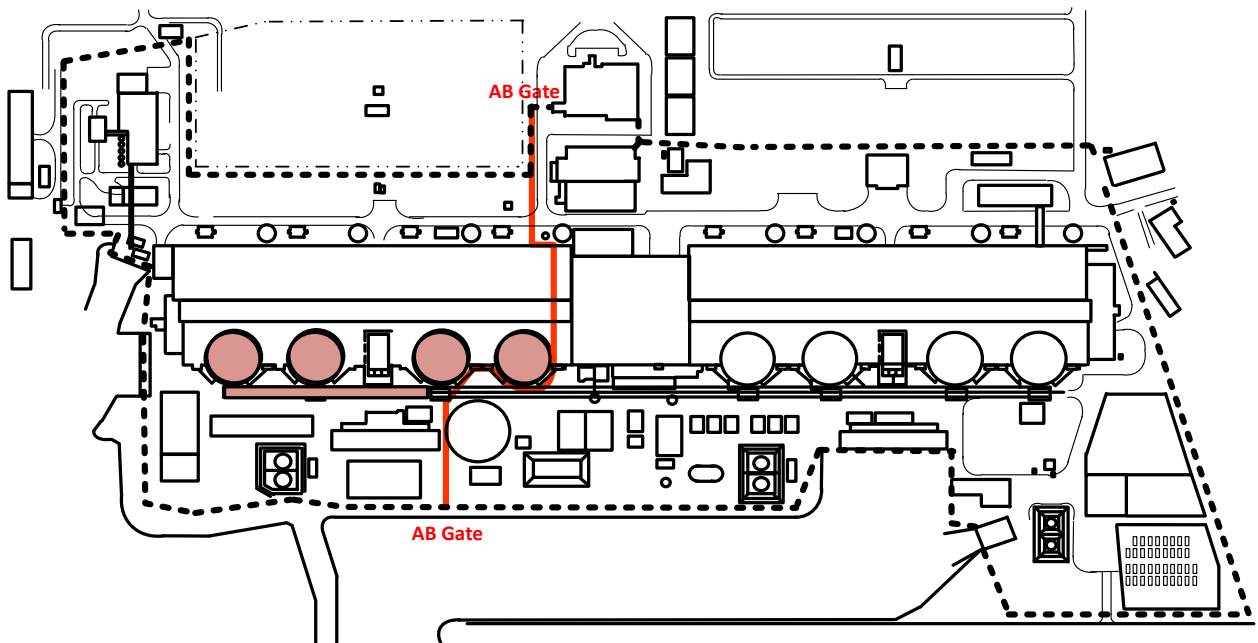


Figure 17 Planning Envelope F - Reactor Building Structure Removal

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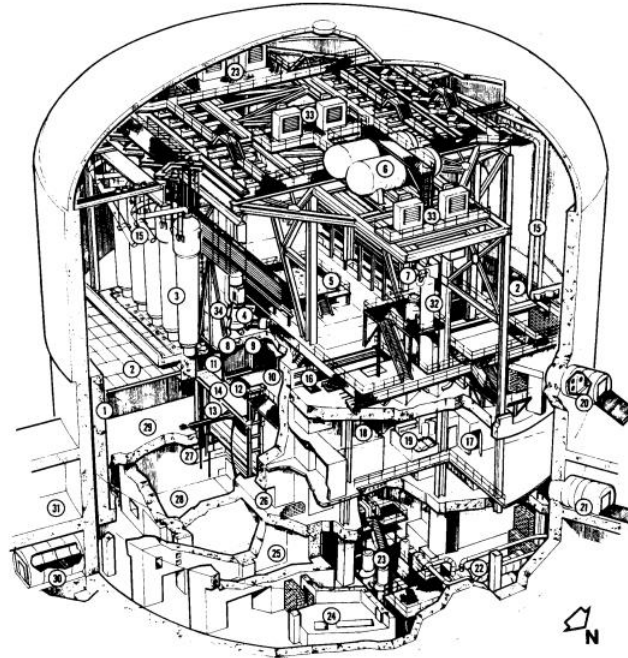


Figure 18 Planning Envelope F - Reactor Building Structure

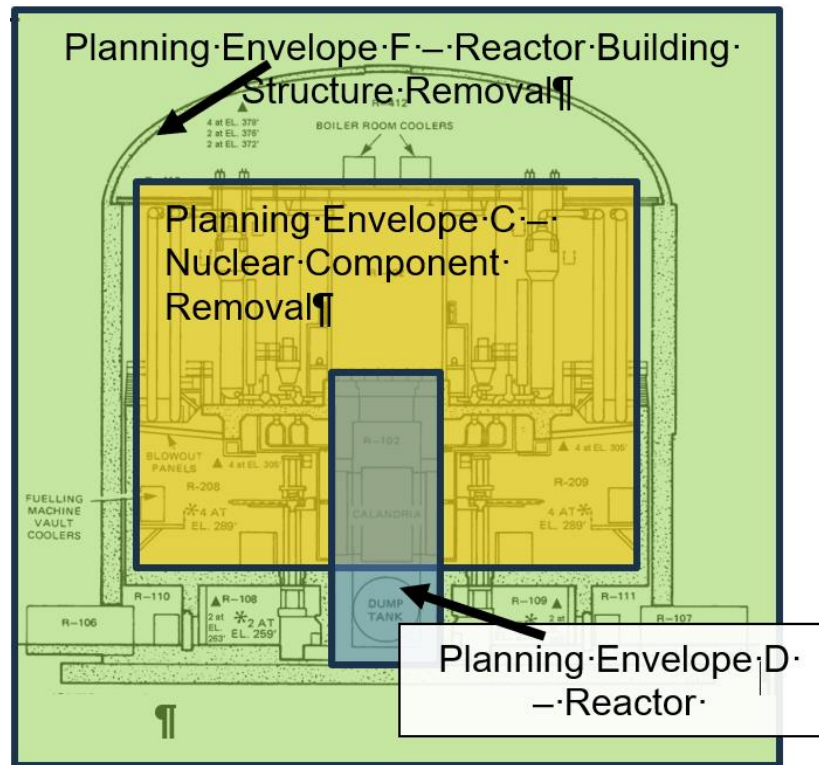


Figure 19 Planning Envelope C, D and F

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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.

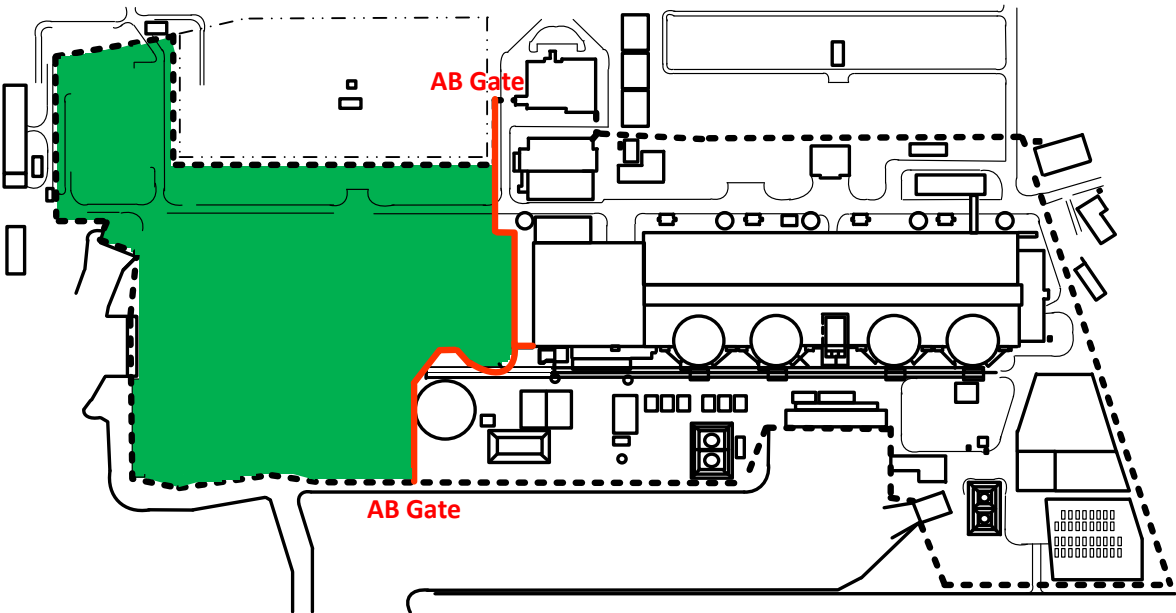


Figure 20 Planning Envelope G Site Restoration

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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

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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.

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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	<p>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.</p> <p>Dismantling these systems is a pre-requisite to removal of the Turbine Hall (PE-E).</p>

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Planning Envelope	Focus Area	Grouping	Sequence Logic
		B-2	<p>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.</p> <p>Dismantling these systems is a pre-requisite to removal of the Turbine Auxiliary Bay (PE-E).</p>
PE-C	Nuclear Component Removal	C-1	<p>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.</p> <p>Dismantling these systems is a pre-requisite to removal of the Reactor Auxiliary Bay (PE-E).</p>
		C-2	<p>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.</p> <p>Dismantling these systems is a pre-requisite to reactor segmentation work (PE-D) and removal of the reactor building (PE-F).</p>
PE-D	Reactor Segmentation	D	<p>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.</p> <p>Removal of the reactor is a pre-requisite to removal of the Reactor Building Structure (PE-F).</p>

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Planning Envelope	Focus Area	Grouping	Sequence Logic
PE-E	Powerhouse Structure	E	<p>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.</p> <p>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.</p>
PE-F	Reactor Building Structural Demolition	F	<p>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).</p> <p>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.</p>
PE-G	Site Remediation	G	<p>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.</p>

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.

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The work package details for each PE will be contained in its appropriate DDP Volume as defined in Table 1 Decommissioning Planning Envelopes.

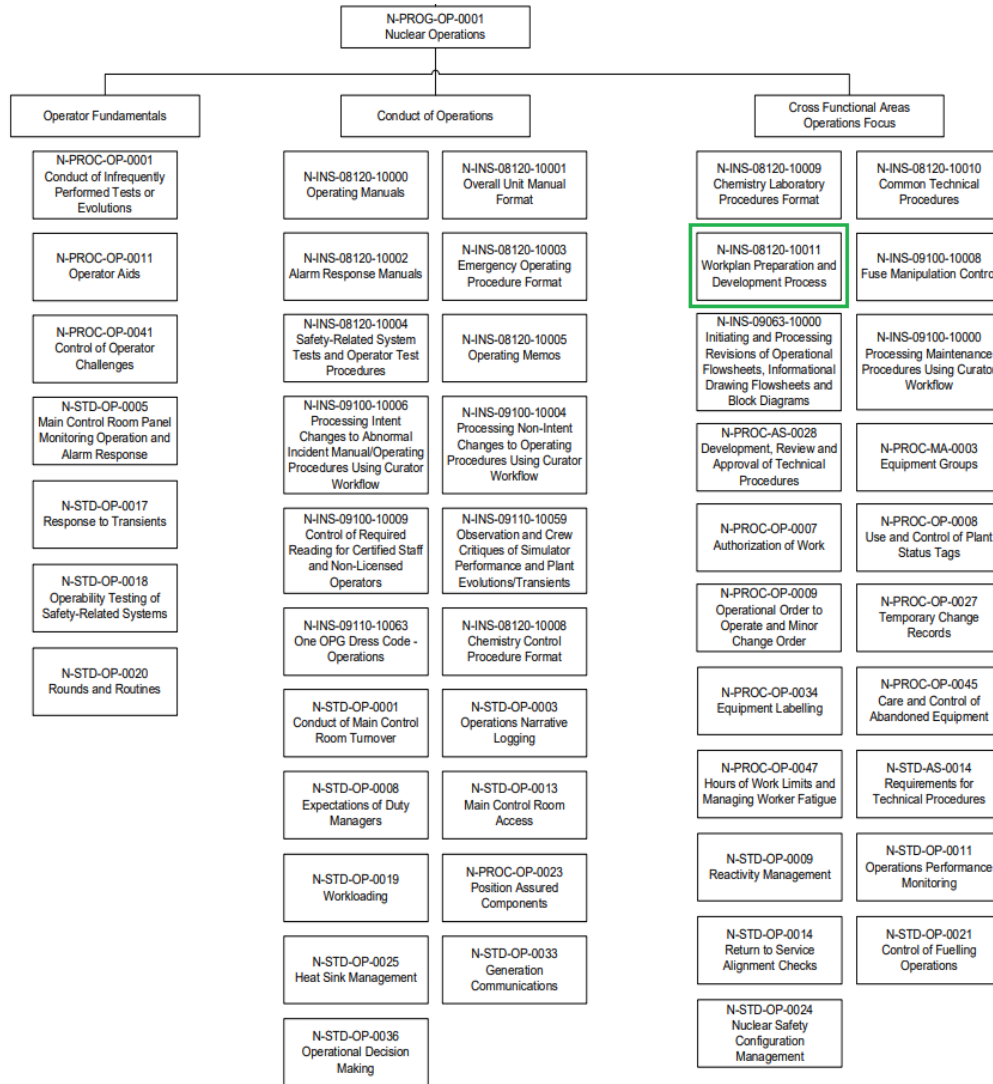


Figure 21 Nuclear Operations Implementing Documents

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:.

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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.

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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.

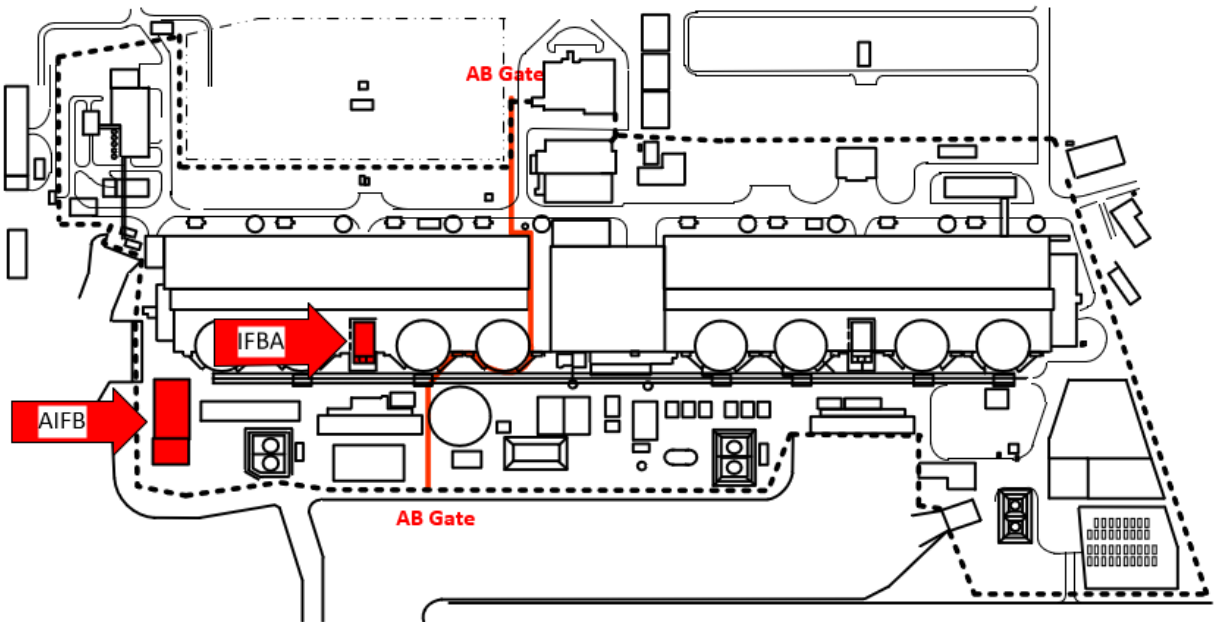


Figure 22 IFB-A and AIFB

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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NOTE

- 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.

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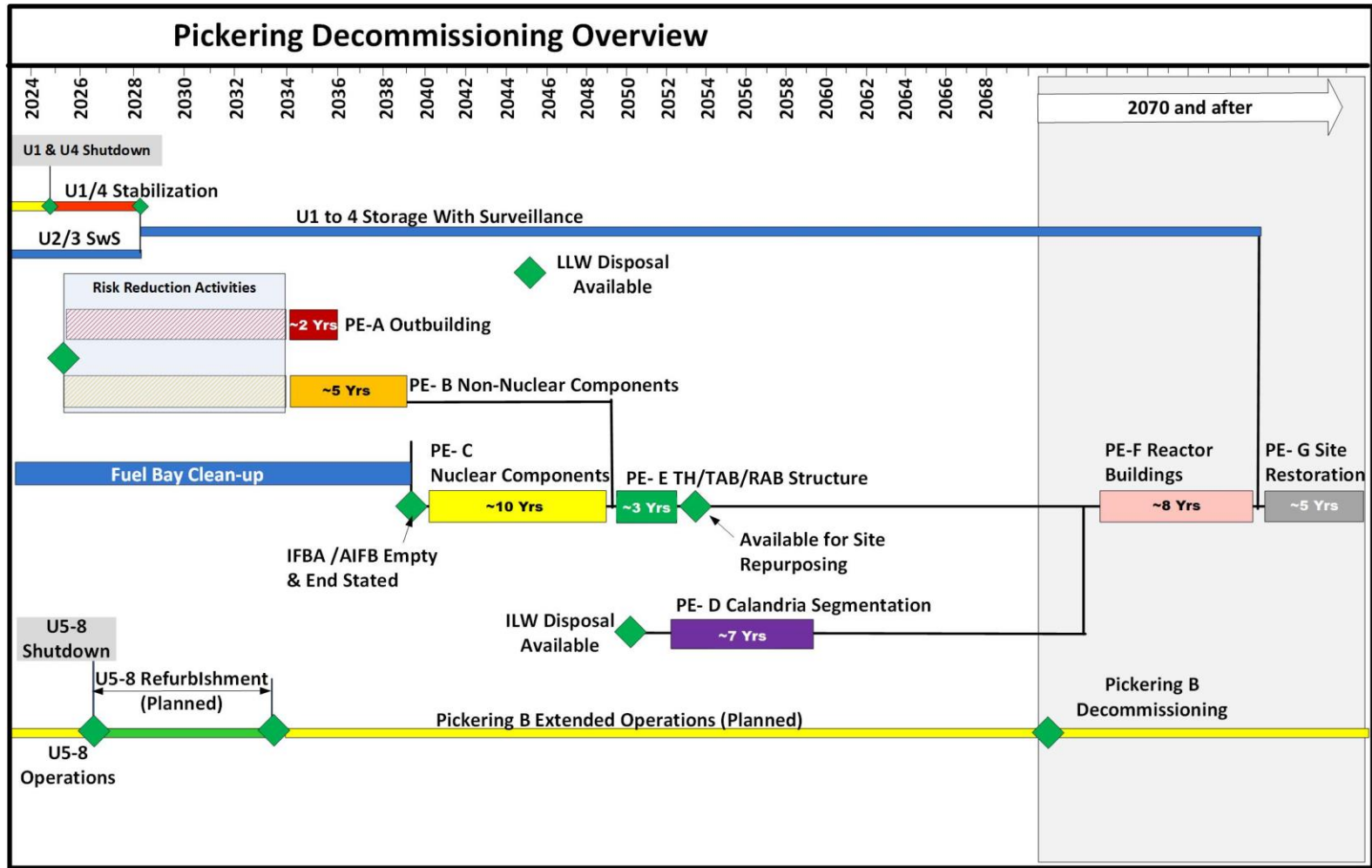


Figure 23 PNGS-A U1 to U4 Full Decommissioning Schedule

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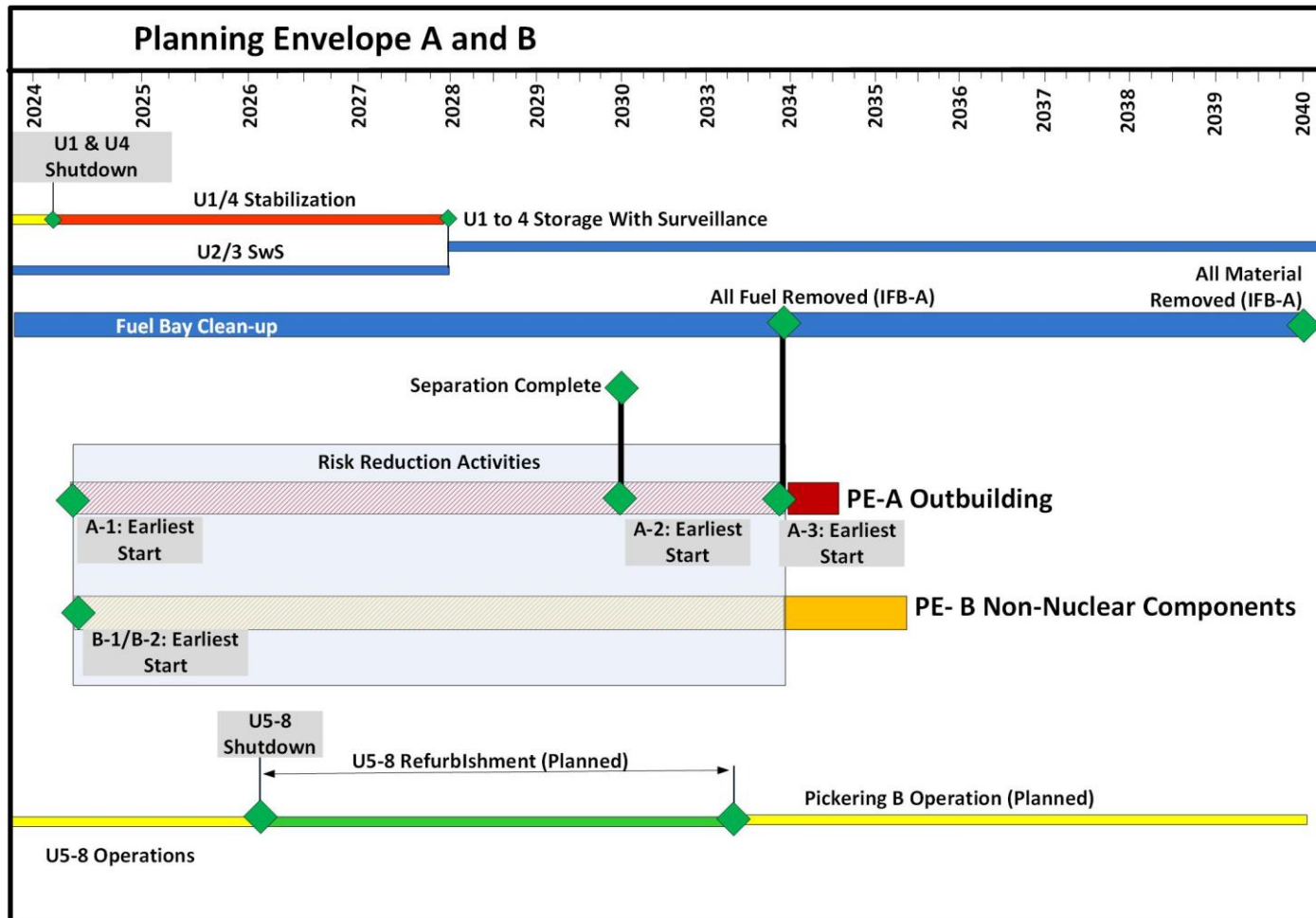


Figure 24 PNGS-A U1 to U4 Decommissioning Schedule for PE-A and PE-B

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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.

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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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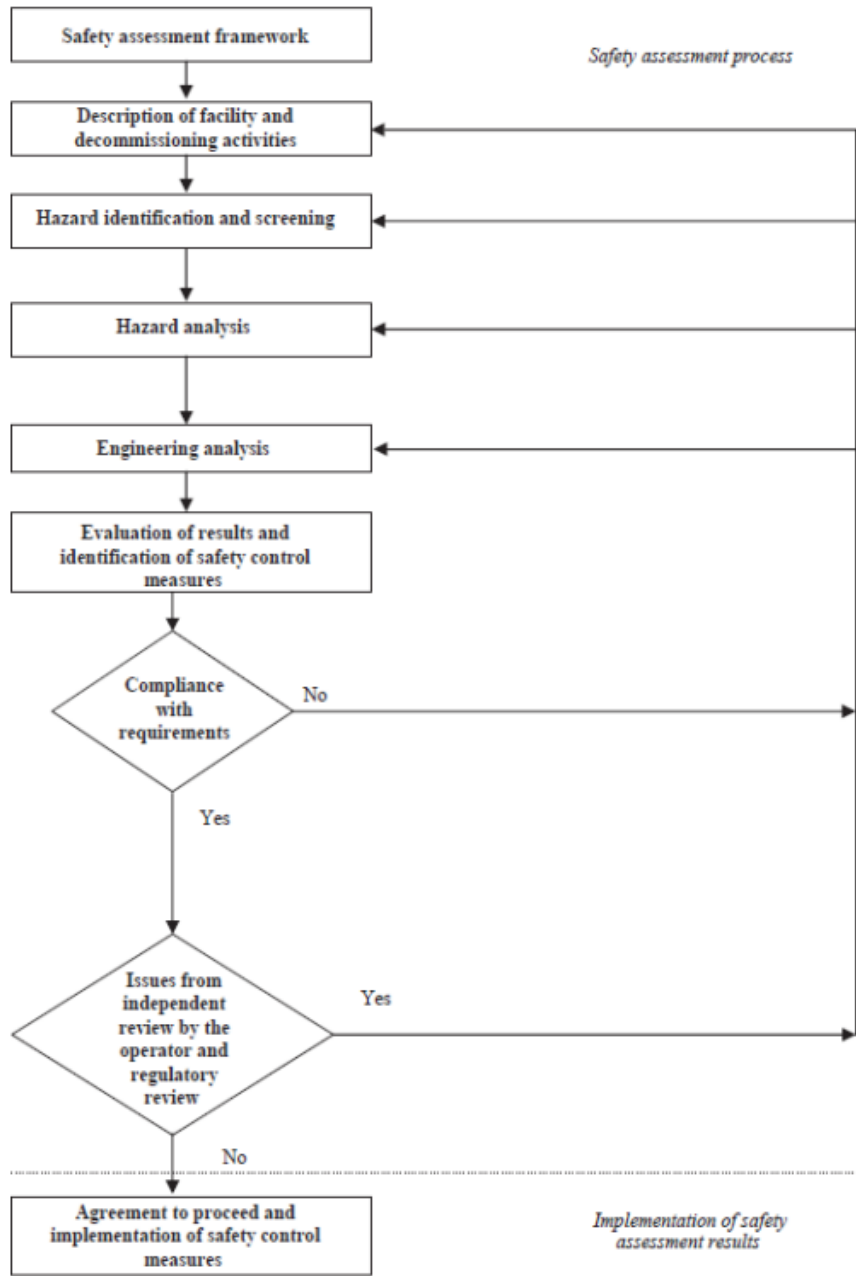


Figure 25 Decommissioning Safety Assessment Methodology

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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 programming 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].

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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.

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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

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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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Conventional Health and Safety Issues ¹	Training	Protection Program
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.