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PRELIMINARY DECOMMISSIONING PLAN DARLINGTON NEW NUCLEAR PROJECT - END OF LIFE

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PRELIMINARY DECOMMISSIONING PLAN

for the

DARLINGTON NEW NUCLEAR PROJECT – END OF LIFE

prepared for

Ontario Power Generation Inc., Canada

prepared by

TLG Services, LLC
Bridgewater, Connecticut USA

March 2023

APPROVALS

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TABLE OF CONTENTS

REVISION LOG

No.	Date	Item Revised	Reason for Revision
0	1/31/2023		Original Issue
1	3/16/2023	Major revision	Revised per OPG comments
2	3/16/2023	Editorial changes	Revised per OPG comments

Acronyms

ALARA	As Low As Reasonably Achievable
CAD	Canadian (Dollars)
CB	Control Building
CN	Canadian National
CNSC	Canada Nuclear Safety Commission
CSA	Canadian Standards Association
D&D	Dismantling and Demolition
DBE	Design Basis Earthquake
DDP	Detailed Decommissioning Plan
DNNP	Darlington New Nuclear Project
DNGS	Darlington Nuclear Generation Station
DOC	Decommissioning Operations Contractor
I&C	Instrument & Control
ICS	Isolation Condenser System
ILW	Intermediate Level Waste
LLW	Low Level Waste
LTC	Licence to Construct
NRC	U.S. Nuclear Regulatory Commission
NSCA	Nuclear Safety and Control Act
NSS-DWMF	Nuclear Sustainability Services – Darlington Waste Management Facility
OPG	Ontario Power Generation
PDP	Preliminary Decommissioning Plan
PLSA	Plant Services Building
PNGS	Pickering Nuclear Generating Station
PPE	Personal Protective Equipment
PSAR	Preliminary Safety Analysis Report
RB	Reactor Building
RPV	Reactor Pressure Vessel
RWB	Radwaste Building
SCCV	Steel-plate Composite Containment Vessel
SCR	Station Condition Record
SMR	Small Modular Reactor
SSC	Systems, Structures, and Components
TB	Turbine Building
TLG	TLG Services, LLC (an Entergy Company)
VSDS	Visual Survey Data System

Darlington Lands Acknowledgment

The lands and waters on which the Darlington New Nuclear Project (DNNP) is situated are the traditional and treaty territory of the Williams Treaties First Nations, which includes Curve Lake First Nation, Hiawatha First Nation, Alderville First Nation, Chippewas of Beausoleil First Nation, Chippewas of Georgina Island First Nation, Chippewas of Rama First Nation, and the Mississaugas of Scugog Island First Nation.

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

Abstract

This Preliminary Decommissioning Plan (PDP) describes the activities that will be required to decommission the Darlington New Nuclear Project (DNNP) facility at the end of its life and restore the site for other Ontario Power Generation (OPG) uses. This PDP demonstrates that decommissioning is feasible with existing technology and it provides the schedule as well as the basis for estimating the cost of decommissioning.

1. INTRODUCTION

1.1 PURPOSE

OPG is responsible for planning, executing, and funding all phases of decommissioning of the Small Modular Reactor (SMR) DNNP facility. This End of Life Preliminary Decommissioning Plan (PDP or plan) has been prepared for Darlington New Nuclear Project (DNNP) to meet the applicable requirements of the Canadian Nuclear Safety Commission's (CNSC) REGDOC 2.11.2, *Waste Management, Decommissioning* referred to herein as REGDOC 2.11.2 (Ref. 1). OPG will use the plan to:

1. Guide the facilitation of the end of life decommissioning process
2. Document the preferred decommissioning strategy for the end of life facility that represents a technically feasible, safe and environmentally acceptable approach in light of current knowledge
3. Provide a reasonable basis for a financial guarantee for future life cycle stages
4. Provide guidance for future decommissioning planning and the preparation of a detailed decommissioning plan

This plan documents the decommissioning actions for the facility at the end of its operating life. This initial end of life decommissioning plan is being prepared very early in the life cycle of the facility, thus there is uncertainty in some of the information being presented herein as the final design for this first of a kind BWRX-300 Small Modular Reactor (SMR) facility is underway. Some of the requirements of REGDOC-2.11.2 have been met with a graded approach at this point in the life cycle, to support deliverables (e.g. Environmental Impact Statement (EIS), Preliminary Safety Analysis Report (PSAR), etc.) for the Licence to Construct (LTC) application. This plan will be updated for future licensing stages and reviewed and updated every five years, or as required by the CNSC, increasing in detail until a detailed decommissioning plan (DDP) is prepared prior to the execution of decommissioning.

1.2 LICENSEE REQUIREMENTS

DNNP will provide a new Class I nuclear facility, as defined by the Nuclear Safety and Control Act (NSCA) (Ref. 2). This facility is a critical new source of clean electricity for the Province of Ontario's future energy needs and will assist Canada in achieving its commitment to be Net- Zero by 2050. The DNNP will be implemented at the existing Darlington Nuclear site that is owned and operated by Ontario Power Generation (OPG).

OPG is the holder of a Nuclear Power Reactor Site Preparation Licence 18.00/2031. This licence permits OPG to perform activities to prepare the DNNP site for the future placement of a nuclear facility. In December 2021, OPG announced the selected technology for this nuclear facility is the grid-scale BWRX-300 SMR, designed by GE-Hitachi Nuclear Energy Americas, LLC (GEH). The BWRX-300 is approximately 300 megawatt-electric in size and, is capable of preventing between 0.3 and 2 megatonnes of carbon dioxide emissions per year, depending on the kind of alternative power generation technology it is displacing. OPG has submitted a Licence to Construct (LTC) application (Ref. 3) in accordance with the NSCA, Class I Nuclear Facilities Regulations (SOR/2000-204) and CNSC REGDOC-1.1.2 (Ref. 4). Once granted, the LTC will permit the construction of one BWRX-300.

All decommissioning activities will be performed in accordance with the most relevant legislation, regulations, codes and standards. REGDOC 2.11.2 provides the requirements and guidance for all phases of decommissioning. REGDOC 2.11.2 is complemented by the requirements and guidance in Canadian Standards Association (CSA) N294, *Decommissioning of Facilities Containing Nuclear Substances* (Ref. 5). Together, these documents provide requirements and guidance for decommissioning. REGDOC 2.11.2 is further complemented by other CNSC regulatory documents. Appendices A and B demonstrate how the applicable requirements of REGDOC-2.11.2 and CSA N294:19 have been satisfied in this PDP.

The following provisions of the NSCA and the regulations made under it are relevant to REGDOC 2.11.2:

1. NSCA, subsection 24(5) and paragraphs 26(e) and 26(f)
2. General Nuclear Safety and Control Regulations, paragraph 3(1)(l)
3. Class I Nuclear Facilities Regulations, sections 7 and 8, subsections 14(3) and 14(4), and paragraphs 3(k), 5(i) and 6(h)
4. Class II Nuclear Facilities and Prescribed Equipment Regulations, sections 3 and 5
5. Uranium Mines and Mills Regulations, section 7, paragraphs 8(b), 8.3(2)(c), and 8.3(2)(d), and subparagraph 3(a)(viii)

In addition to this regulatory document, the CNSC's regulatory framework regarding waste management, specifically decommissioning, includes:

1. REGDOC-2.11, Framework for Radioactive Waste Management and Decommissioning in Canada (Ref. 6)
2. REGDOC-2.11.1, Waste Management, Volume I: Management of Radioactive Waste (Ref. 7)

3. REGDOC-2.11.1, Waste Management, Volume II: Management of Uranium Mine Waste Rock and Mill Tailings (Ref. 8)
4. REGDOC-2.11.1, Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste (Ref. 9)
5. REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities (Ref. 10)

The following CSA standards complement the CNSC's regulatory framework regarding waste management, specifically decommissioning:

1. N294, Decommissioning of Facilities Containing Nuclear Substances (Ref. 5)
2. N286, "Management Systems Requirements for Nuclear Power Plants" (Ref. 11)

1.3 SCOPE

This PDP covers the decommissioning of the facility at DNNP at the end of its operating life. It provides general descriptions of activities that are scheduled to occur many decades in the future. Many of these activities are highly complex in nature, and are likely to involve regulatory and technological issues that are still evolving. Therefore, this PDP is based on conservative information and predictions. This PDP should therefore be considered a living document, which will be periodically reviewed and revised as required. The decommissioning strategy should be reviewed and updated in light of the following, which may have relevant consequences for decommissioning:

- changes in site conditions, or incidents and events
- changes to the proposed decommissioning objectives
- changes to ownership or management structure
- advances in decommissioning technology
- significant modifications to the facility, location or site
- updated schedule, cost and funding information
- operational experience and lessons learned
- revised regulatory requirements
- availability of facilities, locations or sites for the management of radioactive waste

The PDP will ultimately be used in the preparation of the detailed decommissioning plan just prior to the permanent shutdown of the station. The list of buildings and structures included in this decommissioning plan are identified below:

- Reactor Building

- Control Building
- Fire Water Storage Tanks
- Intake Tunnel
- Local Switchyard – 115 kV
- Main Switchyard – 230 kV
- Radwaste Building
- Reactor Aux Bay
- Security Building
- Turbine Building
- Yard Fencing, Paving & Landscaping
- Intake Structure/Forebay & Pumphouse

1.3.1 Assumptions

This PDP is based on the following assumptions:

1) For financial planning purposes, it has been assumed that the final DNNP facility shutdown date is December 2088.
Note: This date is nominal. Any modifications associated with the shutdown dates may impact these dates.

2) OPG will retain ownership of the site throughout the course of the decommissioning and subsequent restoration for other industrial use (commonly known as 'brownfield[1]' status).

3) OPG will be responsible for all work conducted during the shutdown of the facility, although some specialized services may be provided by contractors working under the supervision of OPG staff.

4) A Decommissioning Operations Contractor (DOC)[2], a company or consortium selected on the basis of experience, safety record, overall approach and cost, will perform all work during the Dismantling & Demolition and the Site Restoration stages. OPG will provide the necessary oversight.

5) Electric heating will be available through all phases of decommissioning.

6) Above-ground structures will be surveyed for contamination, decontaminated if required and demolished.

[1] As per nuclear industry practice, a brownfield is defined as a former industrial land that has the potential to be developed for new industrial uses.
[2] Decommissioning Operations Contractor (DOC), is equivalent to "Decommissioning Contractor(s)" terminology, which has been used throughout the PDP document.

7) Underground metal and concrete piping will be excavated for survey and removed, if necessary. Uncontaminated materials beyond one meter below grade will be left in place, while contaminated materials that exceed the site release criteria will be removed and disposed of appropriately.

8) Sub-surface structures will be surveyed for contamination, decontaminated if required and, consistent with international practices, dismantled to a 'nominal removal 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 and provides significant attenuation of any residual gamma radionuclides that may remain within the site release limits. At-grade foundation slabs exceeding one meter in thickness will be abandoned in place and covered with a one-meter-thick layer of backfill.

9) Low- and Intermediate-Level Waste (L&ILW) arising from decommissioning activities will be disposed of in long-term disposal facilities, as described in Section 2.7. Non-radioactive hazardous waste will be disposed of at approved disposal facilities.

10) 'Clearance Levels' based on guidance provided in CSA N292.5, "Guideline for the exemption or clearance from regulatory controls of materials that contain, or potentially contain, nuclear substances", July 2011 (reaffirmed 2016) (Ref. 38) will be developed prior to the decommissioning. 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 or disposed of in conventional waste facilities.

11) For the purpose of the financial guarantee for future life cycle stages, no salvage credit is assigned to clean equipment and components removed during decommissioning.

12) The site will be graded and made available for other OPG uses after completion of decommissioning.

13) The decommissioning activities are assumed to be performed in accordance with the applicable regulations in place at the time of writing. Changes in current regulations may have an impact on the proposed assumptions and activities assumed to be undertaken as part of this plan.

2. STRUCTURE AND CONTENT OF PLAN

This PDP includes the following:

Section 1	Description of the site
Section 2	Description of the facility to be decommissioned
Section 3	Overview of site radiological, chemical and physical conditions expected after station shutdown
Section 4	Discussion of the strategy for decommissioning
Section 5	Discussion of plan for the decommissioning work
Section 6	Description of the hazardous monitoring and survey commitments
Section 7	Description of the waste management strategy
Section 8	Detailed Decommissioning Plan (DDP prior to decommissioning
Section 9	Periodic review and update the PDP
Section 10	Description of the physical state of the facility
Section 11	Records
Section 12	Public Consultation Plan, as per the requirements and guidance of REGDOC-3.2.1, *Public Information and Disclosure* (Ref. 12)
Section 13	Indigenous Engagement Plan, as per the requirements and guidance of REGDOC-3.2.2, *Indigenous Engagement* (Ref. 13)
Section 14	A cost estimate
Section 15	Uncertainty

2.1 DESCRIPTION OF SITE TO BE DECOMMISSIONED

2.1.1 Darlington Nuclear Site Context and Surrounding Land Uses

The Darlington Nuclear site (see Figure 2.1.2-1), is located in the township of Darlington, on the north shore of Lake Ontario at Raby Head, approximately 70 km east of Toronto. The site is approximately 5 km southwest of the community of Bowmanville and 10 km southeast of the City of Oshawa. Immediately to the east of the site is St. Marys Cement limestone quarry and processing plant. The site is traversed by an east-west operating Canadian National (CN) railway and a 8.5m high berm that provides the site protection in the event of a railway accident. The site is also traversed by the Lake Ontario Waterfront Trail, which is a multi- use recreation trail extending from Niagara-on-the-Lake to the Quebec border along the north shores of Lake Ontario and the St. Lawrence River.

Currently, the Darlington Nuclear site (see Figure 2.1.2-2) is home to the 3,512 megawatt-electric Darlington Nuclear Generating Station (DNGS), comprised of four operating CANada Deuterium Uranium (CANDU) pressurized heavy water generating reactors, the Tritium Removal Facility (TRF) that serves all of Ontario's CANDU nuclear reactors, and the Nuclear Sustainability Services-Darlington (NSS-DWMF) facility that stores spent nuclear fuel from the DNGS. The DNNP site is in the eastern one-third of the site bounded by the site property limits to the east and north, by Lake Ontario to the south, and by Holt Road to the west.

Area and Bounding Roads

The Darlington Nuclear site is approximately 4.9 km^2 in size and located within the Municipality of Clarington, Regional Municipality of Durham, Province of Ontario, Canada. OPG also owns and operates the eight-unit Pickering Nuclear Generating Station (PNGS) (with six operating units with a generating capacity of 3,100 MWe and two units in safe storage) within the City of Pickering which is located approximately 30 km to the west of the Darlington Nuclear site, as shown in Figure 2.1.1-1.

The Darlington Nuclear site is bounded by Crago Road to the west, Energy Drive to the north, St. Marys Cement to the east and Lake Ontario to the south. The existing DNGS is located west of Holt Road on the western portion of the site, whereas the lands for the DNNP are located east of Holt Road. The allocation of lands within the Darlington Nuclear site for the DNNP is approximately 1.8 km^2. Also shown in Figure 2.1.1-2 is the 914-meter exclusion zone for the DNGS.

Industrial Facilities

The major industrial facilities in the vicinity of the Darlington Nuclear site, as shown in Figure 2.1.1-3, include:

1. St. Marys Cement Group which is located directly east of the DNNP site on Bowmanville Avenue, and is an active quarry for resources servicing the aggregate and concrete industry
2. The lands designated as Clarington Energy Business Park which is located directly west of the DNGS site and includes:
    a. Covanta Durham York Energy Centre which manages household waste from the regions of Durham and York

b. OPG's Darlington Energy Complex, an approximately 27,900 m^2 multi-use building that provides offices and services supporting the Darlington Refurbishment project

c. CoPart, a vehicle auction and recycling facility

d. A warehousing facility for batteries (East Penn)

e. Courtice Water Pollution Control Plant (WPCP), a wastewater treatment facility commissioned in late 2007, with an average day rated capacity of 68.2 million litres per day with a peak hourly flow capacity of 180 million litres per day

There are some industrial developments in the Courtice Employment Area located northwest of the Darlington Nuclear site, including warehousing and automobile dealerships.

While not located in the survey area, the PNGS is located approximately 30 km west of the Darlington Nuclear site.

Developmental Activities

OPG actively reviews planning applications in the Municipality of Clarington to monitor sensitive land use developments within 3 km of the DNGS and DNNP facilities. Additionally, OPG reviews planning applications within 10 km of the Darlington Nuclear site in the Municipality of Clarington and the City of Oshawa. These applications include official plan amendments, zoning by-law amendments, draft plans of subdivision and condominium, and other miscellaneous planning related documents.

Urban Communities and Rural Areas

The urban communities of Oshawa and Courtice are located northwest of the Darlington Nuclear site, while Bowmanville is located to the northeast of the DNNP site. A rural area providing a separation between the Clarington urban areas of Courtice and Bowmanville is located immediately north of the DNNP site. The community of Newcastle is also located east of the DNNP site within the survey area; albeit only a portion is included in the survey area. The geographic limits defined for the survey area are approximately 10 km from the site and include Taunton Road to the north, Simcoe Street to the west, an approximate border of Darlington Clarke Townline Road to the east, and Lake Ontario to the south.

Land Use Assessment for Environmental Effects

The survey area is consistent with the Land Use Effects Assessment Zone, which was the furthest distance that measurable effects on planned land use structure as well as impacts on sensitive land uses are identified in the proximity to the Darlington Nuclear site. The Land Use Assessment of

Environmental Effects Technical Support Document completed in 2009 identified the Regional Study Area as being approximately 50 km from the Darlington Nuclear site as shown in Figure 2.1.1-4. The DNNP Land Use Environmental Assessment Follow-Up Monitoring Plan / Methodology Report was developed in 2022, NK054-CORR-00531-10635 (Ref. 14) to fulfill the requirement of OPG Commitment D-P-12.7 in NK054-REP-01210-00078 (Ref. 15). As per the report, OPG will continue to monitor planning development in land use in proximity to the DNNP site, and regularly consult with the Municipality of Clarington, City of Oshawa and the Regional Municipality of Durham on proposed land use changes. The effects on implementation of emergency plans will be investigated throughout the site preparation and construction phases.

2.1.2 Description of the Surrounding Environment

2.1.2.1 Natural Environment

The Darlington Nuclear Site is situated in an undulating to moderately rolling limestone till plain, spotted with remnants of a lake plain deposit. Inland, the previously irregular terrain has been graded in the DNGS powerhouse area to an elevation of about 100 m. The surface elevation generally rises towards the north with a mean elevation of 122 m just south of the railway tracks. North of the tracks, the ground is irregular ranging from 120 to 128 m elevation. A higher ridge, starting from the shore just east of Raby Head, extends diagonally across the site in a north-westerly direction. In general, the area possesses no significant topographic features (Ref. 16).

The dominant vegetation cover surrounding the Darlington Nuclear Site relates to agricultural use, including row crops and pastureland. As of 2018, approximately 265 ha, or 57%, of the Darlington Nuclear site area is covered by vegetation communities. Upland vegetation communities and wetland vegetation communities cover approximately 46% and 11% of the Darlington Nuclear Site area, respectively. The Darlington Nuclear site forest community consists of deciduous and mixed forest classes dominated by such indigenous species as Sugar Maple, White and Green Ash, Manitoba Maple, Trembling Aspen, Balsam Poplar, White Birch, Eastern White Cedar, and Willow species (Ref. 17).

Two individual Butternut trees, listed as a nationally endangered species provincially and federally, have been inventoried at the Darlington Nuclear Site in the eastern part of the site, last observed in 2019 (Ref. 17).

Wildlife habitat is associated with the vegetation communities, and natural and developed areas found within the Darlington Nuclear Site. Regionally, over 350 bird species and 50 mammalian species (e.g., coyote, red fox and white-tailed deer) have been inventoried, as well as a number of reptiles and amphibians and insect species of interest (Ref. 17).

Eight species of amphibians and five species of reptiles have been inventoried for the Darlington Nuclear Site during the breeding season from 2008 to 2019. Amphibians that currently breed within the area are American toad, northern leopard frog, and green frog. Reptiles are recorded as incidental observations. In 2019, many Eastern Garter snakes and a Dekay's Brownsnake were found under previously laid snake boards; reports of snakes are generally becoming more frequent (Ref. 17).

To date, 299 insect species (butterflies, dragonflies/damselflies, moths, and other insects) have been inventoried for the Darlington Nuclear Site. Other invertebrate groups that have been identified include tiger beetles (2 species), spiders (2 species) and other insects (9 species) (Ref. 17).

One reptile species, eighteen breeding bird species, three mammals (bats), one insect, and one tree species at risk with a provincial ranking of endangered, threatened or special concern were recorded at the DNGS site over the period from 2006 to 2019 (Ref. 17).

2.1.2.2 Geophysical Environment

Soils

The soils onshore are between 21 m and 36 m thick cover the bedrock over most of the site. The soils consist of a thin layer of topsoil and up to 3 m of loose to dense silt clay and fine sand overlaying between 2 m and 20 m of dense to very dense sandy till. The till is underlain by interglacial soils consisting of alternate layers of very dense, pervious fine sand and hard, impervious varied silt and clay. A layer of very dense silty fill (generally less than 5 m thick) lies between the interglacial soils and the bedrock.

The soils offshore range from 7 m to 8 m thick at the shoreline and become less than 1 m thick about 1000 m offshore. The soils consist of thin interglacial soils overlying silty till. Gravel, cobbles, and boulders are found in some areas.

A sand, gravel, and cobble beach exists at the base of the steep shoreline cliffs that are found to the east and west of the new protected shoreline at the site (Ref. 16).

Bedrock

The bedrock consists of nearly flat lying limestone of Middle Ordovician age. The upper rock unit consists of dark brown, very thin to medium bedded shaley limestone of the Whitby Formation. The Whitby Formation ranges in thickness from 8 m to 1.5 m, thinning towards the eastern part of the site. North of the DNGS Powerhouse area near the CN tracks, the upper surface of the bedrock is at an elevation of about 91 m while the bedrock at the shoreline is around 88 m. At a distance of 1,000 m from the shoreline, the bedrock elevation is about 85 m.

The bedrock is hard and sound. At the bedrock surface, there is a zone of broken, weathered rock up to 2 m in thickness. This zone is characterized by weathered, open, water-bearing bedding joints.

The nuclear containment structures are founded on hard and sound shaley limestone of more than adequate bearing capacity to carry the structural loading without any adverse response (Ref. 16).

Groundwater

Water-bearing zones of low permeability occur within the interglacial soils and in the upper part of the bedrock. The groundwater levels in the interglacial soils were measured in September 1976. The levels ranged from a depth of about 16 m below ground in the west part of the site to about 1 m in the east. The apparent groundwater movement is from north to south toward Lake Ontario. The hydraulic gradient is approximately 2 percent (Ref. 16).

The majority of the groundwater within the interglacial deposits is most likely recharged upstream from the station, north of the CN line where the deposits are close to the surface and the upper till is thin. Recharge to the interglacial deposits in the vicinity of the station will be limited due to the thick upper till layer comprised of fine-grained, low permeability soils.

Tritium concentrations at perimeter groundwater monitoring locations remained very low. Municipal drinking water samples collected from downstream Water Supply Plants, as part of the annual OPG DNGS Environmental Monitoring Program, were well below the Ontario Drinking Water Quality Standard for tritium of 7,000 Bq/L (Ref. 18).

Seismicity

The western Lake Ontario region lies within the tectonically stable interior of the North American continent, which is characterized by low rates of seismicity. Only one seismic event with a magnitude of greater than 4 has ever been recorded within 100 km of the station. This earthquake occurred on April 27, 1954. It had a magnitude of 4.1 and it was centered 9 km southeast of St. Catharines (just under 100 km from the Darlington Nuclear Site).

The historical record of earthquakes for the region confirms relatively low seismic activity. Over the period of record since 1840, within the region to 150 km from the Darlington site, the maximum seismic event has only generated a calculated peak ground motion at the site of less than 1.5% of gravity. Over this period of records, only seven events were reported to have occurred within 150 km of the site with sufficient magnitude to generate a calculated peak ground motion at the site greater than 0.5% of gravity (Ref. 16).

From July 2017 to March 2021 inclusive, there have been an additional 12 seismic events (two of which are man-made seismic events) reported in Ontario of a magnitude greater or equal to 3.0. The magnitude of these earthquakes range between 3.0 and 4.1, with one earthquake of 3.0 magnitude occurring within a 100-km radius of the Darlington Nuclear Site (Ref. 19).

2.1.2.3 Aquatic Environment

Drainage

Darlington Creek is the main drainage feature located to the northeast and east of the DNGS site. The watershed area for Darlington Creek includes the northeastern portion of the Darlington Nuclear Site and there is a direct runoff to the creek in this area. Darlington Creek drains through St. Marys' Cement property as a channelized stream to the immediate east of the Darlington Nuclear Site. Most of the DNGS site drains to the south directly to Lake Ontario. Drainage features on the Darlington Nuclear Site include ditches, ponds and storm drains (Ref. 16). There are also a number of major cold-water streams entering Lake Ontario within 50 km of the station. The Raby Head Wetlands, two small, locally significant wetlands, are located just east of DNGS. The Bowmanville and Westside Marshes are located further to the east. These two large, provincially significant wetlands are managed by the Central Lake Ontario Conservation Authority (CLOCA) (Ref. 20). Coot's Pond is located about 900 meters northwest of the Darlington Nuclear Site and another smaller pond (Tree Frog Pond) is slightly further away to the northeast.

Fish

In 2019, the total commercial catch from Lake Ontario commercial fishery harvested over 305,800 pounds of locally caught fish (Ref. 21).

While recreational fishing does occur at the Darlington Nuclear Site, the site is not known to host concentrations of sport fish similar to the Pickering Nuclear Site and Bruce Nuclear Site, because DNGS utilizes an offshore diffuser for cooling water discharge rather than a surface discharge channel. The diffuser prevents the formation of an extensive thermal plume, and therefore does not seem to be a fish attractant. In addition, DNGS was the first OPG station where fish protection principles were considered in the decision-making process for both design and shoreline location of the intake. The intake incorporates a porous concrete intake “field” that circumvents the impingement and entrainment problems associated with a more traditional velocity cap intake. The intake is designed to minimize the entrainment of all juvenile and adult fish and the drawdown of cooling water (i.e. the maximum height above the intake from which water is drawn) (Ref. 22). The DNNP facility cooling water intake will also be designed to minimize impingement and entrainment problems and the discharge will have an offshore diffuser to prevent the formation of an extended thermal plume (Ref. 28).

Major cold water streams are along the northern shore of Lake Ontario. These streams are concentrated within 50 km of the Darlington Nuclear Site, but they also extend in the west to the 100 km limit. The major species of fish found either inhabiting or migrating up these streams during the spawning season are the salmonoids: Coho Salmon, Chinook Salmon, Rainbow Trout, Brown Trout, and Lake Trout. Highest fishing activities are found at the branches of these streams (Ref. 16). Alewife and emerald shiner are two of the most abundant fish species along the Darlington Nuclear Site shore.

Major populations of warm water species of fish inhabit the Kawartha Lakes, distributed 25 to 100 km from Darlington Nuclear in the north to east quadrant. The major species of fish are walleye, muskellunge, small-mouth bass, large-mouth bass, and yellow perch. The data required to carry out a detailed analysis of distribution of the fish populations in these lakes are not presently available. Lake Simcoe supports large populations of lake trout, herring, smelt and whitefish, walleye, northern pike, muskellunge, panfish, large-mouth and small-mouth bass (Ref. 16).

Although the fish community also includes species that are subject of conservation concern, there is no evidence that the Darlington Nuclear Site nearshore area contains unique habitat such as spawning or limited nursery areas for any of these species. Further detail on the fish community is provided in the DNGS Environmental Risk Assessment (Ref. 17).
Lake Water Levels

The Darlington Nuclear Site is protected from high lake levels by the new shoreline, which is built to elevation 101 m, 1 m above site grade level and about 2.9 m above the highest water level recorded. This new shoreline will provide an adequate safety barrier against the severest anticipated combination of spring runoff and wave action (Ref. 16).

Based on measurements of the monthly average water levels of Lake Ontario (i.e., the average levels of the whole lake) from 1918 to 2019, the annual maximum monthly average water levels range from a low of 73.74 m relative to the International Great Lakes Datum (IGLD) (1934) to a high of 75.91 m relative to the IGLD (2019). Lake Ontario water levels have been regulated since the completion of the St. Lawrence Power Project in 1958. The mean monthly Lake Ontario water level from 2004 to 2019 has varied between 74.63 m (December) – 75.79 m (June) above the mean sea level (Ref. 23).

2.1.3 BWRX-300 Facility Layout and Exclusion Zone

The layouts of the DNNP site and BWRX-300 Power Block and other infrastructures satisfy the regulatory requirements of Subsection 4.5.2 of REGDOC-1.1.2 (Ref. 4). The site layout shows a single unit but incorporates considerations that support adding future units. The selected location, in the southwestern corner of the DNNP area, limits the amount of spoilage to remove and avoids encroachment on the Bank Swallow habitat. This location is also in proximity to DNGS ensuring effective connections to DNGS available infrastructure. The 230 kV switchyard is located closer and more central to the DNNP site to allow for expansion for future units. Existing roads are being used to the maximum extent practicable and no new off-site roadways are required.

The Pumphouse/Forebay structure is positioned outside the northwestern corner of the protected area. The discharge structure is located near the lakeshore and does not require lake infill.

Required Exclusion Zones

The exclusion zone is established at 350m from the Reactor Building (RB) outside wall, as shown in, Figure 2.1.2-2.

Description of Site Layout

See Section 2.2

Minimizing Environmental Impacts

Measures are included in the DNNP site layout and BWRX-300 design to minimize the impact on the surrounding environment, for example:

1. The location and placement of the lakebed intake structure regarding the commitment for fish entrainment and impingement as well as the discharge diffusers to meet the commitment for effluent plume in NK054-REP-01210-00078 (Ref. 15).
2. Consideration of sensitive land features, such as shoreline bluffs and Bank Swallows, habitat to the extent practicable.
3. A smaller BWRX-300 footprint which does not need any additional land area that could be obtained from lake infill.
4. Designing into the site storm water management provisions for the construction and post construction phases.
5. Minimizing the area of disturbance for permanent structures on the DNNP site by optimizing the BWRX-300 footprint.

2.1.4 Population Distribution and Density

The Municipality of Clarington and the City of Oshawa have both experienced steady growth over the last ten years. According to recently released Statistics Canada data, Clarington's population was 101,427 in 2021, which is an increase of 10.2% from that in 2016 when the population was recorded at 92,130.

The rural area of Clarington has a population of 11,297.

The Municipality of Clarington Official Plan forecasts that Clarington will have a population of 140,340 by 2031, with 124,685 in its urban areas and 15,655 in its rural areas.

The population of the City of Oshawa was 149,607 in 2011 and grew to 159,458 in 2016, which was a 6.6% increase. The City of Oshawa's Official Plan provides population forecasts of 174, 695 in 2021, 184,460 in 2026 and 197,000 in 2031. The population data listed in Table 2.1-2 for the Municipality of Clarington is distributed amongst four urban areas including Courtice, Bowmanville, Orono, and Newcastle as shown in Figure 2.1.3-1.

Table 2.1-2: Population Data for the Municipality of Clarington for 2016 and 2021

Urban Area	Population (2021)	Population (2016)
Courtice	28,545	n/a
Bowmanville	47,176	39,371
Orono	2,476	1,105
Newcastle	11,933	9,167
Total	90,130	49,643

2.1.5 Indigenous First Nations and Communities

The DNNP is located on the treaty and traditional territory of the Williams Treaties First Nations (WTFN). There are six WTFN communities located within distances between 50 km to 135 km of the Darlington Nuclear Site, one each in Durham Region and Northumberland County, two in southern Peterborough County, one located on Georgina Island in South Lake Simcoe in York Region, and another near Orillia. Another is located further, approximately 210 km from Site, on Beausoleil Island in the municipality of Georgian Bay. The Mohawks of the Bay of Quinte is a Haudenosaunee community located approximately 140 km from site near Belleville. These Indigenous First Nations and communities all have a historical relationship with the lands along the north shore of Lake Ontario from Toronto east to the Bay of Quinte, and north to Lake Simcoe and Rice Lake as a result of their occupation and traditional use of these lands prior to European settlement and subsequent signing of treaties.

These Indigenous communities are listed below along with their approximate locations:

- **Alderville First Nation:** 20 km southeast of Peterborough on south side of Rice Lake.
- **Curve Lake First Nation:** 15 km north of Peterborough on Buckhorn Lake.
- **Hiawatha First Nation:** 15 km southeast of Peterborough on north side of Rice Lake.
- **Mississaugas of Scugog Island First Nation:** 35 km north of Oshawa on Scugog Island in Lake Scugog.
- **Chippewas of Georgina Island First Nation:** 10 km north of Sutton

West on the southern end of Lake Simcoe.

- **Mohawks of the Bay of Quinte**: 35 km east of Belleville.
- **Beausoleil First Nation**: 30 km northwest of Midland on the southern tip of Georgian Bay on Christian, Beckworth and Hope Islands.
- **Chippewas of Rama First Nation**: 10 km east of Orillia on the eastern side of Lake Couchiching.

There are no Métis settlements in or near the Darlington Nuclear Site property; however, there are Métis persons residing within the regional area. The Oshawa and Durham Region Métis Council represents Métis people in Durham Region (Ref. 24).

2.1.6 Community Relationships

OPG believes in open and transparent communication with the public in a timely manner, in accordance with CNSC REGDOC-3.2.1. As such, OPG regularly and proactively provides information to the public on its operations and projects. OPG's Stakeholder Relations manages communications and relationships between the nuclear facilities and the host communities by fostering healthy, open relationships and sustainable partnerships with communities, including government, media, business leaders, educational institutions, interest groups and community organizations. OPG's Stakeholder Relations organization adheres to the principles and process for external communication as governed by the nuclear standard N-STD-AS-0013 (Ref. 25), Nuclear Public Information and Disclosure.

OPG conducts integrated communications and regular community liaison activities. For the Darlington Nuclear Site, the community relations program proactively provides information on DNGS and NSS-DWMF operations and the status of key projects, including the Darlington Refurbishment Project, and the Darlington New Nuclear Project. OPG regularly provides milestones and regular waste management updates to Indigenous rights holders and key stakeholders. Presentations are regularly made at the Darlington Community Advisory Committee and Durham Nuclear Health Committee. In addition, presentations and informal meetings are held with local elected officials and community leaders a number of times each year to provide updates on performance and other activities taking place both at the stations and waste facilities.

A major component of the site public affairs program is Darlington's Public Information Program, which includes key activities such as the Darlington Information Centre, the Darlington 'Neighbours' newsletter and the

Speaker's Bureau. Ongoing communication of Darlington Nuclear operations is provided through these public information programs and vehicles, including social media (Facebook, Twitter, and Instagram). It is expected that the same mechanisms will be employed during the site's decommissioning phase.

In 2017, OPG conducted a one-day emergency exercise at the Darlington Nuclear to test the emergency response plans and demonstrate how the participating agencies and government work together. OPG also conducts multiple Emergency Response Organization drills throughout the year to demonstrate proficiency and capture lessons learned. In 2021, a number of DNNP contract partners participated in the annual DNGS full site assembly and accounting drill with early dismissal (Ref. 39). The DNNP contract partners were conducting early site preparation geotechnical field work on site the day of the drill. This allowed the opportunity for OPG and contract partners to effectively test the unique nuclear assembly and accounting protocols as identified in the contract partners SSSP including station emergency tone notifications and follow up. OPG regularly meets with citizens and community groups in a variety of forums to discuss issues related to the Nuclear Emergency Preparedness program.

Under CNSC's mandate, potassium iodide (KI) pills have been distributed by OPG to all homes and businesses within a 10 km zone surrounding Darlington Nuclear Site in 2015. New residents and businesses within the 10 km zone are sent KI pills every year based on data provided by Canada Post, and KI pills remain available to the public within 50 km around Darlington Nuclear Site through a dedicated website.

In addition to operational-related liaisons, Darlington also supports a large number of local not-for-profit organizations. Of note, OPG has worked with Bring Back the Salmon, Scientists in School, Toronto & Region Conservation Authority, Rouge Valley Health System Foundation (Ajax & Pickering Site), and the Oshawa & Durham Region Métis Council's Heritage Celebration in a corporate-wide initiative to better the local environment, education, and community.

OPG's community relations and public information program has been recognized as a strength by national international utility peers. OPG benchmarks current practices amongst other industries to ensure continuous performance improvement.

2.1.6.1 Indigenous Relations

OPG has a board-level Indigenous Relations Policy (Ref. 26) and active community relations program that focuses on:

- Community relations and outreach

- Capacity building support with communities
- Employment/business contracting opportunities
- OPG staff education

Building positive, community-minded relationships with Indigenous First Nations and community leaders is important to OPG with respect to current operations and the planning of new projects. OPG recognizes close consultation with Indigenous First Nations and community leaders is an essential part of the process. OPG continues to engage in active dialogue with Indigenous First Nations and communities on a number of issues and operational decisions related to our nuclear operations. Discussions and information sharing to build long-term mutually beneficial working relationships with Indigenous First Nations and communities near the nuclear host communities occurs on a regular basis (Ref. 24).

2.1.7 Municipal Services

Within the survey area, there are 17 education institutions available for students: 12 primary schools and five secondary schools. In addition, there are six fire emergency stations (excluding OPG's on-site Darlington fire station) and one regional police station (plus one administrative police department) within the survey area. Additionally, one hospital, Lakeridge Health in Bowmanville, is located in the survey area.

2.1.8 Site Access and Transportation Networks

The Darlington Nuclear site can be accessed via two roads. Holt Road runs north to south and allows for direct access to the site. Energy Drive runs west to east and connects to Park Road for access to the site. Multiple parking lots are present on the site.

Within 10 km of the site, there are many arterial roads, minor arterial roads, highways, residential roads, and rural roads. These roads fall within the borders of the survey area defined in Subsection 2.1.

Transportation networks of significance are listed in the following:

1. Three 400-series highways are located within 10 km of the site - Highways 401, 407, and 418.
2. Two railway lines are located within 10 km of the site which converge and run adjacent to one another east of Lakeshore Road, Newcastle:

a. The Canadian Pacific line runs west east, which is located just north of Highway 401, and is used for trains transporting cargo.

b. The Canadian National line runs west east, which is located south of Highway 401 and used for trains transporting people and cargo, and part of which bisects the DNNP and DNGS sites.

3. Oshawa Executive Airport is located at the southeast corner of Taunton Road and Thornton Road North. The airport is located just outside the 10 km survey area.
4. The Port of Oshawa East Pier (at the bottom of Simcoe Street South) is located west of the site and allows cargo ships to receive/deliver shipments.
5. St. Marys Cement has a private dock at its facility to the east of the DNNP site for the shipment of aggregate from its operations.

2.1.9 Active Hiking and Cycling Trails

As shown in Figure 2.1.9-1, the Darlington Waterfront Trail, part of the Great Lakes Waterfront Trail, is a multi-use path that forms part of the recently approved Durham Regional Cycling Plan. The trail is used by pedestrians and cyclists for transportation or recreational purposes, provides direct access to the Darlington site and falls within OPG owned lands. Additionally, hiking trails are available near Lakeview Park in Oshawa, as the Larry Ladd Harbour Trail connects to Lakeview Beach. The Primary Cycling Network Durham currently provides over 400 km of cycling infrastructure in the region; it is unclear what percentage of infrastructure is located within the survey area.

2.1.10 Park Spaces and Waterbodies

There is abundance of parks, greenspaces, conservation areas, and waterbodies located within the survey area, with multiple public recreational spaces directly adjacent to DNGS site. Part of the Darlington Waterfront Trail - a multi-use recreational trail network for cyclists and pedestrians - runs through the DNGS site. Directly adjacent to the west of the DNGS site is Alijco Beach, a beachfront which can be accessed by users for recreational purposes. Other Park spaces and waterbodies are dispersed throughout the rest of the survey area, with places of significance listed below:

1. One provincial park falls within the survey area: Darlington Provincial Park.
2. The Darlington Hydro Soccer Fields facility (owned by OPG and licensed to the Municipality of Clarington) falls within the survey area, as does Bowmanville's Baseball Fields Complex (located at Green Road just north of Highway 401).

3. Five conservation areas fall within the survey area: three are located in Bowmanville (Bowmanville Valley Conservation Area, Bowmanville Westside Conservation Area, Stephen Gulch's Conservation Area) and two are located in Oshawa (Harmony Valley Conservation Area, Oshawa Valleylands Conservation Area).
4. Three beaches fall within the survey area: two are located in Bowmanville (Alijco Beach, Port Darlington Beach) and one is located in Oshawa (Lakeview Beach).

2.1.11 Industrial Facilities

The industrial facilities that are within the survey area of 10 km, and with directly adjacent to Darlington Nuclear site are discussed in Subsection 2.1.1. Other industrial facilities are dispersed throughout the rest of the survey area, with most facilities located west of the site in Oshawa.

While not located in the survey area, the PNGS is located approximately 30 km west of the Darlington Nuclear site.

Figure 2.1.1-1: Darlington Nuclear Site Proximity to Pickering Nuclear Generating Station

Figure 2.1.1-2: Darlington Nuclear Generation Station and Darlington New Nuclear Project Lands

Figure 2.1.1-3: Darlington Nuclear Generating Station and – Darlington New Nuclear Project Proximity to Industry

Figure 2.1.1-4: DNNP Regional Study Area

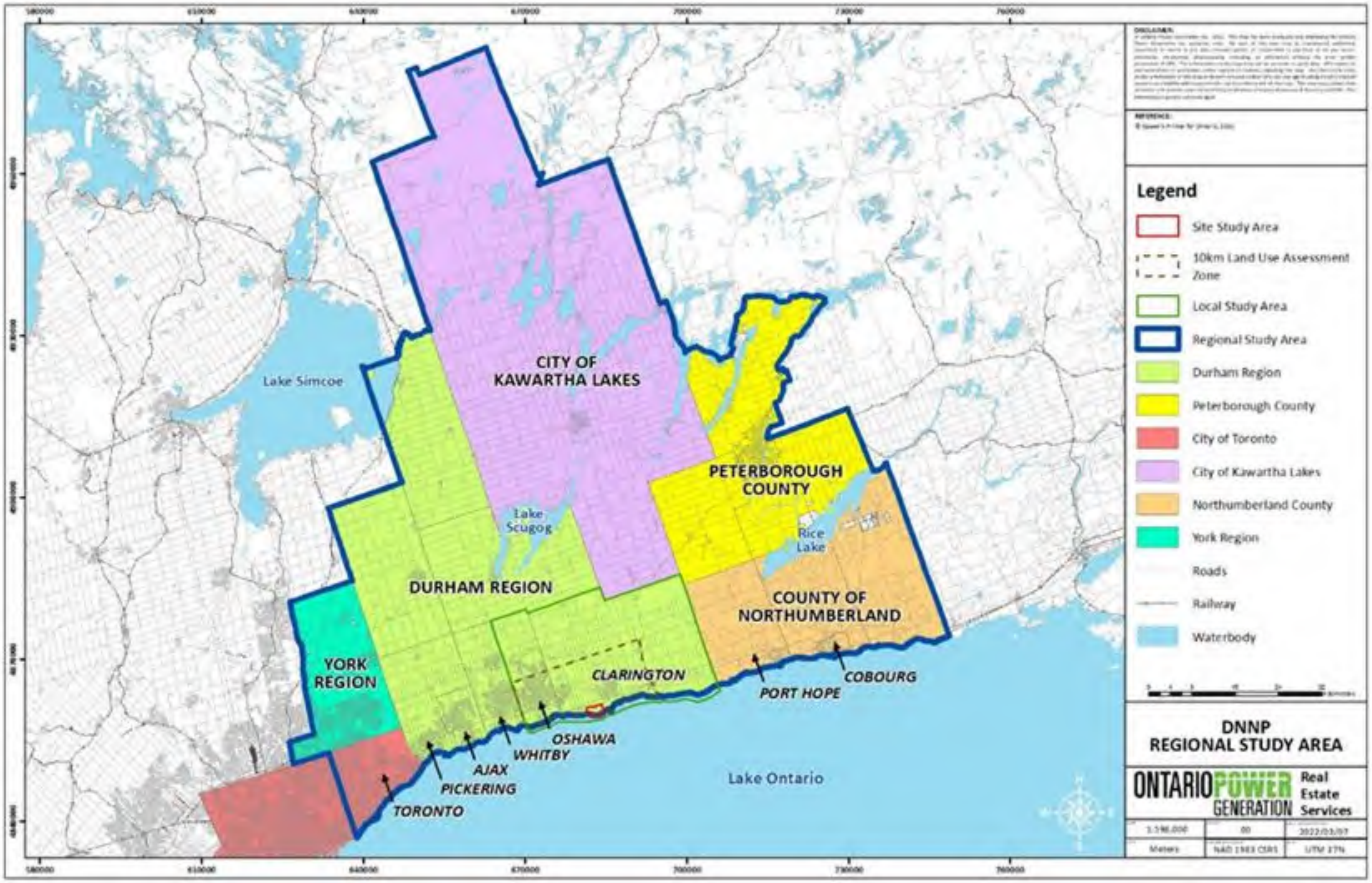


Figure 2.1.2-1: Darlington Nuclear Site Regional Location

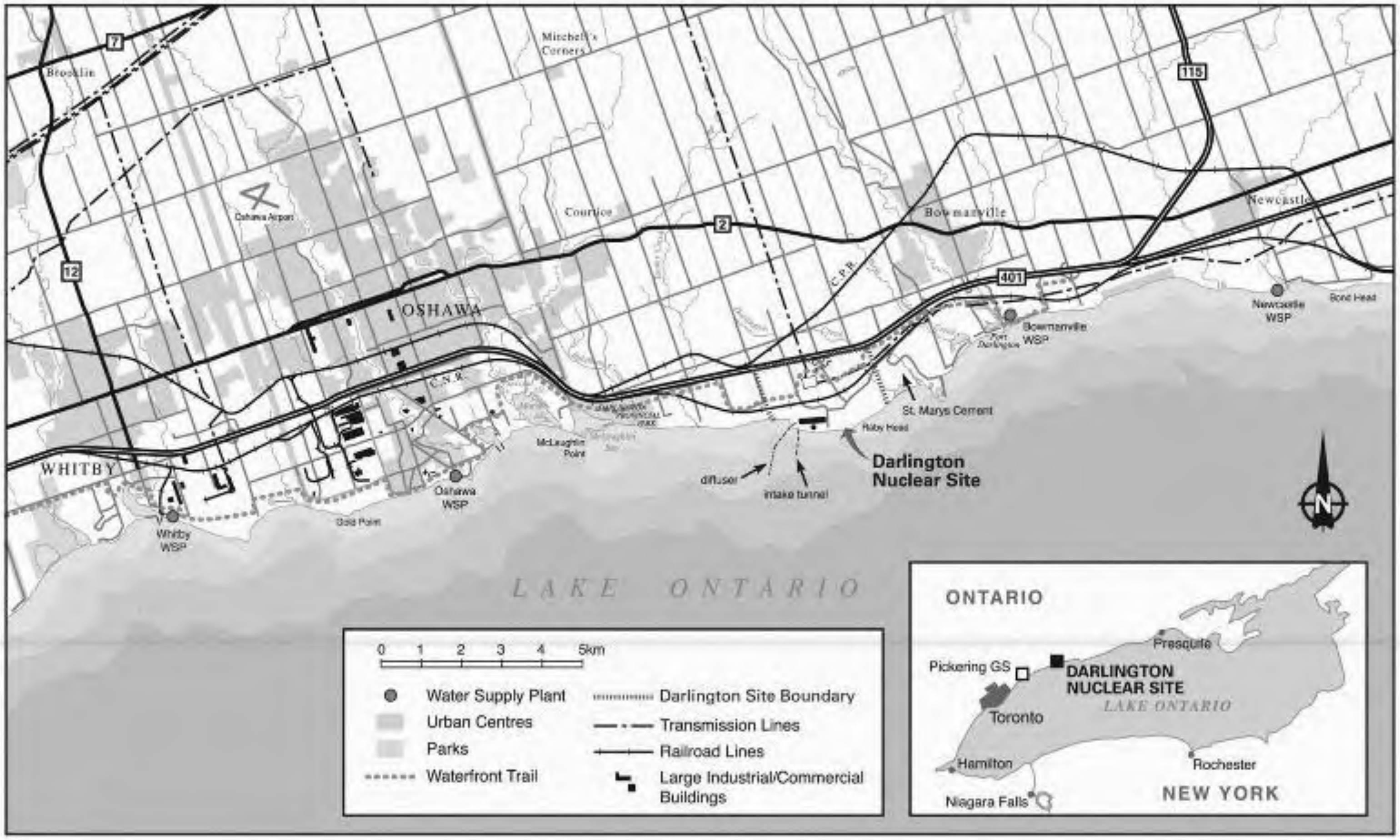


Figure 2.1.2-2: Darlington Nuclear Site (DNNP Proximity to DNGS)

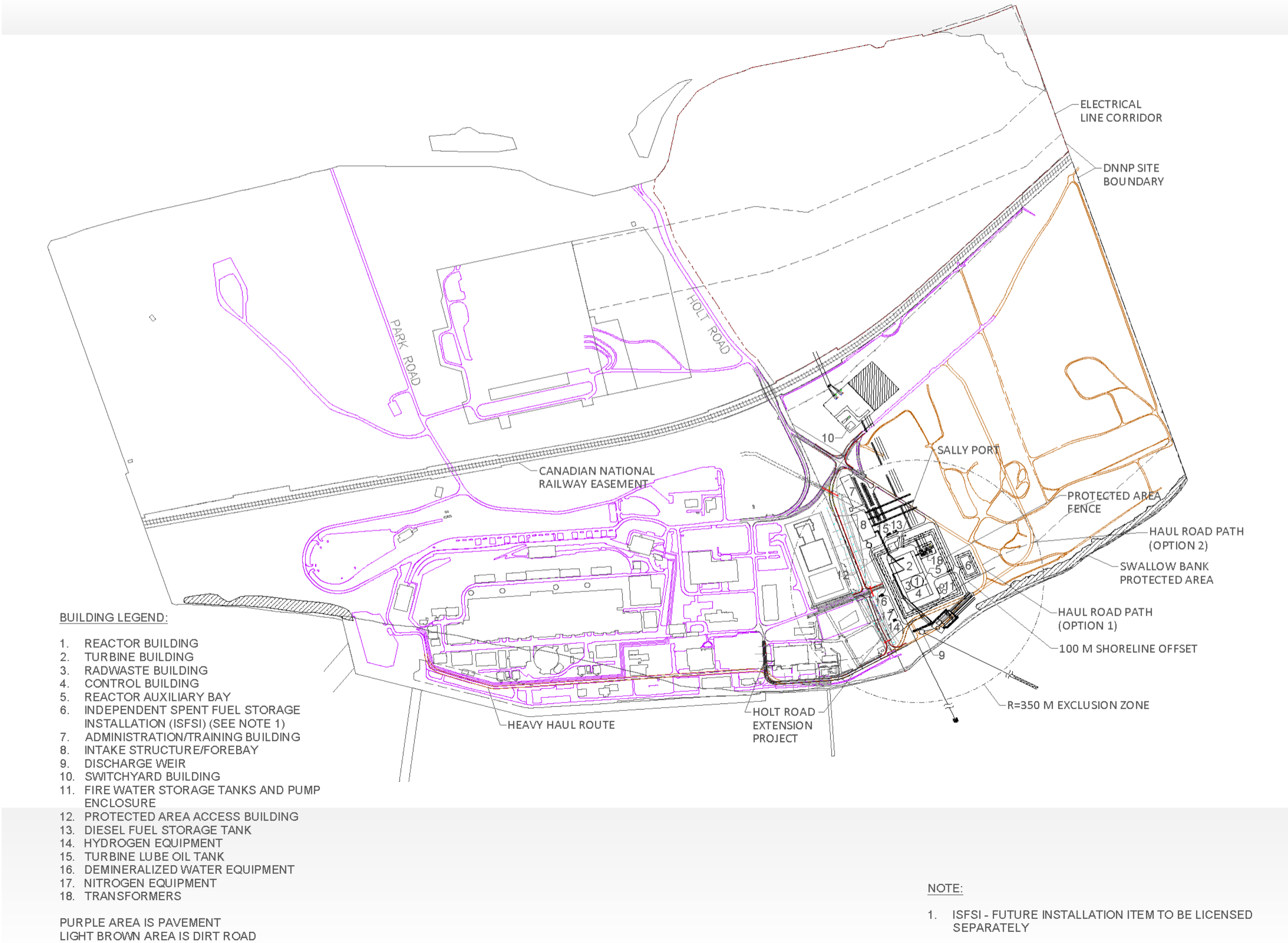


Figure 2.1.3-1: Clarington Urban Areas

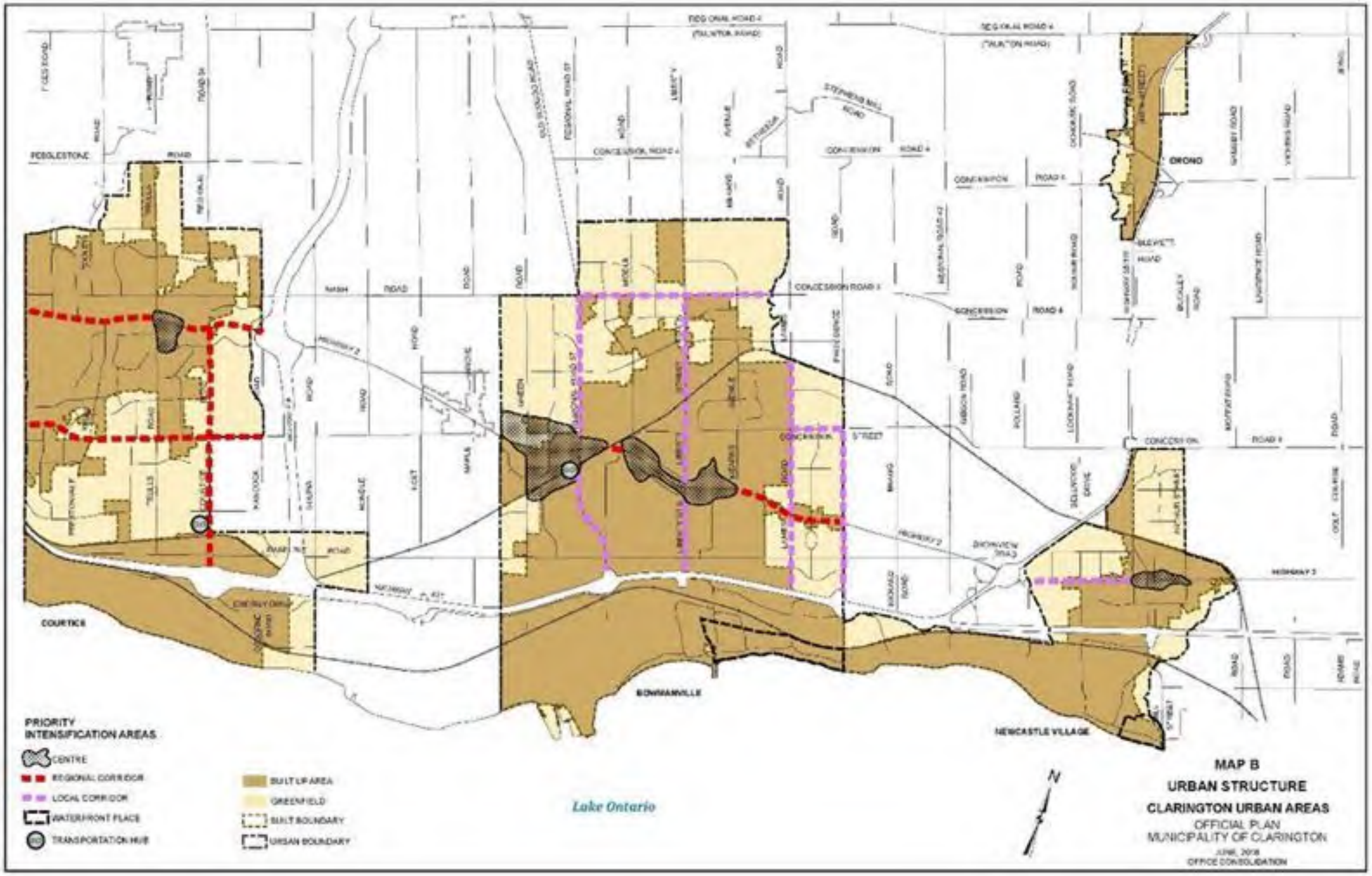
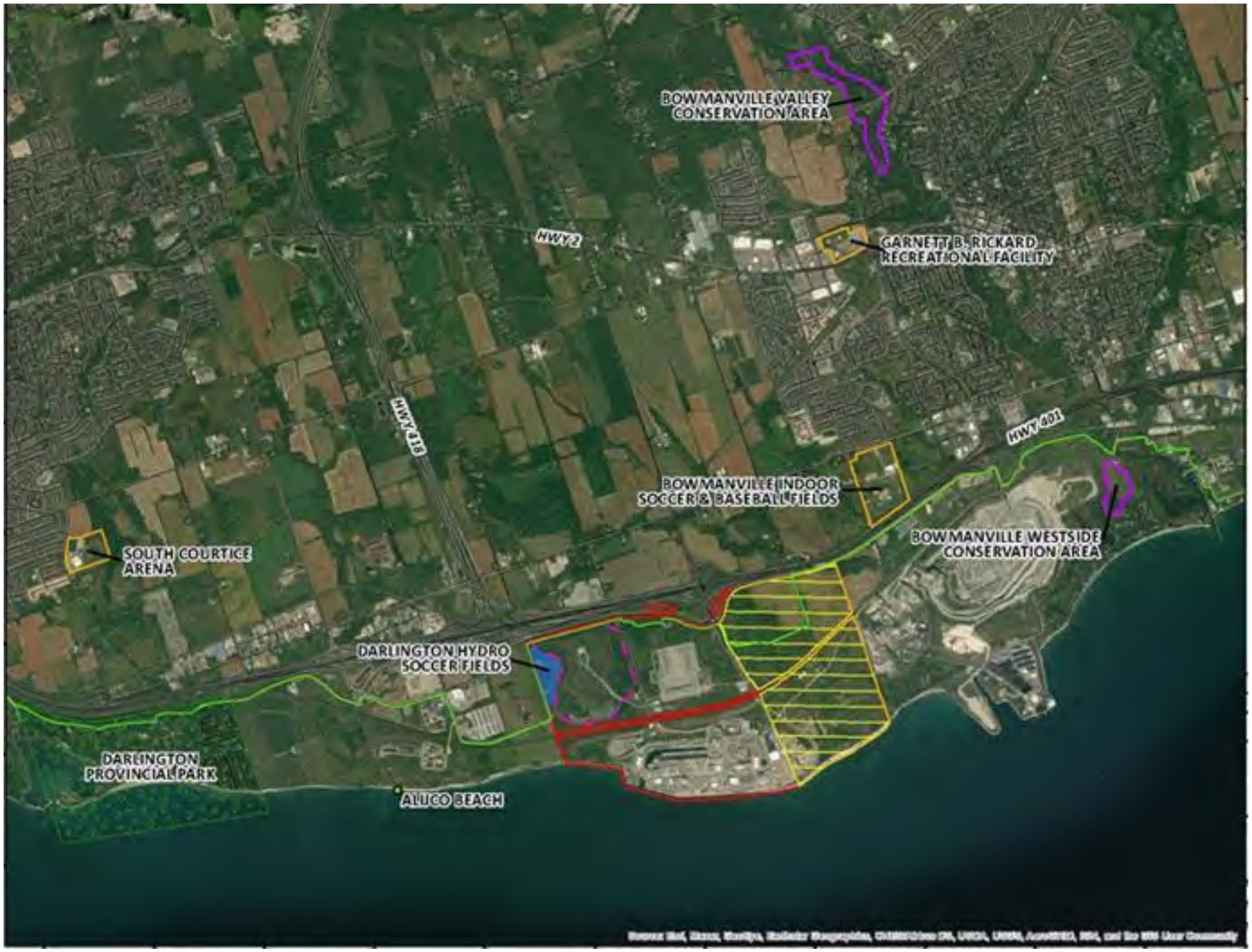


Figure 2.1.9-1: Darlington Nuclear Site – Active Darlington Waterfront Trail



2.2 DESCRIPTION OF THE FACILITY TO BE DECOMMISSIONED

The DNNP site layout, infrastructure, intake and discharge water, switchyard, BWRX-300 Power Block, and their respective interfaces are shown in Figures 2.2-4 and 2.2-6. Descriptions of the site layout, infrastructure, intake and discharge water, and switchyard are provided in this Section.

Descriptions of the BWRX-300 Power Block are provided in Section 2.2.6.

2.2.1 BWRX-300 SMR Decommissioning Design Elements

Decommissioning considerations made during the BWRX-300 Small Modular Reactor (SMR) design phase are discussed in this subsection.

2.2.1.1 Site Plot Plan

The BWRX-300 design has been optimized for constructability, which may be beneficial for dismantling the facility during decommissioning. Space allocation is considered to accommodate construction activities (i.e., access area around the plant, areas for laydown, etc.), thereby facilitating the ability to decommission and dismantle the plant once a Licence to Decommission the plant is granted.

2.2.1.2 Modular Construction

A modularization strategy will be used to design and construct the BWRX-300 at the DNNP site. The module and skid assemblies are intended to be built off-site, transported to the site, and erected on-site. This modularization strategy will provide guidance in selection of disassembly methods employed during decommissioning.

2.2.1.3 Control of Materials During Design

Specific guidance for plant systems materials to minimize corrosion products during plant operation is a design requirement, which provides restrictions regarding use of cobalt-based alloys and cobalt in stainless steel and nickel base alloys. These restrictions reduce personnel dose exposure during plant operation and decommissioning activities.

2.2.1.4 Decommissioning Considerations for As Low As Reasonably Achievable

Decommissioning considerations made to comply with the principle of As Low As Reasonably Achievable (ALARA), in the design of the BWRX-300, include the following aspects:

1. Shielding design considers protection during maintenance, inspection, decommissioning and operations.

2. To facilitate decommissioning, the Reactor Building, Turbine Building, and Radwaste Buildings are designed for large equipment removal, consisting of entry doors from the outside and numerous cubicles with equipment hatches inside the buildings.
3. To facilitate decommissioning and ease of access, the radwaste process systems are skid-mounted and located in the Radwaste Building to allow truck access, and system skid loading and unloading.

2.2.1.5 Design Features that Facilitate Decommissioning

BWRX-300 design features that facilitate decommissioning by maintaining low occupational exposures are summarized below:

- Provisions for draining, flushing, and decontaminating equipment and piping
- Design of equipment to minimize the buildup of radioactive material and to facilitate flushing of piping systems
- Shielding that provides protection during maintenance, inspection, and operations, that may facilitate decommissioning
- Provision for adequate space for utilization of movable shielding
- Separation of more highly radioactive equipment from less radioactive equipment
- Provision for separate shielded compartments for adjacent items of radioactive equipment
- Provision for access hatches for the installation or removal of plant components
- Provision for the Reactor Water Cleanup System, Shutdown Cooling System, and the condensate demineralizer to minimize crud buildup

BWRX-300 design objectives that minimize radioactive contamination include:

1. Provide containment in areas where leaks and spills are most likely to occur.
2. Provide leak detection capability for prompt detection of leakage from Structures, Systems, and Components (SSC).
3. Use leak detection methods (e.g., instrumentation, automated samplers) capable of early detection of leaks in areas where it is difficult (inaccessible) to conduct regular inspections (such as the Spent Fuel Pool and buried, embedded, or subterranean piping) to avoid release of contamination. BWRX-300 active liquid waste is kept within the radwaste building in tanks located in cubicles.
4. Facilitate decommissioning by minimizing embedded piping, sumps, or buried equipment.
5. Design the plant to facilitate the removal or replacement of equipment or components during facility operation or decommissioning.

6. Minimize the generation of radioactive contamination and waste during operation and decommissioning by reducing the volume of components and structures that become contaminated during plant operation.

2.2.2 Site Layout and Infrastructure

The DNNP site will contain infrastructure, including additional buildings, to support operations inside the Power Block.

Currently anticipated services include:

1. A demineralized water supply pipeline extending from the Darlington Demineralized Water Plant eastwards approximately 400m towards the DNGS/DNNP property line along the Third Line Road corridor. The demineralized water is used for the Power Block operations.
2. A potable water pipeline extension tying into the existing municipal water supply just south of the CN railway and west of Holt Road bridge on the west side of the road. This pipe carries potable water for use inside the power block as well as various outbuildings around the DNNP property including the administration building, warehouse, temporary construction buildings, and potentially other buildings to be determined.
3. Sanitary sewer connections to the existing Darlington East Sewage Lift Station are planned. These carry sewage from inside the power block as well as the administration building, warehouse, and potentially other buildings not yet determined, to the lift station. From here the effluent is pumped north and west towards the Courtice Water Pollution Control Plant for treatment and eventual discharge to Lake Ontario.
4. Fibre-optic cables for a business Local Area Network and copper telephone/public address cables to create a communications link between DNGS and DNNP. These run from the DNGS Engineering Support Services Building in an underground duct bank eastwards approximately 400m towards the DNGS/DNNP property line mostly along the Second Line Road corridor.
5. Additional fibre-optic cables for a security Local Area Network are brought from the Darlington Main Security Building approximately 600m east towards the DNGS/DNNP property line in an underground duct bank mostly along the Second Line Road corridor.
6. Up to 10MW of construction power are brought from the existing 54M15 feeder through Darlington DS5 substation at 13.8kV, located near the intersection of Park Road and Second Line, approximately 1km east to a new switchgear to be located near the northeast corner

of the Nuclear Sustainability Services-Darlington. This switchgear is planned to feed construction loads as well as the new administration building and warehouse. A second feed will be taken from the same 54M15 through the existing Darlington DS1-F1 substation at 8.32kV and will supply construction loads including the construction trailers.

Planned structures/features include:

1. An administration building with office spaces and a simulator training space. The simulator space will support the SMR full scope simulator and desktop simulator plus limited maintenance training space.
2. A warehouse is necessary to provide long term storage space for SMR components and equipment. It has some maintenance space and a calibration shop suitable for the service of non-contaminated equipment.
3. There is a parking lot near the administration building. There is an existing parking lot south of the Canadian National Railway near the border between DNNP and St. Marys Cement that will also be utilized.
4. A Steel Bricks production facility is planned to be constructed on the northwest quadrant of the intersection of Maple Grove Road and Second Line. This facility produces the Steel Bricks components for the construction of the reactor building.
5. A concrete batching plant will be provided suitably located if it is determined that onsite concrete batching is required.
6. Holt Road will be improved in two phases:
    a. Phase 1 - The Holt Road extension is a new stretch of road to be built from the intersection of Second Line and Old Holt Road at the northwest corner of DNNP property. This will extend south along the DNGS/DNNP property line between the Nuclear Sustainability Services-Darlington and the SMR facility until it reaches Lake Ontario. At this point it turns west and continues until it connects with the existing Lakeshore Road. The portion of Holt Road along Lake Ontario will be reinforced, and form part of the heavy haul route used to transport heavy components from the DNGS wharf to DNNP.
    b. Phase 2 - The Holt Road expansion will add an additional northbound lane from Second Line north towards Highway 401. This additional lane will end south of Energy Drive and will be used by soil transport trucks to place soil onto the northern parts

of DNNP property forming the spoils piles. There will also be a new southbound left turn lane to be created just south of the Holt Road bridge to aid traffic turning onto DNNP property.

7. The existing Old Holt Road that stretches diagonally across DNNP property will be kept intact up to the point it joins the ring road around the Power Block facility.
8. The heavy haul road along Lakeshore Road will extend east onto DNNP property to support the construction of the Power Block. It is planned to extend as far east as the Power Block facility and then extend only as far north as necessary to support the Power Block facility construction.
9. Maple Grove Road is planned to be improved and extended south and then west to join the heavy haul road at the south part of the DNNP property. The improvements will likely include a new bridge to cross over the Canadian National Railway.
10. A soil conditioning pile is created from excavated earth during the site preparation phase and located at the southeast quadrant of the Maple Grove Road and Second Line intersection This soil will be reconditioned and placed back into the SMR facility foundation.
11. A soil spoils pile is located in the northern part of DNNP property south of Energy Drive and west of Maple Grove Road. Excavated earth from the site preparation phase will be placed here.
12. Storm water management features are part of the overall site layout. One known feature is the relocation of the existing Bowmanville SS drainage ditch that currently runs from Bowmanville SS through DNNP property, southeast along Old Holt Road and draining into Lake Ontario. This will be relocated west to run along the eastern edge of the new Holt Road Extension.

2.2.3 DNNP Switchyard

The local DNNP switchyard (see Figure 2.2-5) is located North of the SMR Facility, East of the Extended Holt Rd and South of the CN Rail tracks. The local switchyard consolidates power produced by the Power Block facility. The Power Block facility has two 230kV lines connected to the local DNNP switchyard. One line connects the Facility Generator Step Up Transformer, and one line connects to the Reserve Auxiliary Transformer. The local switchyard has two redundant 230kV connections with the transmitter. The transmitter is working to connect these lines to Clarington Transformer Station, 22km North of the DNNP site.

The operating organization is responsible for the ownership and operation of the local DNNP switchyard, containing the high voltage circuit breakers and disconnect switches, in addition to equipment within the Power Block facility. Hydro One, the transmitter for the electrical grid, is responsible for the ownership and operation of the two redundant 230kV lines connecting the local DNNP switchyard with Clarington Transformer Station.

2.2.4 Normal Heat Sink

The normal heat sink removes excess heat to a large water body. For the DNNP, water withdrawn from Lake Ontario flows through the plant surface condensers to remove the excess energy of the turbine exhaust steam. The amount of heat removed during this process depends on the flow rate and the temperature rise of the water passing through the condensers. The plant heat is rejected to Lake Ontario.

Cooling water from Lake Ontario is delivered to an intake structure for the nuclear facility through an intake tunnel. The intake structure sends the cooling water to the Pumphouse/Forebay that contains circulating water pumps which deliver the cooling water to plant surface condensers before returning the heated water back to the lake through the discharge tunnel.

The Normal Heat Sink includes, but is not limited to the following:

1. Intake Tunnel, located deep in Lake Ontario to decrease potential impacts to fish habitat and is sized to provide the required flow of cooling water to the plant. It is also constructed to minimize the intake velocity to prevent impingement and entrainment of fish and effect on local currents.
2. Discharge Tunnel and diffusers are constructed deep in Lake Ontario to meet regulatory requirements by limiting the temperature increase to minimize thermal and flow effects of the plant cooling water discharge to ensure surface water temperature does not exceed 2 degrees C above ambient surface temperature and minimize impact to aquatic habitat.
3. Pumphouse/Forebay is composed of the forebay, pump bays and superstructures to house the Circulating Water System pumps and related equipment.

2.2.5 Security Building

A security building, known as the Protected Area Access Building, is provided on the protected area boundary to allow for ingress and egress to and from the protected area. Additionally, a sally port is provided adjacent to the security building to allow for vehicular traffic to enter the protected area. Detailed information about the protected area and vital areas, including their structures and/or barriers, are provided in a separate security annex of the PSAR (Ref. 28) since the content contains prescribed information as defined by Section 21 of the General Nuclear Safety and Control Regulations (SOR/2000-202) (Ref. 27).

2.2.6 General BWRX-300 Power Block Description

The BWRX-300 is a Boiling Water Reactor (BWR) that employs natural circulation and passive emergency cooling features and is rated at approximately 300 megawatts-electric.

The passive design features of the BWRX-300 provide decay heat removal capability using only installed systems with no reliance on operator actions or external resources for at least 72-hours. For the BWRX-300, a safe stable condition ("stable shutdown") is defined as safe shutdown with average reactor coolant temperature ≤ 215.6°C (420°F). Following 72-hours post-accident, on- site or off-site resources are used to power non-safety equipment for proceeding to cold shutdown conditions, as needed.

The BWRX-300 design applies a defence-in-depth process for safety assessment and safety analysis to ensure that radiological acceptance criteria are met. The leveraging of passive design features greatly simplifies the design and results in a significant reduction in total number active systems, structures, and components (SSCs) compared to conventional Nuclear Power Plants (NPPs).

See Figures 2.2-1 – 2.2-3 for schematics of the BWRX-300 systems. For more detailed information, see section 1.7 in the PSAR, September 30, 2022 (Ref. 28).

Figure 2.2-1: BWRX-300 Major Systems

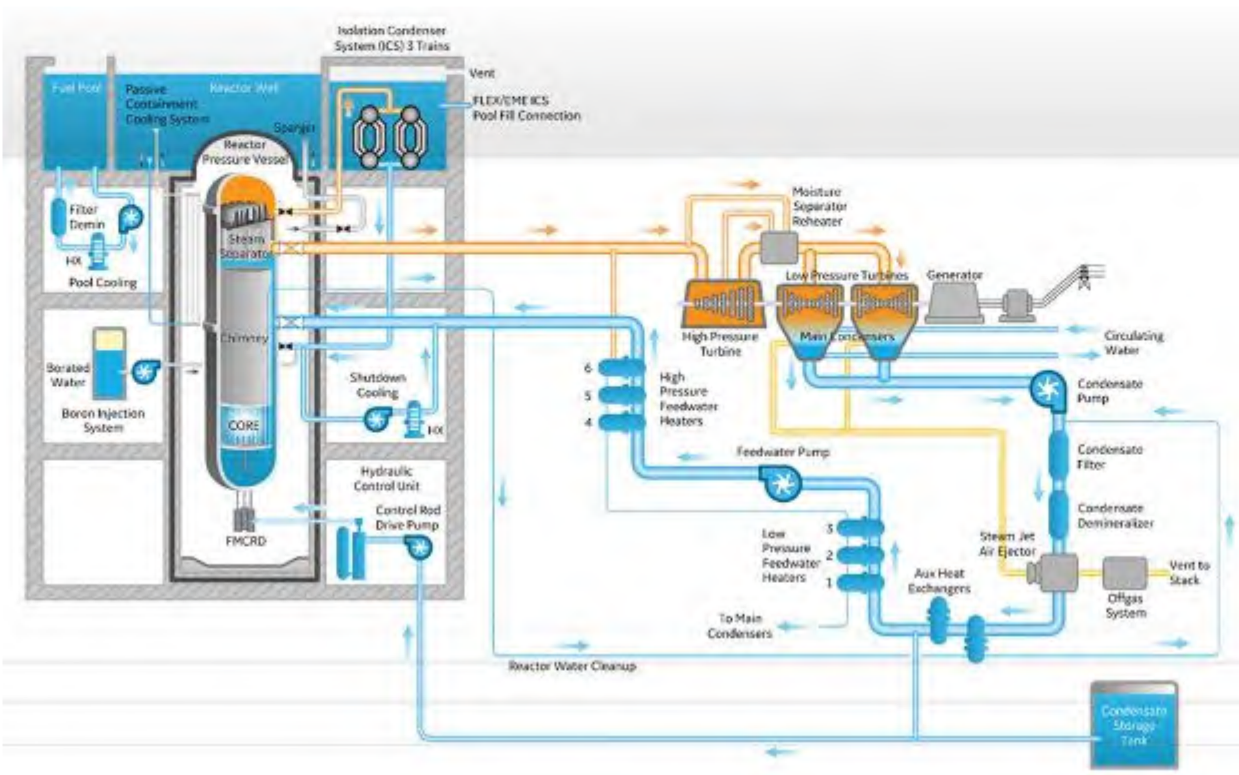


Figure 2.2-2: BWRX-300 RPV and Internals

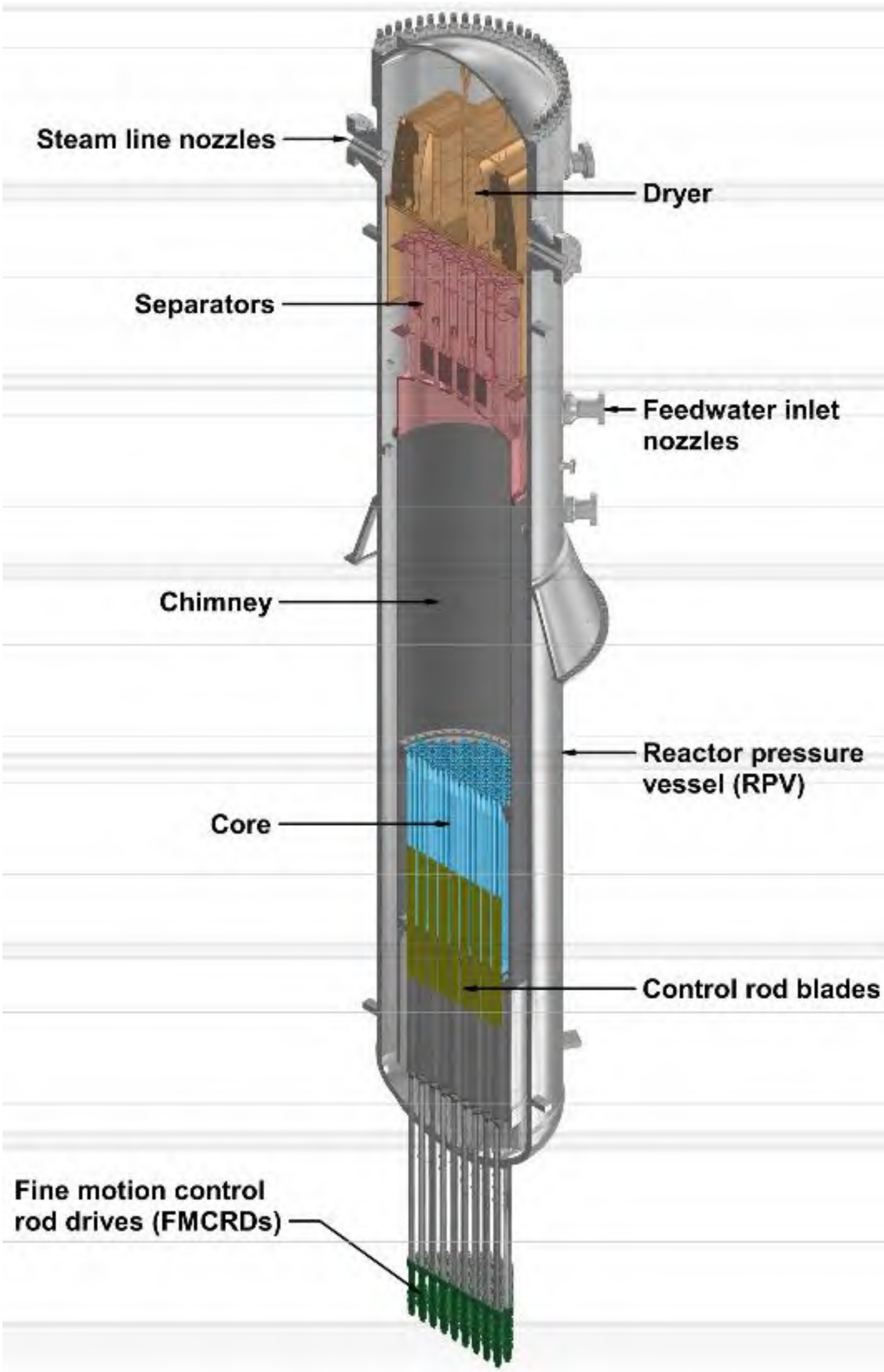
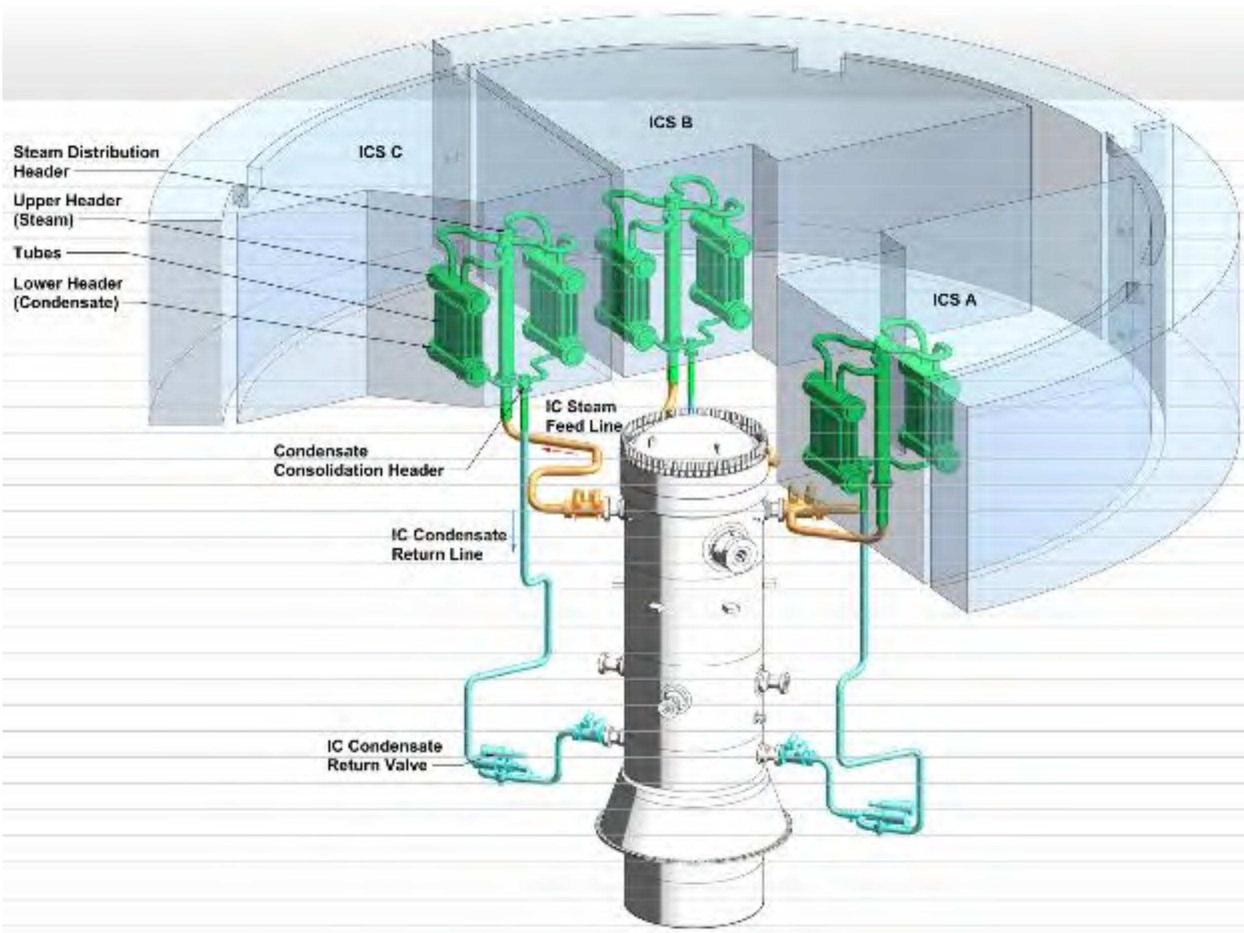


Figure 2.2-3: Isolation Condenser System



2.2.6.1 Basic Technical Characteristics

The principal technical characteristics of the BWRX-300 are provided in Table 2.2.6-1.

Table 2.2.6-1: Principal Characteristics of Interest for the DNNP BWRX-300

Parameter Description	Value	Comments
Type of plant	Boiling Water Reactor	
Core coolant	Light Water	
Neutron moderator	Light Water	
Nuclear Steam Supply System layout	Direct-Cycle	
Primary circulation	Natural	
Thermodynamic cycle	Rankine	
Type of containment structure	Dry	
Reactor thermal power level	870 MWth	
Normal Heat Sink	Once Through Cooling System using water from Lake Ontario	
Ultimate Heat Sink	ICS pools	Pools are vented to atmosphere
Plant gross electrical power output	~ 300 MWe	
Plant Footprint	~ 9,800 m2	Rectangular building envelope
Site Footprint	~ 30,000 m2	Fenced area
Design life	60 years	
Exclusion Zone	350 m (radius)	Measured from exterior of the Reactor Building
Seismic Design (DBE)	0.310 g (horizontal and vertical)	Bounding rock peak ground acceleration Bounding surface peak ground acceleration
Reactor Design Pressure	10.3 MPa	
Fuel	UO2 pellets	
Fuel enrichment	<5% U-235	
RPV diameter (ID)	~ 4 m	
RPV height (Inside)	~ 26 m	
Control rod drive type	Fine Motion Control Rod Drive (FMCRD)	
Containment Vessel type	Steel-plate Composite	
Fuel pool capacity	Up to 8 years of full-power operation	Fuel pool accommodates up to 8 years of spent fuel plus one core load of new fuel and one full core off-load
Refueling cycle	12 - 24 months	
Emergency Power Supply	Safety Class 1 DC batteries	Capable of sustaining required loads for 72 hours

2.2.6.2 Reactor Building

The Reactor Building (RB) is a Safety Category 1 and Seismic Category A structure. It is a cylindrical shaped structure embedded in a vertical shaft to a depth of approximately 36 m below grade. The Reactor Pressure Vessel (RPV), Steel-plate Composite Containment Vessel (SCCV) and other important systems and components are located in the deeply embedded RB vertical right-cylinder shaft to mitigate effects of external events, including aircraft impact, adverse weather, fires, and earthquakes. The Secondary Control Room is located in the RB. The below-grade portion also contains reactor support and safety class systems and the Safety Class 1 power supply and equipment. The reactor cavity pool is above the containment dome. Also, within the RB, three separate Isolation Condenser System (ICS) pools sit next to the reactor cavity pool above the SCCV, with one isolation condenser located in each pool. The Fuel Pool is also located in the RB.

2.2.6.3 Turbine Building

The Turbine Building (TB) houses the steam turbine generator, standby diesel generators, main condenser, condensate and feedwater systems, turbine-generator support systems, and parts of the offgas system (excluding the offgas charcoal adsorbers).

While considered a separate functional area from the Turbine Building, the northern portion of the Plant Services Area (PLSA) is structurally integrated with the Turbine Building. See Section 2.2.6.6 for a description of the PLSA.

The TB is a Safety Class 2 structure and is categorized as Non-Seismic. Additionally, it is evaluated for seismic interaction to ensure that it will not compromise the structural integrity and safety functions of the adjacent Seismic Category A RB following a Design Basis Earthquake (DBE) or extreme Tornado wind conditions.

2.2.6.4 Control Building

The Control Building (CB) houses the MCR, Emergency Operations Centre (EOC), electrical, control, and instrumentation equipment. The CB is a Safety Class 2 structure and is categorized as Non- Seismic. Additionally, it is evaluated for seismic interaction to ensure that it does not compromise the

structural integrity and safety functions of the adjacent Seismic Category A RB following a DBE or extreme Tornado wind conditions. The CB serves as main entrance and exit for the Power Block unit during normal operations.
While considered a separate functional area from the Control Building, the southern portion of the PLSA is structurally integrated with the Control Building. See Section 2.2.6.6 for a description of the PLSA.

2.2.6.5 Radwaste Building

The Radwaste Building (RWB) houses rooms and equipment for handling, processing, and packaging liquid and solid radioactive wastes as well as the Offgas System charcoal adsorbers that are used for processing radioactive gas. Some of these systems contain highly radioactive materials during operations. The RWB is classified as a Safety Class 3 building and categorized as RW-IIa in accordance with Regulatory Guide (RG) 1.143, Rev. 2, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light Water-Cooled Nuclear Power Plants." Additionally, it is also evaluated for seismic interaction to ensure that it will not compromise the structural integrity or safety function of the adjacent Seismic Category A RB following a DBE or extreme Tornado wind conditions.

2.2.6.6 Plant Services Area and Reactor Auxiliary Bay

The PLSA houses a decontamination area, a contaminated part/tool storage room, an Instrument and Control (I&C) calibration room, a truck space for cask removal, a hot machine shop, laydown areas for new fuel and the Fine Motion Control Rods Drives (FMCRD), and a miscellaneous storage area.

While the PLSA is a separate functional area from the CB and TB, the northern portion of the PLSA shares a foundation and is structurally integrated with the TB and the southern portion of the PLSA shares a foundation and is structurally integrated with the CB (see Figure 2.2.-6).

A portion of the PLSA, the Reactor Auxiliary Bay, is constructed on a separate foundation with respect to the portions of the PLSA that are adjacent to the CB and TB. The functions performed in the Reactor Auxiliary Bay include new fuel and spent fuel cask transit, equipment ingress and egress to the RB, and personnel access to the RB. The Reactor Auxiliary Bay is a Safety Class 2 structure and is categorized as Non-Seismic. Additionally, it is evaluated for seismic interaction to ensure that it does not compromise the structural integrity and safety functions of the adjacent Seismic Category A RB following a DBE or extreme Tornado wind conditions.

Figure 2.2-4: DNNP BWRX-300 Facility Site Layout

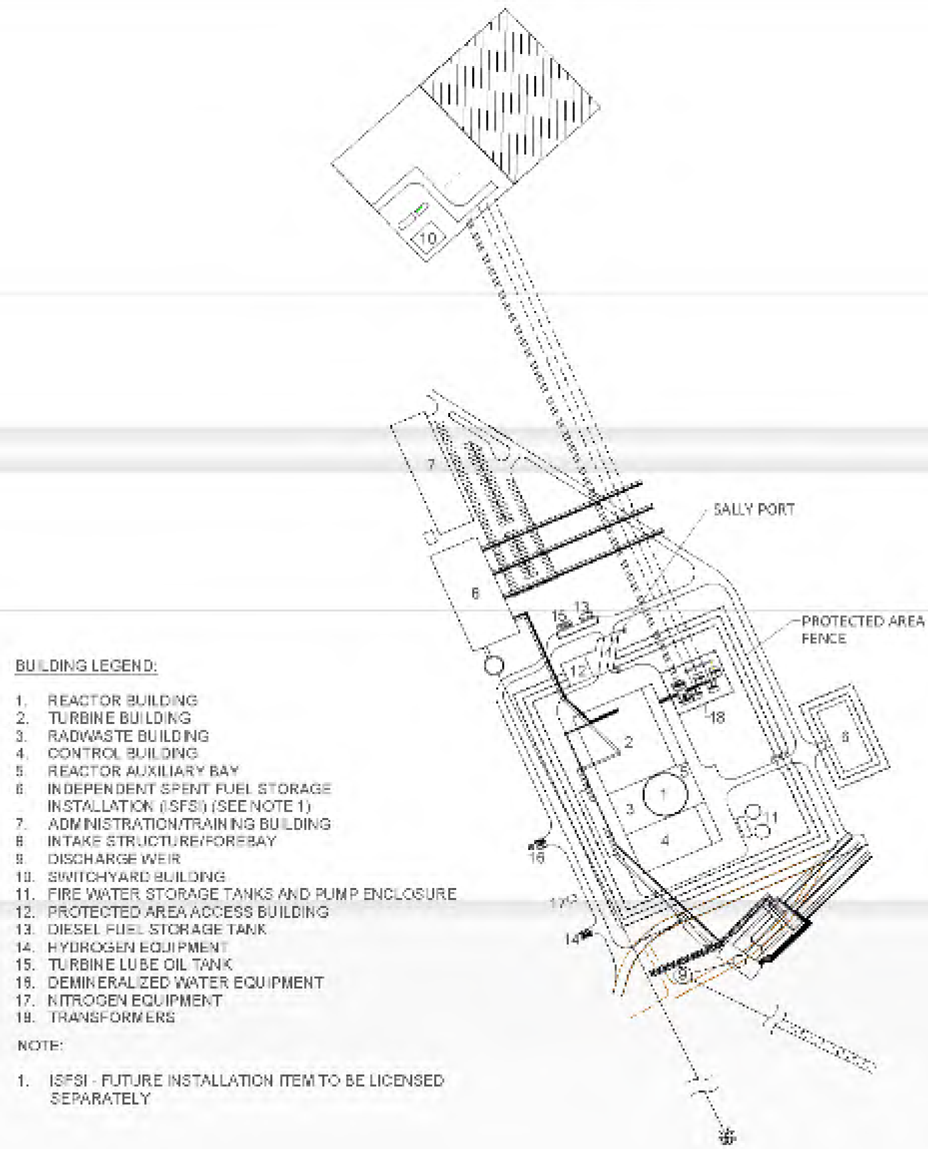


Figure 2.2-5: DNNP Switchyard Site Plan

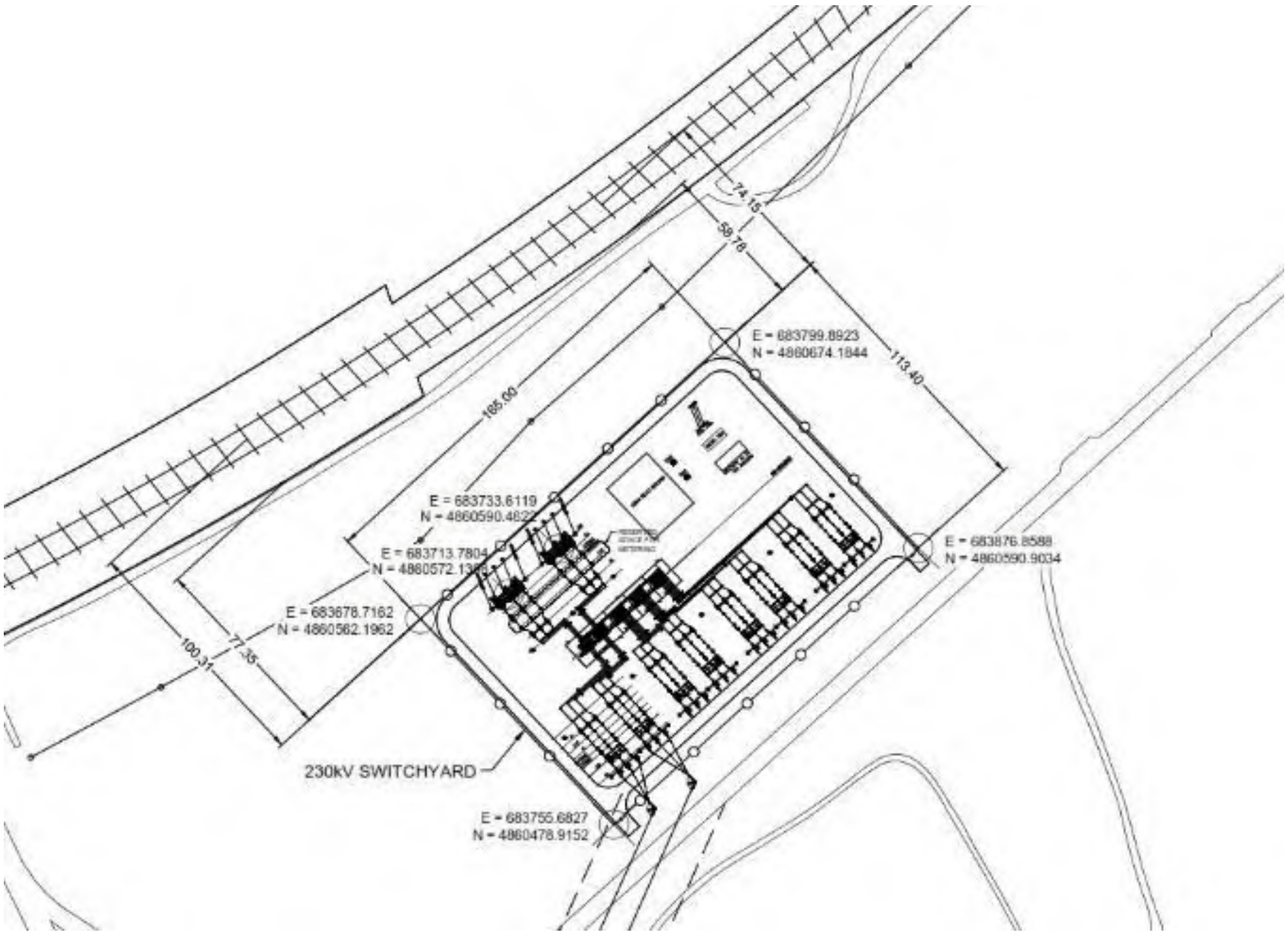
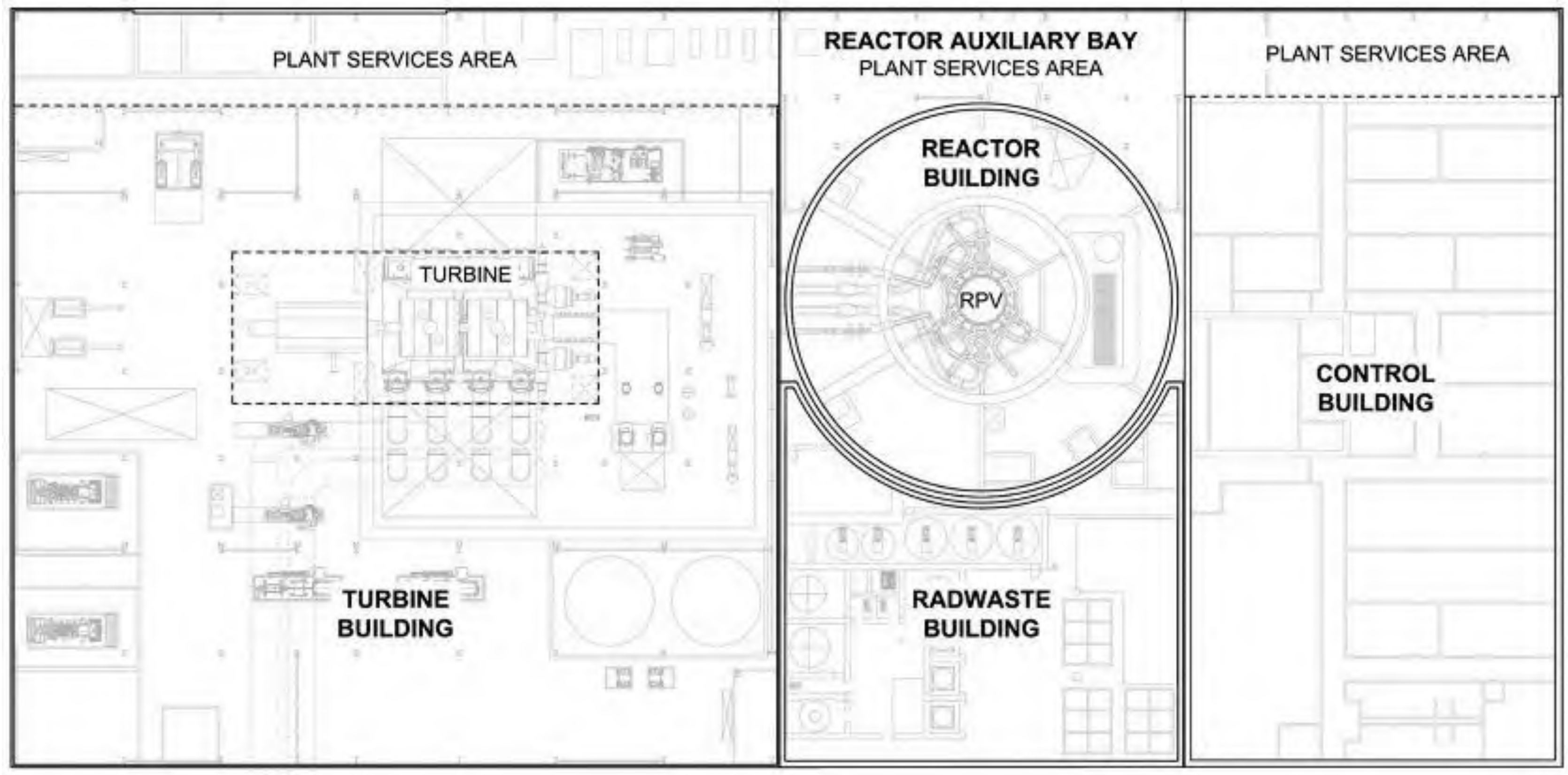


Figure 2.2-6: BWRX-300 Power Block Plan View at Elevation 0



2.3 OVERVIEW OF SITE RADIOLOGICAL, CHEMICAL AND PHYSICAL CONDITIONS EXPECTED AFTER STATION SHUTDOWN

The station will be transitioned from Operations to Stabilization (Preparation for Dismantlement) as soon as practical after shut down to ensure a smooth transition from Operations. The subsequent stages of decommissioning will be Dismantling & Demolition and then Site Restoration. The actual station condition will be characterized, as required, prior to each stage. However, certain conditions such as the radiological, chemical and the physical conditions of the station can already be predicted with sufficient accuracy for preliminary decommissioning planning purposes. A general description of the radiological, chemical and the physical conditions of the station at the time of shutdown is outlined in Sections 2.6 and 2.7.

The radiological condition of the station will depend on both the design and the operating history of the reactor. Generally, the main sources of radiation at shutdown will be the used fuel resident in the reactor and stored in the spent fuel pool, the activated and contaminated sections of the reactor internals and the Nuclear Steam Supply System (NSSS). Other sources of radiation can be found in the radioactive waste systems, in the ion exchange resins, Reactor Coolant and Turbine systems.

During operations, routine radiation dose rate and contamination surveys of the accessible, normally frequented areas of the facility will be performed at regular intervals. Any loose contamination discovered outside of contamination control areas will be removed or the area is re-designated as a contamination control area. In addition, non-routine radiation dose rate and contamination surveys (for exposure control) will be carried out whenever abnormal or changed radiological conditions are known or suspected to exist (Ref 29).

In preparation for the decommissioning of DNNP a Historical Site Assessment (HSA) is planned as a precursor for further site characterization activities in a Radiation Survey and Site Investigation (RSSI) process that will be maintained up to the Dismantling & Demolition stage of decommissioning as per MARSSIM (Ref 40).

Post-operational/scoping surveys will be performed after the station is shut down. Characterization surveys will also be performed prior to the start of the Dismantling & Demolition stage. The acquired site characterization field data will permit an appropriate assessment of the radiological and conventional hazards that can affect workers, the public and the environment.

The Radiation Survey and Site Investigation (RSSI) will use a graded approach for performing a site investigation and will begin by preparing an HSA and includes various surveys and sampling to assess site radiological conditions.

The RSSI will conclude with a Final Status Survey, which is designed to show that residual radioactivity at the site meets regulatory approval, and which ultimately leads to release from regulatory control after decommissioning is completed.

The results of the radiation dose rate and contamination surveys, together with other information on the radiological hazards and conditions in the facility, are recorded in OPG's electronic database known as the Visual Survey Data System (VSDS). The information in this database will be available for use in preparation of the DDP. Other information on hazards that are discovered is also recorded in this database. A 'Station Condition Record' (SCR) is used to document, evaluate and correct an adverse condition related to personnel performance, procedure, or programs and an adverse condition causing or identified as a result of an event. The SCRs are recorded in an electronic database that will also be available during the preparation for decommissioning.

Most of the hazardous materials stored on the site (flammable, cryogenic gases, oxidizers, corrosives, etc.) will be consumed during routine station operations. Some of the remaining materials will be consumed during the shutdown period. Others, such as the fuel oil for the standby generators, can be removed for use at other sites when the systems have been permanently removed from service.

Until the final shutdown of DNNP, OPG will continue to maintain and operate the station SSCs in a manner that will minimize the deterioration of these assets. It is anticipated that these SSCs will be in good working condition at the time of shutdown. Individual component condition assessments will be conducted prior to station shutdown.

2.4 DECOMMISSIONING STRATEGY

Consistent with REGDOC-2.11.2, there are three decommissioning options available for a decommissioning strategy:

a) Immediate (Prompt) decommissioning – to decontaminate, dismantle and/or clean up without any planned delays

b) Deferred decommissioning –
   i. to place the facility, location or site in a period of storage with surveillance (sometimes referred to as care and maintenance), followed by decontamination, dismantling and/or clean-up

   ii. to conduct activities directed at placing certain buildings or facilities, locations or sites in a safe and secure interim end state, followed by a period of storage with surveillance, and ultimately, decontamination, dismantling and/or clean-up

c) In situ decommissioning – to place the facility, location or site, or portions thereof, in a safe and secure condition in which some or all of the radioactive contaminants are disposed of in place, which may result in the creation of a waste disposal site

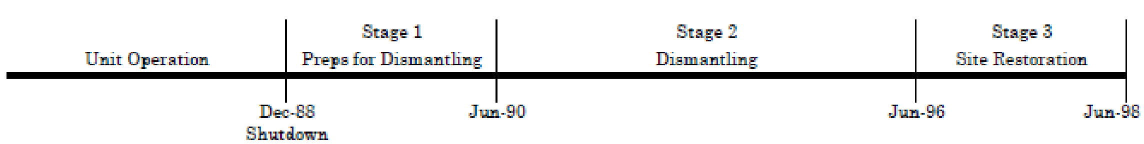
OPG has not considered In-situ decommissioning as there are no exceptional circumstances associated with the DNNP that would warrant its use.

Of the other two options, OPG has for financial planning purposes preliminarily chosen to assume a prompt decommissioning strategy primarily because the DNNP is a smaller reactor that can be easily isolated from the other units on the site and this strategy will allow the licence to terminate sooner than with deferred decommissioning. This decision will be reassessed periodically in light of stakeholder and community input, experience, cost, changing technology, the possible requirement of the site for other purposes and the guidance in REGDOC-2.11.2 and N294:19 for other factors which may have relevant consequences for decommissioning.

2.5 PLAN OF DECOMMISSIONING WORK

The following sections describe the basic activities associated with the prompt decommissioning of the DNNP facility which will progress following permanent cessation of operations. Although detailed procedures for each activity identified are not provided, and the actual sequence of work may vary, these activity descriptions provide a basis not only for estimating, but also for the expected scope of work, i.e., engineering and planning at the time of decommissioning. Decommissioning work will be executed in accordance with the accepted DDP and detailed work plans. See Figure 2.5-1 for a conceptual decommissioning schedule.

FIGURE 2.5-1: PROMPT DISMANTLING TIMELINE



Applying the 'Prompt Decommissioning' strategy, the DNNP facility will pass through three distinct stages:

a. Stabilization and Preparations for Dismantling

b. Dismantling

c. Site Restoration

Stage 1 – Stabilization and Preparations for Dismantling

In anticipation of the cessation of plant operations, detailed preparations are undertaken to provide a smooth transition from plant operations to site decommissioning. Through implementation of a staffing transition plan, the organization required to manage the intended decommissioning activities is assembled from available plant staff and outside resources. Preparations include the planning for permanent defueling of the reactor, revision of programs and procedures applicable to the operating conditions and requirements, a characterization of the facility and major components, and the development of the Permanent Shutdown Plan, the Stabilization Activity Plan and the Detailed Decommissioning Plan (DDP).

Planning also includes site characterization, description of the dismantling activities, plans for site remediation, detailed plans for the final radiation survey, designation of the end-use of the site, an updated cost estimate to complete the dismantling, and any associated plans for environmental remediation. In addition, the plan for release from regulatory control is developed.

OPG's existing programs would be utilized (or modified as required) for waste management, work planning, environmental protection, etc. to protect or mitigate against specific hazards or atypical situations envisioned to occur during dismantling or site restoration. This includes planning for hazard surveys throughout the decommissioning project for the protection of the workers, the public, and the environment to ensure risks are being adequately controlled and to confirm the effectiveness of risk reduction strategies. Work plans will be developed for CNSC acceptance for monitoring work hazards, environmental emissions and effluents, and for disposal of wastes.

Engineering and Planning

The dismantling operations shall be designed to accomplish the required tasks within the ALARA guidelines for protection of personnel from exposure to radiation hazards. The engineering and planning will also address the continued protection of the health and safety of the public and the environment during the dismantling activity.

Much of the work in preparing the plan is also relevant to the development of the detailed engineering plans and procedures. This work includes, but is not limited to:

- Site preparation plans for the proposed dismantling activities.
- Detailed procedures and sequences for removal of systems and components.
- Evaluation of the disposition and selection of the most suitable option for the reactor vessel and internals.
- Plans for decontamination of structures and systems.
- Design/procurement and testing of tooling and equipment.
- Identification/selection of specialty contractors.
- Procedures for removal and disposal of radioactive materials.
- Sequential planning of activities to minimize conflicts with simultaneous tasks.
- Obtain any additional licences, permits or approvals that may be required and complete any other regulatory requirements that may be applicable (this includes an environmental review if required). Note: a decommissioning licence to allow decommissioning activities will be required prior to starting decommissioning.
- Submission of interim end state reports (as required).

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. Security staff will be available for all facilities on the Darlington site for the duration of decommissioning.

Safeguards

In accordance with an agreement between the Government of Canada and the IAEA, nuclear safeguards are implemented at OPG's NGSs. These international safeguards apply to used fuel management.
The existing safeguards arrangements for used fuel will continue until modified or terminated by agreement with the CNSC.

Preparations for Dismantling

In preparation for dismantling, the following activities are initiated:

- Prepare site support and storage facilities, as required.

- Perform site characterization study to determine extent of site contamination.
- Clean all plant areas of loose contamination and process all liquid and solid wastes.
- Conduct radiation surveys of work areas, major components (including the reactor vessel and internals), sampling of internal piping contamination levels, and primary shield cores.
- Correlate survey data for development of packaging and transportation procedures.
- Defuel the reactor and transfer fuel to the fuel pool. This activity will be carried out by plant personnel in accordance with existing operating technical specifications. The existing used fuel storage facilities will continue to operate until the used fuel is transferred to the fuel repository or to dry storage.
- Isolation of the spent fuel storage services and fuel handling systems located in the reactor building so that safe-storage operations may commence on the balance of the plant. This activity may be carried out by plant personnel in accordance with existing operating technical specifications. Activities are scheduled around the fuel handling systems to the greatest extent possible.
- Drain/de-energize/secure all non-contaminated systems not required to support dismantling.
- Dispose of contaminated filter elements and resin beds not required for processing wastes from decontamination activities.
- Determine transport and disposal container requirements for activated, contaminated, and/or hazardous materials, including shielding and stabilization. Fabricate or procure such containers.
- Begin procuring waste containers from suppliers.
- Develop procedures for occupational exposure control, control and release of liquid and gaseous effluents, processing of radwaste (categories such as; resins and filter media used during the site decontamination process, metallic and non-metallic effluents generated in dismantling), site security and emergency programs, and industrial safety.

Stage 2 - Dismantling

This stage includes the physical decommissioning activities associated with the removal and disposal of contaminated and activated components and structures. Significant dismantling activities involve the following steps:

- Construct temporary facilities and modify existing storage facilities to support the dismantling activities. These may include a cutting station (for large components), additional changing rooms and contaminated laundry facilities for increased work force, establishment of laydown areas to facilitate equipment removal, upgrading roads to facilitate hauling and transportation, and modifications to the Reactor Building to facilitate access of large/heavy equipment, as required.

- Design and fabricate shielding and contamination control envelopes to support removal and transportation activities. Specify and/or procure specialty tooling and remotely operated equipment. Modify containment to support segmentation activities and prepare rigging for segmentation and extraction of heavy components.
- Procurement of waste containers from suppliers, continued.
- Transfer of the steam separator and dryer assemblies to the equipment pool for segmentation. Segmentation by weight and activity maximizes the loading of the shielded transport casks. The operations are conducted under water using remotely operated tooling and contamination controls.
- Disconnection of the control blades from the drives on the vessel lower head. Blades are transferred to the spent fuel pool for packaging.
- Disassembly, segmentation, and packaging of the core shroud, chimney, and in-core guide tubes.
- Removal and segmentation of the remaining internals including the fuel support castings, and core plate assembly.
- Removal of spent fuel storage racks from spent fuel pool, and cleanup of spent fuel pool.
- Draining and decontamination of the reactor cavity and the permanent sealing of the spent fuel transfer gate. Installation of a shielded platform for segmentation of the reactor vessel. Reactor vessel cutting operations are performed in air using remotely operated equipment within a contamination control envelope, with the water level maintained just below the cut to minimize the working area dose rates. Sections are transferred to the equipment pool for packaging and interim storage. Remove vessel wall segments down to the elevation of the vessel support skirt.
- Disconnection of the control rod drives and instrumentation tubes from the reactor vessel lower head. Install a temporary vessel support structure below the vessel lower head to support the lower portion of the vessel once the vessel support skirt is cut free. Remove the vessel support skirt section, and continue removing vessel wall segments down to the elevation of the vessel lower head.
- The lower reactor head and vessel supporting structure are then segmented or removed.
- Conduct decontamination of components and piping systems as required to control (minimize) worker exposure. Remove, package, and dispose of all piping and components that are no longer essential to support dismantling operations. Exterior surfaces are decontaminated, and openings covered. Large components (tanks, heat exchangers, etc.) may serve as their own burial containers provided that all penetrations are properly sealed.
- Remove isolation condensers for shipment and controlled disposal. The isolation condensers will be segmented prior to disposal. They are considered large objects which exceed the waste disposal facility size/weight guidelines for disposal.
- Demolition of the reactor pedestal.

- Remove systems and associated components as they become non-essential to the vessel removal operation, related decommissioning activities, or worker health and safety (e.g., waste collection and processing systems, electrical and ventilation systems, etc.).
- Removal of the steel liners from the equipment pool, reactor cavity pool, isolation condenser pools, and spent fuel storage pool.
- Surveys of the decontaminated areas of the containment structure.
- Removal of the contaminated equipment and material from the turbine and radwaste buildings, and any other contaminated facility. Use radiation and contamination control techniques until radiation surveys indicate that the structures can be released for unrestricted access and conventional demolition. This activity may necessitate the dismantling and disposition of most of the systems and components (both clean and contaminated) located within these buildings. This activity will facilitate surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.
- Removal of the remaining components, equipment, and plant services in support of the area release survey(s).
- Routing of material removed in the decontamination and dismantling to a central processing area. Material certified to be free of contamination is released for unrestricted disposition, e.g., as scrap, recycle, or general disposal. Contaminated material is packaged for controlled disposal at OPG's proposed Low-Level Waste (LLW) Disposal Facility and Intermediate-Level Waste (ILW) Disposal Facility.
- Remove all remaining LLW and ILW along with any remaining hazardous and toxic materials. Material removed in the decontamination and dismantling of the facility will be routed to an on-site central processing area. Material that meets clearance criteria will be released for unrestricted disposition, e.g., as scrap, recycle or general disposal. Contaminated material will be characterized and packaged for controlled disposal at OPG's proposed LLW Disposal Facility and ILW Disposal Facility.
- Conduct final radiation survey, in accordance with the requirements and guidance found in REGDOC-2.11.2 and N294:19, to ensure that all radioactive materials in excess of permissible residual levels have been remediated. This survey may coincide with the regulator's site inspection. A termination survey can be developed using a guidance document such as the "Multi-Agency Radiation and Site Investigation Manual," (Ref. 15) issued by the U.S. Nuclear Regulatory Commission (NRC). This manual delineates the statistical approaches to survey design and data interpretation. It also identifies state-of-the-art, commercially available, instrumentation and procedures for conducting radiological surveys. Use of guidance such as this ensures that survey design and implementation are conducted in a manner that provides a high degree of confidence that applicable criteria are satisfied. Once the survey is complete, the results are provided to the regulator(s) in a format that can be verified. The regulator can then review

and evaluate the information, perform an independent confirmation of radiological site conditions, and make a determination on release from regulatory control. An interim end state report will be prepared for submission to the regulatory body, ideally no more than 2 years after demolition is complete.

Stage 3 – Site Restoration

Site restoration activities may begin following the completion of dismantling operations. Efficient removal of the contaminated materials and verification that residual radionuclide concentrations are below regulatory limits may result in substantial damage to many of the structures. Blasting, coring, drilling, scarification (surface removal), and the other decontamination activities will substantially degrade power block structures including the reactor, turbine and radwaste buildings. Verifying that subsurface radionuclide concentrations meet site release requirements may require removal of grade slabs and lower floors, potentially weakening footings and structural supports. This removal activity will be necessary for those facilities and plant areas where historical records, when available, indicate the potential for radionuclides having been present in the soil, where system failures have been recorded, or where it is required to confirm that subsurface process and drain lines were not breached over the operating life of the station.

It is assumed that non-essential structures and site facilities will be dismantled as a continuation of the decommissioning activity. Foundations and exterior walls are assumed to be removed to a nominal depth of one meter below grade whenever possible. Foundation grade slabs greater than one meter in thickness are abandoned in place and covered over with a one-meter layer of fill. The one-meter depth allows for the placement of both gravel for drainage and topsoil for erosion control through restoration of vegetation. DNNP facility areas affected by the dismantling activities are cleaned and the plant area graded as required to prevent ponding and inhibit the resurfacing of subsurface materials.

Activities include:

- Perform demolition of the remaining portions of the power block. Internal floors and walls are removed from the lower levels upward, using controlled blasting techniques. Concrete rubble and clean fill produced by demolition activities are used on-site to backfill voids. Suitable materials can be used on site for fill; otherwise the rubble is trucked off site for disposal as construction debris. The volume of concrete rubble inventory developed for the end of life decommissioning plan was not enough to backfill the voids. As such, backfill is included as additional cost.

- Remove remaining buildings using conventional demolition techniques for above ground structures, including the turbine hall, and other site structures.

- Apply for release from regulatory control for the facility from the CNSC.

- Prepare the final end state report and submit to CNSC for acceptance.

Final End State

By the end of the Dismantling & Demolition and Site Restoration periods, the site will be free of industrial and radiological hazards. All of the station's 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 will remain for continued use.

All radioactive contamination in excess of the established clearance levels 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. All of the station systems will have been dismantled and all of the buildings demolished. 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 clean concrete rubble and/or soil and graded over, along with restoration of vegetation. 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.

Release from Regulatory Control

Upon completion of decommissioning, the Darlington Nuclear Site will be in a condition that will support its removal from regulatory control. A final end state report (or site abandonment plan) will be prepared. The Final End-State Report will describe the decommissioning work that has been performed and the outcome of that work, the results of the final surveys which were performed to a survey plan, and the interpretation of those results (i.e. whether the results meet the end-state objectives defined in the Detailed Decommissioning Plan). The report will also include any other information required by the applicable regulations and should be submitted no more than two years after the end of decommissioning activities. The Final End-State Report will be submitted to the CNSC for acceptance as part of the request for a release from regulatory control. Institutional controls are not expected to be required.

2.6 HAZARDOUS MONITORING AND SURVEY COMMITMENTS

2.6.1 Hazard Assessment

A thorough assessment of the radiological, chemical and construction safety hazards that may be encountered during the course of the decommissioning project shall be performed in preparation for decommissioning. A preliminary assessment of hazards likely to be encountered during the course of the decommissioning of DNNP is summarized in Table 2.6-1. This preliminary hazard assessment is not exhaustive. Other potential hazards may be identified during the course of decommissioning planning and will be addressed as appropriate.

Table 2.6-1: Preliminary Hazard Assessment for the Decommissioning of DNNP

Hazard	Most Likely Source(s) of Hazard	Description/Comments	Hazard Impact On
Radiation Hazard	**Preparation for Dismantling** • Handling used fuel, filters and resins. • Performing decontamination work (including the chemical decontamination). • Working in gamma radiation fields produced by fission and activation products in station systems and components.		Workers
	Dismantling & Demolition and Site Restoration Internal and external radiological hazards include: • Radiation fields produced by the fission and activation products that remain in station systems and components. • Hot spots from radioactive particles. • Radiation fields produced by the radionuclides in the waste. • Loose surface contamination (including alpha emitting radioisotopes) on tools, equipment and systems that are opened during the work. • Airborne contamination generated during the decontamination work or the packaging of the waste.	All of the radiological hazards will be removed by the end of the decontamination and disposal work during Dismantling, Demolition and Site Restoration period.	Workers, public, environment
Chemical Hazard	**Preparation for Dismantling** • Draining and cleaning of water treatment facility tanks, etc. • Handling the cleaning agents used during decontamination work. • Transporting bulk/waste chemicals.		Workers, public, environment
	Dismantling & Demolition and Site Restoration • Handling the cleaning agents used during decontamination work. • Transporting bulk/waste chemicals. • Concrete dust generated during the dismantling work.	Chemical storage during decommissioning will include appropriate storage requirements including separation of chemicals where required to avoid potential chemical hazards/explosions in case of spills or common mode event (earthquake).	Workers, public, environment
Industrial and Construction Hazards	**Preparation for Dismantling** • Similar hazards to those encountered in an operating station during a routine maintenance outage. • Airborne hazards necessitating the use of supplied breathing air or Powered Air Purifying Respirator (PAPR).		Workers

Hazard	Most Likely Source(s) of Hazard	Description/Comments	Hazard Impact On
Industrial and Construction Hazards	**Dismantling & Demolition and Site Restoration** • Airborne hazards necessitating the use of breathing air or PAPR. • The operation of heavy construction equipment in close proximity to workers. • Fires caused by cutting torches and grinders. • The collapse of equipment or structures during dismantling. • The use of blasting and other techniques to demolish concrete structures. • Falls, lifting heavy objects, falling objects, use of hand tools and the other hazards routinely encountered during construction work. • Working at heights inside the station. • Hazards from decontamination activities (mechanical/chemical). • Hazards from concealed or hidden services.		Workers
Biological Hazards	Biological organisms and materials that might be found on the site during the decommissioning could also produce hazards that include: • Stings and bites from insects, rodents, birds or other animals that might live or nest inside accessible buildings. • Toxins and antigens produced by moulds and other fungi that might grow on surfaces (particularly those made of biological materials). • Infections or adverse reactions resulting from exposure to organisms living in decaying biological material (such as carcasses and droppings) or their by-products.		Workers
Motor Vehicle Accidents	• Highway travel/shipments. • Vehicle/pedestrian collisions. • Vehicle/wildlife collisions.		Workers, public, environment
Inclement Weather	• Temperature extremes (hot/cold). • Lightning. • High winds.	Workers at the above-grade structures face the greatest risk of lightning strike.	Workers
Work around Open Water	• Work around the forebay and Pump Houses.		Workers
Work at Heights	• Work on stacks and other tall structures.		Workers
Fire/Explosion	• Hot work (e.g., cutting torches, etc.). • Storage of flammable liquids.		Workers, public, environment
Flying/Falling	• Objects falling from heights.	Pipes, walkways and other equipment will fall to the ground after it is cut.	Workers
	• Objects falling off buildings/structures as they are demolished.	Objects could fly off buildings and structures as they are being demolished.	Workers

Hazard	Most Likely Source(s) of Hazard	Description/Comments	Hazard Impact On
Sharp/Heavy Objects	• Heavy objects.	Objects will be cut to the size required by recyclers, etc. Most objects will be too heavy to lift by hand.	Workers
	• Sharp objects.	Metal objects that are cut or torn may have sharp corners/edges.	Workers
Confined Spaces	• Work in confined spaces.	Little work will be performed in confined	Workers
Power/Hand Tools	• Working with power tools and hand tools.		Workers
Heavy Equipment	• Working around heavy equipment.		Workers
Excavations	• Work in or near below-grade structures.	There are open, below-grade concrete structures on the site.	Workers, environment
	• Work in or near excavation in soil.		
Demolitions	• Working near buildings and structures under demolition.		Workers, public, environment
Noise	• All conventional industrial processes.	PPE will be used.	Workers, public, environment
Work around Live Services	• Work near live above-ground services.	Due to the tight footprint of the DNNP site, the logistics for safe work areas, laydown areas and access for heavy lifts, etc. need to be planned.	Workers
	• Work near live underground services.	Live electrical and water lines are buried below the site.	Workers

Occupational Dose Estimate

The occupational radiation exposure to DNNP plant personnel will be maintained As Low As Reasonably Achievable (ALARA) and below the occupational dose limits in Radiation Protection Regulations SOR/2000-203, (Ref. 29) during decommissioning. The need for plant personnel to routinely enter radiological areas to conduct maintenance, calibration, inspection, and other activities associated with an operating plant will be reduced, thus it is expected that the occupational dose to plant personnel will significantly decrease after the plant is shut down and defueled. The station ALARA program will be maintained during Dismantling and Demolition (D&D) periods to ensure that occupational dose is maintained ALARA and well within Radiation Protection Regulation limits.

While a preliminary occupational dose estimate for the decommissioning of DNNP has not yet been prepared, it is expected to be consistent with the occupational exposure per the generic guidance for Boiling Water Reactors (BWRs) provided in NUREG-0586, (Ref. 37), specifically table 4.1, which indicates a range from 700 to 1600 person-rem (7 to 16 person-Sv) for prompt decommissioning. Since the design of DNNP is a first of a kind construction, there is no specific Operating Experience regarding an expected dose estimate.

An Occupational Dose Estimate for the decommissioning of the DNNP will be prepared prior to Dismantling & Demolition. The Occupational Dose Estimate will be prepared by:

- Reviewing the work breakdown to identify those decommissioning tasks that will result in an occupational exposure to workers;
- Determining the location of the work that will be performed and the number of person-hours required to complete each task;
- Using survey results or numerical models to estimate the radiation dose rates that will be encountered in each location during the performance of each task; and
- Calculating the anticipated occupational dose that will result from the performance of each task.

Hazards to Workers

Primary hazards to workers throughout the decommissioning will be from conventional (non-radiological) hazards, particularly through the Dismantling & Demolition and Site Restoration period. Radiological hazards will be significantly reduced by removal used fuel from the fuel pool. Further details on the hazards that are likely to exist during decommissioning are provided in Table 2.6-1.

Hazards to the Public

It is currently assumed that throughout the decommissioning project, radiological hazards to the public are most likely to result from accidents during the off-site transport of radioactive wastes. The bulk of the off-site transport is expected to occur during the Dismantling & Demolition period. OPG will perform an in-depth analysis prior to proceeding with waste shipments.

2.6.2 Radiological Safety

All decommissioning activities will be carried out in accordance with the ALARA principle and the Radiation Protection Program of OPG. The procedures set out in the Radiation Protection Program with respect to dose control, contamination control and so forth will continue to be followed until they are suspended or modified as approved by the CNSC. Some of the actions that will be taken to help ensure the radiological safety of workers during the different phases of the decommissioning program are described below. Where required, Radiation Work Plans and detailed procedures will be prepared before work begins.

Throughout the decommissioning phases, qualified personnel will be selected to perform the work assigned to them using approved procedures to mitigate/eliminate hazards and any potential releases.

Preparation for Dismantling

Detailed preparations will be undertaken to provide a smooth transition from plant operations to decommissioning. Preparations include the planning for permanent defueling of the reactor, revision of programs and procedures applicable to the operating conditions and requirements, a characterization of the facility and major components, and the development of the Permanent Shutdown Plan, the Stabilization Activity Plan and the Detailed Decommissioning Plan (DDP).

Planning also includes site characterization, description of the dismantling activities, plans for site remediation, detailed plans for the final radiation survey, designation of the end-use of the site, an updated cost estimate to complete the dismantling, and any associated plans for environmental remediation. In addition, the plan for release from regulatory control is developed at this time. OPG station staff will perform the defueling and dewatering activities.

Dismantling & Demolition and Site Restoration Period

In order to minimize radiation doses during the Dismantling & Demolition process:

- Radiation surveys will be performed and dose estimates will be prepared before work begins.
- Work plans that make allowance for the difficulty of the work to be performed will be prepared (the cost and duration estimates will make allowance for the difficulty of the work by adjusting for respiratory protection, protective clothing, work breaks and radiation protection/ALARA).
- Workers will be qualified in radiation protection and trained to perform the work. The level of training will be commensurate with the work being performed.
- The most radioactive part of the station, the reactor and associated systems, will be dismantled using remotely-controlled cutters and manipulators. The operators will remain in a shielded control room and the resulting wastes will be packaged by remotely controlled manipulators.
- Where possible, components will be removed in one piece without dismantling.
- Because of the potential for airborne radioactivity, temporary containment envelopes will be erected and many dismantling operations will be carried out by workers using approved Personal Protective Equipment (PPE) and respiratory protection.
- Contamination control procedures will be strictly observed; and
- Routine contamination and dose rate surveys will be performed and documented.

Procedures will be implemented to ensure that all persons, packages or flasks leaving the site satisfy the radioactive material transport or clearance levels. Environmental monitoring of the site and the surrounding area will be maintained throughout dismantling and waste transport operations. On completion of these operations, the final surveys will be performed to confirm that all prescribed substances have been removed to the extent specified in the DDP.

2.6.3 Chemical and Demolition Safety

OPG will ensure that all decommissioning work is conducted in accordance with the requirements of the applicable federal and provincial Occupational Health and Safety (OH&S) regulations. OPG currently has a comprehensive OH&S program that meets the requirements of the OH&S Act of Ontario (Ref. 30). This program recognizes:

- The right of employees to know of the hazards associated with their work.
- The right of employees to participate in decisions related to health and safety.
- The right of employees to refuse to perform work that is considered to be unsafe.

A Decommissioning Contractor(s) will be retained to perform the decommissioning work on behalf of the owner during the Dismantling & Demolition and Site Restoration period of the decommissioning project. The Decommissioning Contractor(s) will be given charge and control of the work area (or designated parts of the work area) as the "Constructor". The Decommissioning Contractor(s) will be responsible for:

- Registering the Construction Project with the Ontario Ministry of Labour as required by the Construction Safety Regulations made pursuant to the OH&S Act.

- Providing the personnel, equipment, procedures and training required for the protection of workers, the public and environment.

OPG will provide oversight of the Decommissioning Contractor(s) to ensure that the work is performed in accordance with the requirements of the decommissioning licence (or a licence which authorizes decommissioning activities), OPG policies and the contract(s).

2.6.4 Emergency Response Planning

During the preparation of the DDP, OPG will prepare an assessment of the potential hazards to workers, the public and the environment. During stabilization, while there is still fuel in the reactor, it is anticipated that the emergency situations that might occur will be similar to those that might occur in an operating station during a routine maintenance outage. It is also anticipated that the emergency response plans and resources required to deal with these situations would be similar to those required in an operating station during an outage and, on this basis, it will be necessary to maintain the operational emergency response capability until the reactor is defueled and dewatered. For example, the provision of Emergency Mitigating Equipment or equivalent will still be retained for backup fuel cooling in the fuel pools to respond to emergencies (such as Total Loss of Off-Site Power). Subsequently, the response may be reduced to address spent fuel stored in spent fuel pool.

As the project progresses (particularly after all of the radioactive materials have been removed from the site), the postulated emergency situations will more closely resemble those that might occur during the course of a major construction project.

At all stages of the project, OPG will ensure that:

- The plans are reviewed and exercised regularly.
- An adequate number of personnel are available to respond to any emergency situation that may occur.
- The emergency response personnel receive the training required to respond appropriately to any emergency situation that may occur.
- The necessary equipment and supplies are available for use by emergency response personnel.

OPG will coordinate its response to a real or potential emergency situation with the appropriate agencies.

2.7 WASTE MANAGEMENT STRATEGY

The waste material inventory of the facility at the time of shutdown will depend on both the design and the operating history of the unit. The radioactive inventory will decrease over time due to the removal of activity by any decontamination work that is performed and the natural decay of the radioactive material. Estimates of the decommissioning waste inventory (i.e., the types and volumes of waste) have been prepared and will be updated as needed based on surveys, sampling information, and operating history. Detailed characterization surveys will also be performed prior to the start of the D&D phase. The acquired characterization field data will permit an appropriate assessment of the radiological and conventional hazards that can affect workers, the public and the environment and be used to develop the detailed decommissioning waste inventory for waste management planning.

Preliminary estimates of the radioactive waste volumes generated during the various decommissioning activities from one BWRX-300 plant are shown in summary Table 2.7-1.

Table 2.7-1: Decommissioning Radioactive Waste Disposal Volume Estimates

Volume by Waste Class (m^3)

	LLW	ILW
Unit 1	8,719	299

Preliminary estimates of the operating (including maintenance) nuclear by-product volumes and activity produced from one BWRX-300 plant for LLW, ILW, and used fuel are shown in Table 2.7-2 (Ref. 36).

Table 2.7-2: Operating Solid Nuclear By-product Estimates

Category of Solid Nuclear By-Product	BWRX-300 Operating Estimate[4]	Estimated Activity Level
Low Level Waste[5]	39 m^3/y	200 Bq/g
Intermediate Level:		
Spent Resins	27.5 m^3/y	4170 GBq/m^3
Sludges	8.5 m^3/y	306 GBq/m^3
ILW In-Core Components		
Fuel Channels	1500 kg/year	0.13 GBq/g
Hafnium Control Rods	100 kg/y	2.1 GBq/g
Boron Control Rods	100 kg/y	0.73 GBq/g
Other Neutron Probes	100 kg/y	3.0 GBq/g
Used Fuel	2368 bundles	

[4] The average quantities below of solid radioactive wastes are produced at one BWRX-300 plant with a single unit.
[5] Excludes miscellaneous operational waste volumes at this time

OPG is exploring radioactive waste disposal options after the cancellation of the Deep Geologic Repository for LLW and Intermediate-Level Waste at the Bruce Nuclear Site and remains committed to the permanent and safe disposal of its future decommissioning waste, including the DNNP facility waste.

OPG is also participating in Natural Resources Canada's work in public engagement on the existing Radioactive Waste Policy to ensure they are meeting international best practices. The Nuclear Waste Management Organization was asked to lead a dialogue to develop an integrated strategy for Canada's radioactive waste through close collaboration among waste owners and producers (including OPG), Indigenous people, and other interested Canadians. Progress on the Policy and Integrated Strategy will be taken into consideration in OPG's decommissioning waste disposal strategy. For financial planning purposes, the LLW and Intermediate-Level Waste generated during decommissioning is assumed to be transferred to long-term disposal facilities for respective LLW and Intermediate-Level Waste.

Hazardous wastes generated during the D&D and Site Restoration periods of the decommissioning will likely be limited to hazardous materials originally used as building materials (if any). Volumes of these wastes are likely to be small, since very few hazardous materials are expected to be used in the construction of the plant. An allowance for the removal and disposal of approximately 81,000 pounds of hazardous materials is included. This is an estimated amount for station batteries and other hazardous material required to operate the plant which is assumed to be on-site during dismantling. Dry active waste such as combustibles (paper, cloth, wood, filter cartridges) could also be generated in the removal of plant systems. The potential for generating hazardous wastes (e.g. silica from crushing concrete) will be incorporated into the waste management strategy and the necessary precautions and reporting will be incorporated into the decommissioning programs and procedures during execution of the project. Table 2.7-3 provides a summary of gases and chemicals that will be store on DNNP site to support plant operations (Ref. 16) and may need to be accounted for when developing the previously discussed strategy and procedures.

Table 2.7-3: Operating Summary of Gases and Chemicals used on DNNP site during plan operations

Chemical/Material (Formula/Trade/State)	Location (subject to change)	Quantity
Nitrogen	Gas Storage Area West of TB	Approximately 50 m^3 (Cryogenic Storage Tank)
Hydrogen	Gas Storage Area West of TB	To be determined
Diesel Fuel	Tank North of TB	Approximately 114,000 L Tank
Turbine Oil	Tank North of TB	Approximately 20,000 L tank (volume of the tank does not impact MCR habitability)
Sodium Hypochlorite (7 to 15% Solution)	Adjacent to Intake Structure	Approximately 4,000 L tank
Sodium Bisulphite (24 – 38% Solution)	Adjacent to Intake Structure	Approximately 11,400 L tank
Captor Thiosulphate Dichlorination	Adjacent to Intake Structure	Approximately 11,400 L tank
Gasoline	Vehicle Maintenance Garage	Approximately 20 L containers
Propylene Glycol	Within the P25, Chilled Water System, throughout the Power Block	39,000 L
Tetrafluoroethane (R- 134a Refrigerant)	P25 Chillers on RadWaste Building Roof	Each Chiller contains a refrigerant charge of 250 kg
Noble Metal Solution	Reactor Building	Approximately 38 L of 1% noble metal solution is utilized over a 2-week time frame per year.
Depleted Zinc Oxide	Turbine Building (TB)	90 kg dissolution vessel (quantity does not impact MCR habitability)

Appropriate disposal facilities for hazardous wastes will be identified prior to the beginning of the decommissioning project. Hazardous wastes will be packaged for transport and disposal according to the requirements of the applicable provincial regulations, and OPG's waste management standard (Ref. 31). All hazardous wastes, including nonradioactive hazardous wastes, will be transferred to an appropriate, licenced waste management facility for storage or disposal at approved disposal facilities. Waste manifests will be prepared and submitted as required by provincial regulations. Mixed waste (i.e., radioactive waste mixed with clean waste that is also hazardous) will be transferred to an appropriate long- term disposal facility.

If the volume or value of the contaminated scrap metal generated during decommissioning is sufficient to justify further processing, then chemical cleaning, electro polishing, mechanical abrasion, or melting might be used to decontaminate scrap metal. Metals that are below the clearance levels established in the Detailed Decommissioning Plan will be released for recycling or disposal.

Non-hazardous wastes that meet established clearance levels will be reused or recycled wherever possible or disposed of appropriately. Clean concrete rubble may be used to fill the demolished DNNP facility or disposed appropriately. Existing programs, instructions, and procedures will be evaluated to reflect the addition of the BWRX-300 plant for the handling of radioactive waste and revised if necessary.

2.8 COMMITMENT TO PREPARE A DETAILED DECOMMISSIONING PLAN FOR CNSC ACCEPTANCE PRIOR TO DECOMMISSIONING

A DDP will be prepared and submitted for CNSC acceptance approximately two to five years prior to start of decommissioning. The DDP will describe OPG's detailed plan for managing the arrangements and activities conducted in support of the D&D and Site Restoration phases. The DDP will be prepared to meet the requirements of CNSC REGDOC-2.11.2 and CSA N294, "Decommissioning of Facilities Containing Nuclear Substances".

The DDP establishes criteria (i.e. clearance levels) that are used to determine if the material is suitable for uncontrolled release. The DDP also establishes the clearance levels and end-state criteria that are used to determine if the DNNP facility itself is suitable for release from further regulatory control.

The safety assessment for the DNNP facility decommissioning will be prepared in conjunction with the DDP, consider identified uncertainties, and address them as the decommissioning activities progress. Uncertainties regarding the radioactive inventory and the condition of the facility are reduced as decommissioning progresses. The decommissioning safety assessment addresses potential radiological hazards to workers, the public, and the environment, from both routine decommissioning activities and credible accidents during decommissioning utilizing the defence-in-depth principle. A criticality safety assessment shall be included while fuel is present at the facility during decommissioning. The decommissioning safety assessment also identifies the mitigating methods to address the risks associated with these hazards and residual risks to the public once decommissioning is complete. The safety assessment will be reviewed, revised, or updated, as required, when additional information becomes available and as conditions change.

The DDP will be reviewed and, as necessary, updated every 5 years or as requested by the CNSC. The DDP will be reviewed and updated in light of incidents or events with relevant consequences for decommissioning, revised regulatory requirements, operational experience, and lessons learned, and advances in decommissioning technology.

2.9 COMMITMENT TO PERIODICALLY REVIEW AND UPDATE THE PDP, IN ACCORDANCE WITH SECTION 6.1 of REGDOC 2.11.2

OPG shall review and, as necessary, update the PDP and submit it to the CNSC every five years or as requested by the CNSC. Guidance for review and update of the PDP for factors relevant to decommissioning is contained in REGDOC-2.11.2 and N294.

This section is an acknowledgement that the PDP is a living document and will be updated in accordance with all CNSC requirements and submitted for regulatory acceptance as required. The level of detail included in the PDP will increase as the facility progresses through its life cycle toward permanent shutdown, where the PDP will evolve into the DDP. REGDOC-2.11.2 and CSA N294:19 have a requirement for an overarching site PDP to be produced to take into account the interdependencies between facilities located on the same site. The DNGS PDP (Ref. 32) meets this requirement for the DNGS site (including the Nuclear Sustainability Services - Darlington (NSS-DWMF) facility). As the DNNP SMR will be a new facility on the site, the interdependencies with the rest of the facilities are described below and will be included in the next revision of the DNGS site PDP.

Interfacing systems between the DNNP facility and the rest of the site are provided in section 2.2.2. Interfacing services for DNNP are expected to be similar as provided between the DNGS station and the NSS-DWMF facility, for example: security, environmental monitoring, emergency response, and radiation protection (if required). Utilizing the Prompt Decommissioning strategy for the DNNP facility, there will be an overlap between decommissioning of the remaining facilities on the Darlington site. Future updates of the DNGS site PDP and this (DNNP) PDP will optimize the decommissioning planning and identify the interdependencies of all three facilities.

2.10 PHYSICAL STATE OF THE FACILITY

The proposed end-state of the DNNP facility is that OPG will decommission and restore the site to an industrial end-state status suitable for other OPG uses, commonly known as “brownfield”. As per nuclear industry practice, a brownfield is defined as a former industrial land that has the potential to be developed for new industrial uses. By the end of the D&D and Site Restoration periods, the DNNP facility will be free of industrial and radiological hazards. Station SSCs will have been dismantled.

Radioactive contamination in excess of established clearance levels and other hazardous materials will have been removed from the DNNP facility. The clearance level used for the clean-up of the facility should not require institutional controls after the release from regulatory control. Station systems will have been dismantled and buildings demolished. 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 clean concrete rubble and soil, and graded over and vegetation restored. The remaining facility will have been backfilled to prevent future subsidence and restored to a state suitable for other OPG uses. By the end of this phase, the end-state objectives defined in the Detailed Decommissioning Plan will be verified to have been achieved by submitting a final end-state report to the CNSC for acceptance and the DNNP facility will meet the criteria for release from regulatory control.

2.11 RECORDS REQUIRED FOR DECOMMISSIONING

The International Atomic Energy Agency (IAEA) Technical Report (Ref. 33) states that operational records should be retained in order to meet the needs of future decommissioning. It is recognized that there is a potential for information about the DNNP to be lost as work transitions through the stages of decommissioning, and staff numbers decrease. It is therefore necessary that measures are taken to preserve and improve the existing records database, capturing all potentially relevant information. Records filing and retention are governed by OPG’s Information Management program (Ref. 34), which identifies records relevant to decommissioning are permanent records. Decommissioning-related documentation will also be managed and maintained in accordance with CSA N294:19. The IAEA documents on record keeping (e.g., Technical Reports Series No. 411) will also be consulted to provide additional guidance. These records will contain historical information that may be required in the future in order to update this PDP, prepare the DDP and ultimately facilitate successful decommissioning. They will include, but are not limited to:

(a) The Permanent Shutdown Plan, Stabilization Activity Plan, and DDP including support documents (e.g. safety assessment, survey results, etc.)

(b) End-State Reports (interim and final, as applicable)

(c) Design of facilities and buildings included in the decommissioning plan

(d) Licences and permits required for the decommissioning work

(e) Details of the operating history of the reactor

(f) Details of the initial design and configuration of station systems and the maintenance and modifications made to that configuration over the course of the station's operating lifetime including records of:

- Updated drawings and photographs taken from inspections, modifications, and repairs to SSCs
- Details of materials used
- Special repair or maintenance activities and techniques
- Details of the design, material composition and the history and location of all temporary modifications and devices

(g) Records of routine and extraordinary radiation dose rate and contamination surveys that are performed throughout the station (these records are stored in an electronic database called the VSDS)

(h) Records of worker and contractor doses received during the course of the station's operating lifetime

(i) Descriptions of the nature and location of any hazardous materials in the station and the disposition of any hazardous materials that have been removed

(j) Reports and other documents that describe the criteria used to define radioactive and hazardous materials and to distinguish contaminated from uncontaminated materials:

(1) the criteria used to define the final contamination status of the facility

(2) the principles and models used in deriving the criteria in Items a) and b)

(3) the residual radionuclide inventory after decontamination

(4) the amounts of radioactive and hazardous materials removed and the disposition method

(5) waste management and transfer records

(6) the equipment and materials removed from the facility for recycling or use elsewhere, their treatment prior to removal from the site, and the disposition method

(7) the survey methods and the types of instruments used

(k) The equipment, nuclear and non-nuclear materials, and structures remaining at the end of decommissioning

(l) Details of any spills or releases of radioactive materials or environmentally hazardous substances that may have occurred over the course of the station's operational lifetime

(m) Records of any unplanned events or unusual occurrences

(n) Site characterization and environmental review or Impact Assessment

(o) Public and Indigenous engagement/communications records

Records pertinent to the shutdown of the station will also be maintained. The shutdown of the operational reactor is very similar its commissioning. Record keeping during shutdown will be performed in a similar manner as well. Records from Stabilization such as the system end-stating activities, scoping and characterization surveys, etc. will be well documented and readily available for Preparation for Dismantling and Demolition. OPG will document the progress of decommissioning in a traceable manner.

Furthermore, during the course of the decommissioning, OPG will retain records of:

- The plans and procedures used in decommissioning
- The progress achieved in meeting the schedule for the decommissioning
- The implementation and results of the decommissioning, including the residual radionuclide inventory after decontamination
- The results and interpretations of environmental monitoring programs
- The manner in which and the location where any nuclear or hazardous waste is managed, stored, disposed of or transferred (i.e., waste management and transfer records)
- The name and quantity of any radioactive nuclear substances, hazardous

substances and radiation that remain at the nuclear facility after completion of the decommissioning

- The amount of radionuclides discharged via airborne and liquid pathways
- Occupational dose records, i.e., records of worker and contractor doses received during the decommissioning phases
- The status of each worker's qualifications, re-qualification and training, including the results of all tests and examinations completed in accordance with the licence
- Any deviations from plans and procedures
- The quality assurance records
- The final radiological and hazardous materials surveys
- Final end-state reports
- The land remediation undertaken, including the results of verification analyses as compared to criteria used or derived for soil and water quality (defined in the DDP), and the disposition of any affected media

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
- Responding to possible liability claims

Decommissioning records will be kept in the storage medium in standard use at the time of the decommissioning. All records will be assembled and maintained in accordance with the document and record management process and governance. Because of the long time frame anticipated until the decommissioning, records will be periodically checked to ensure their preservation and protection from loss, deterioration and destruction.

2.12 PUBLIC CONSULTATION PLAN

A public and stakeholder consultation plan will support the dismantling activities and also support consultation for future uses of the site. This plan will include both information and consultation opportunities. The plan will be designed to involve a broad cross-section of stakeholders employing a variety of methods that will meet the needs of the participants and the objectives of the business.

The plan will identify issues and concerns; ensure opportunities for involvement; ensure that all inputs were considered in decommissioning planning and/or in the environmental risk assessment, and include the documentation of the process and results. The public and stakeholder consultation plan will also support the development of an integrated community impact management plan.

The public and stakeholder consultation plan will comply with the applicable requirements of REGDOC-3.2.1, "Public Information and Disclosures" (Ref. 12).

2.13 INDIGENOUS ENGAGEMENT PLAN

An Indigenous engagement plan will support the dismantling activities and support consultation for future uses of the site. The plan will be designed to involve Indigenous rights holders employing a variety of methods that will meet the needs of the participants and the objectives of the business. The plan will focus on information sharing, constructive dialogue, collaboration, and meaningful engagement.

The plan will include identification of issues and concerns; ensure opportunities for involvement; ensure that all inputs were considered in decommissioning planning and/or in the environmental risk assessment and include the documentation of the process and results. The Indigenous engagement plan will also support the development of an integrated community impact management plan.

The Indigenous engagement plan will comply with the applicable requirements of REGDOC-3.2.2, Indigenous Engagement (Ref. 13).

2.14 DECOMMISSIONING COST ESTIMATE AND FINANCIAL GUARANTEE

Decommissioning costs are provided in a separate Decommissioning Cost Estimate report as allowed by REGDOC-2.11.2, and details of the financial guarantee will be provided for future licensing stages.

2.15 UNCERTAINTY

There are several elements of risk and uncertainty associated with decommissioning of the DNNP facility. At this point in the facility lifecycle, some of the main sources of uncertainty and risk are:

- Design is still underway
- Planning assumptions;
- Physical, radiological and non-radiological state of the facility;
- Regulatory framework;
- Technical strategy/approach for decommissioning;
- Waste disposition; and

- Indigenous rights holders and stakeholder concerns.

As mentioned previously, this initial end of life decommissioning plan is being prepared very early in the life cycle of the facility, thus there is uncertainty in some of the information being presented herein as the final design for this first of a kind BWRX-300 SMR facility is underway. This plan has been developing utilizing OPEX from the decommissioning of the first generation of Boiling Water Reactors (BWRs) in the US and internationally. Incorporation of design improvements that facilitate decommissioning (as documented in section 2.2.1), should improve the efficiency and safety of the decommissioning process when these improvements are incorporated into future updates of this plan, thus reducing uncertainty.

Any risks associated with the current planning assumptions supporting this PDP have been identified, documented and are being tracked by OPG. As mentioned above, the decommissioning process is also based on a well-established methodology through OPEX from the decommissioning of other BWRs and industry best practices. Planning assumptions will evolve through the life cycle of the facility and will be incorporated into future updates of the PDP reducing uncertainty and mitigating risks as the facility approaches the execution of decommissioning.

As mentioned in Section 2.3, a comprehensive site characterization will be completed and will be used as an input in the development of the DDP. This thorough site characterization based on the MARSSIM approach will reduce the uncertainties associated with execution of decommissioning by addressing the following:

- Understanding of the conditions of facility – radiometric, chemo-toxic, biological, physical and structural;
- Defining the amount, location and composition of contaminants (radiological and non-radiological) and the associated physical parameters;
- Categorizing the SSCs and site areas (including ground water) in contaminated, potentially contaminated and non-contaminated areas as a basis for zoning or implementation of a graded approach for clearance.

The safety assessment, which will be prepared in conjunction with the DDP (see Section 2.8), will take into account all identifiable uncertainties and address them as the decommissioning activities progress. The safety assessment should be conservative though not normally unduly, unless this allows the safety assessment to be simplified and gives overall benefit to the decommissioning project. Typical sources of uncertainty as identified in IAEA Safety Guide WS-G-5.2 (Ref. 35) include:

- Source and magnitude of radiological hazards (e.g., inventory characteristics and source terms – location, dimensions, spatial distribution, constituents, quantities);
- Scenarios that could lead to these hazards, such as the frequency of occurrence, exposure pathways, assumptions required in support of the calculations of frequencies and consequences, during both normal and accident conditions;
- Predicted consequences – such as the dose rate and occupational doses; and
- The mathematical models used in the calculation of the effective doses or risks following normal and accident scenarios.

Elements of uncertainty can typically arise since:

- The quality, reliability and availability of information from the characterization of the stations may be limited, prior to the actual decommissioning; and
- Relevant supporting information, such as drawings and records of modifications, to be used as input data to the safety assessment may not be available in the detail needed.

In addition, generic data may be primarily used in the preparation of the preliminary safety assessment. There is also an uncertainty issue arising from the state of the facility after shutdown, in particular, the extent to which aging may have compromised the building structures or engineered safety measures, which may affect the safety margins.

The safety assessment will be reviewed, revised or updated, as required, when additional information becomes available as compared to the earlier phases of the decommissioning project. It is also expected that the uncertainty with regard to the radioactive inventory and the condition of the facility may be reduced as decommissioning progresses.

Further details on the uncertainty associated with decommissioning safety assessment are given in (Ref. 35).

In terms of any uncertainty related to the regulatory framework, OPG maintains a good communication protocol with the CNSC and ensures that the PDP meets the regulatory requirements in its licence, as described in Section 2 and 0.

This PDP demonstrates that decommissioning is feasible with existing technology and as mentioned previously is based on OPEX from actual decommissioning of BWR reactors, thus reducing uncertainty in the decommissioning planning. OPG will continue to incorporate OPEX to ensure the decommissioning planning is consistent with improvements in technology and processes.

Up until January 2020, the L&ILW Deep Geologic Repository (DGR) has been the long-term disposal strategy for OPG's L&ILW decommissioning waste. The L&ILW DGR was planned to be in-service for the purpose of receipt of decommissioning waste in 2050. On January 31, 2020, the Saugeen Ojibway Nation (SON) members voted not to support the L&ILW DGR project. Since then, OPG is not proceeding with the DGR at the Bruce site without SON support. Therefore, OPG is working on an alternative long-term disposal strategy for L&ILW decommissioning waste as described in Section 2.7. Updates to the waste disposition will be included in future revision of this document contributing to a reduction of uncertainty.

To manage uncertainty related to Indigenous rights holder and stakeholder perception for the DNNP facility decommissioning, OPG has extensive Indigenous and stakeholder engagement activities, as described in Section 2.13.

It is also expected that the level of uncertainty of knowledge relevant to decommissioning will decrease with maturity of the decommissioning planning, i.e., as this plan evolves from a PDP to a DDP.

3. REFERENCES

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Appendix A - Compliance Matrix with REGDOC-2.11.2 and this Plan

Section in REGDOC-2.11.2	Requirement in REGDOC-2.11.2	Section in This PDP
3.1. The Lifecycle Approach to Decommissioning	The CNSC requires that planning for decommissioning take place throughout the lifecycle of a nuclear facility, location or site or for the duration of a licensed activity.	1.3
	Throughout the lifecycle of a nuclear facility or for the duration of a licensed activity, except for release from CNSC regulatory control, a decommissioning plan is required. A preliminary decommissioning plan (PDP) is developed during the siting phase for a Class I nuclear facility and uranium mine and mill, the construction phase for a Class II nuclear facility, or prior to submitting an application for a CNSC licence to possess, manage, use or store nuclear substances at a location. The PDP is progressively updated, where needed, to reflect the appropriate level of detail required for the respective licensed activities. Prior to the decommissioning stage, a detailed decommissioning plan (DDP) is developed. The DDP refines and adds details to the PDP.	1.3, 2.9
	A licence to decommission or a licence that authorizes decommissioning activities is required for Class I and Class II nuclear facilities and uranium mines and mills prior to the execution of decommissioning. For sites with more than one facility or location that are at different lifecycle stages, the CNSC may issue a licence that includes multiple activities (e.g., operate and decommission).	N/A for PDP, relevant for execution of decommissioning, 2.5
4 Optimization and Graded Approach in Decommissioning	The licensee shall ensure that protection of health, safety, security and the environment is planned and optimized during decommissioning.	1.1, 2.1.3, 2.5, 2.6.2
	With a graded approach, all of the requirements in this document shall apply, but to varying degrees depending upon the safety significance and complexity of the work being performed. The level of analysis, the depth of documentation and the scope of actions necessary to comply with the requirements of this document shall be commensurate with the nature and level of the hazards; the complexity of the facility, location or site; and the characteristics of the waste.	1.1
	A graded approach, if utilized, shall be applied in a way that does not compromise the protection of health, safety, security and the environment. Further information on the graded approach can be found in REGDOC-3.5.3, Regulatory Fundamentals.	1.1
5 Decommissioning Strategy	The licensee shall select a decommissioning strategy that will form the basis for planning for decommissioning and facilitate achieving the desired end state of the decommissioning project. For Class I nuclear facilities and uranium mines and mills, the decommissioning strategy shall be selected during the siting stage. For Class II nuclear facilities, the decommissioning strategy shall be selected during the construction stage. Prior to submitting an application for a licence to possess, manage, use or store nuclear substances at a location, the decommissioning strategy shall be selected. For existing facilities, uranium mines and mills, and nuclear substances and radiation device licensees who are required to have a decommissioning strategy and where there is no decommissioning strategy, the licensee shall select a suitable strategy for decommissioning as soon as possible.	2.4
	If shutdown of a facility, location or site is sudden, the decommissioning strategy shall be reviewed on the basis of the situation that initiated the sudden shutdown in order to determine whether a revision of the strategy is required.	N/A

Section in REGDOC-2.11.2	Requirement in REGDOC-2.11.2	Section in This PDP
5.1 ***In Situ* Decommissioning**	*In situ* decommissioning shall not be considered a reasonable decommissioning option for planned decommissioning of existing or future nuclear facilities and situations where removal is possible and practicable; nevertheless *in situ* decommissioning may be considered a solution only under exceptional circumstances (e.g., following a severe accident) or for legacy sites. *In situ* decommissioning for legacy sites is only considered viable where the use of *in situ* will be protective of workers, the public and the environment; decommissioning was not planned as part of the design; the fuel has been removed; and the site will remain under institutional control for the period defined in the safety case. In a case where the end state for *in situ* decommissioning results in a waste disposal facility, location or site, the licensee shall satisfy all regulatory requirements for a radioactive waste disposal facility, location or site and demonstrate safety in a safety case and safety assessment of the disposal facility, location or site.	2.4 N/A
6 **Planning for Decommissioning**	Where required by a condition of the licence, a licensee shall maintain a financial guarantee for decommissioning that is acceptable to the CNSC. Requirements and guidance on financial guarantees can be found in REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities*.	2.14 This is applicable for future life cycle stages.
6.1 **Preliminary Decommissioning Plan**	The licensee shall prepare a PDP and submit it to the CNSC for acceptance with an application for a licence in respect of a nuclear facility or the conduct of a licensed activity, in accordance with the conditions of its licence. The PDP shall document the selected decommissioning strategy; main decontamination, dismantling and/or clean-up activities; end-state objectives; an overview of the principal hazards and protection strategies; a waste management strategy; a cost estimate; and financial guarantee arrangements. The licensee shall review and, as necessary, update the PDP and submit it to the CNSC every five years or as requested by the CNSC. For licensed sites with more than one facility or location for which the licensee is responsible, the licensee shall submit an overarching PDP to ensure that interdependencies between planning envelopes or facilities, locations or sites are taken into account.	1.1 2.9 2.9

6.1.1
Content of the Preliminary Decommissioning Plan
	A PDP for a nuclear facility with a Class I or uranium mines and mills licence shall include, as applicable:
	• a description of the location of the facility, including:
	  ◦ a map of the facility and its specifications
	  ◦ geographic information
	  ◦ details regarding the surrounding environment
	  ◦ land uses
	  ◦ illustrations and maps of the facility in relation to the municipality
	• the purpose and description of the facility, including:
	  ◦ primary SSCs
	  ◦ the building type and construction, including location of any hazardous building materials (e.g., asbestos, polychlorinated biphenyls)
	  ◦ the building services (e.g., power, heating, ventilation, sewer, water, fire protection)
		2.1
		
		2.1
		
		2.2
		Figures 2.2.-1 to 2.2-3

Section in REGDOC-2.11.2	Requirement in REGDOC-2.11.2	Section in This PDP
	◦ laboratories and other hazardous handling areas	
	◦ the type, quantity and form of radioactive and hazardous materials managed, stored, produced or used during operation	2.7
	◦ the design features used to reduce the spread of contamination and facilitate decontamination, dismantling and/or clean-up	
	• the anticipated post-operational conditions, including:	
	◦ a summary of the shutdown process, including planned removal of stored inventories of hazardous or radioactive materials	
	◦ the predicted nature and extent of contamination remaining in the primary SSCs (in list or table format with reference to applicable illustrations)	2.3
	◦ the predicted nature and extent of contamination on floors, walls and work surfaces, in ventilation systems, etc.	
	◦ an overview of the principal hazardous conditions anticipated	
	◦ the identification of any separate planning envelopes	
	• the decommissioning strategy, including:	
	◦ the final end-state objective	
	◦ the rationale for:	2.6
	▪ the decommissioning strategy selected	N/A
	▪ interim end states	
	▪ periods of storage with surveillance	
	▪ any institutional controls	2.4,2.10
	◦ the assessment of alternative strategies (or a rationale for why alternatives do not exist or do not warrant consideration)	
	• the plan of the decommissioning work, including:	
	◦ a work breakdown structure	
	◦ a summary of the main steps for decontamination, dismantling and/or clean-up, and removal of each of the SSCs, preferably grouped into work packages	2.5
	◦ for each work package, an identification of those types of activities that could pose a significant hazard to workers, the public or the environment	2.5
	◦ the role of existing operational standard procedures for radiation protection, hazardous materials handling, industrial safety, and environmental protection in managing hazards	2.6 2.7, 2.6.2
	◦ the specific activities for which additional protection/mitigation procedures will be required at the detailed planning stage (preparation for decommissioning phase)	2.5, 2.6
	◦ a summary of the final dismantlement of the structures	
	◦ a conceptual schedule showing the approximate year of facility shutdown and the approximate sequencing and duration of the decommissioning work packages and, where relevant, storage periods	2.10 Figure 2.5.1
	• the hazardous monitoring and survey commitments, including:	

Section in REGDOC-2.11.2	Requirement in REGDOC-2.11.2	Section in This PDP
	• a program for conducting periodic contamination surveys and the recording of contamination events during facility operation • a commitment to develop plans and protocols acceptable to the CNSC at the detailed planning stage for monitoring: ▪ work hazards during decommissioning ▪ personnel dosimetry ▪ environmental emissions and effluents ▪ materials, sites and structures to be cleared from regulatory control	2.5, 2.6
	• a waste management strategy specifying: • the conservative quantities and characteristics of radioactive and chemically hazardous wastes expected to arise from the decommissioning (tied to specific work packages, if possible) • the anticipated final disposition of radioactive and chemically hazardous materials • a commitment to segregate as much material as possible for reuse and recycling	2.7
	• a commitment to prepare a DDP for CNSC acceptance prior to decommissioning	2.8
	• a commitment to periodically review and update the PDP, in accordance with section 6.1	2.9
	• the physical state of the facility at: • the end of operations (permanent shutdown state) • the start of decommissioning (stable state for decommissioning)	2.3, 2.5
	• the records required for decommissioning, including a description of the facility's operational records that will be maintained to periodically update the PDP and prepare the DDP(s)	2.11
	• a public consultation plan, including a public information program and avenues for public participation as per the requirements and guidance of REGDOC-3.2.1, *Public Information and Disclosure*	2.12
	• an Indigenous engagement plan as per the requirements and guidance of REGDOC-3.2.2, *Indigenous Engagement*	2.13
	• the conservative cost estimate of decommissioning and a financial guarantee, as described in REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities*, specifying: • an estimate of the total present-value cost of the decommissioning • a reasonable basis for how cost estimates were derived • a description of how the required funds will be provided	2.14 This is applicable for future life cycle stages.
6.2 **Waste Management Strategy**	The licensee shall prepare a waste management strategy that identifies the categories and estimated quantities of all waste streams that will be generated and managed during decommissioning, and the planned disposition path. Requirements and guidance for radioactive waste management can be found in REGDOC-2.11.1, *Waste Management, Volume I: Management of Radioactive Waste*.	N/A for PDP, relevant for execution of decommissioning, 2.7

Section in REGDOC-2.11.2	Requirement in REGDOC-2.11.2	Section in This PDP
7 **Preparation for Decommissioning**	During the preparation for decommissioning phase, the licensee shall review and revise its impacted program documents to ensure that they align with the decommissioning activities. The licensee shall inform the CNSC, in writing, prior to shutting down a facility, location or site permanently or ceasing to manage, possess, use or store nuclear substances. For nuclear facilities with a Class I or a uranium mines and mills licence, the licensee shall submit to CNSC staff, for acceptance, the following documents, in order to transition from operation to decommissioning: • a permanent shutdown plan – includes the steps to transition the facility from operation to a permanent shutdown state • a stabilization activity plan – comprises steps for the facility's transition from a permanent shutdown state to a stable state for decommissioning • a DDP – see section 7.1	2.5 2.5 2.8
7.1 **Detailed Decommissioning Plan**	Prior to the execution of decommissioning, the licensee shall submit a DDP to the CNSC for acceptance, where required by a condition of the licence. For a Class I nuclear facility, the licensee should typically submit a DDP to the CNSC two to five years prior to executing decommissioning. The DDP shall document the decommissioning strategy; decontamination, dismantling and/or clean-up activities; final end-state objectives; the principle hazards and protection plans; a waste management plan; a cost estimate; and financial guarantee arrangements. Once accepted by CNSC staff, the DDP will be incorporated into a licence authorizing decommissioning. For immediate (prompt) decommissioning, the licensee shall detail, in the DDP and supporting documents (e.g., safety assessment for decommissioning), the decontamination, dismantling and clean-up. For deferred decommissioning, the licensee shall detail, in the DDP and supporting documents (e.g., safety assessment for decommissioning), the activities that will be performed during the storage with surveillance period. Toward the end of the storage with surveillance period, the DDP and supporting documents shall be revised, detailing the decontamination, dismantling work and clean-up activities to be completed and submitted to the CNSC for acceptance. For *in situ* decommissioning, the licensee shall detail, in the DDP, any decontamination, dismantling, clean-up and storage with surveillance activities, as applicable. In cases where the end-state result is a waste disposal facility, location or site, the licensee shall submit, in addition to a safety assessment for decommissioning, a safety case and supporting post-closure safety assessment. Applicable requirements and guidance can be found in REGDOC-2.11.1, *Waste Management, Volume III: Safety Case for the Disposal of Radioactive Waste*. Where decommissioning takes longer than five years, the DDP shall be reviewed and, as necessary, updated every five years or as requested by the CNSC. For licensed sites with more than one facility or location preparing to undergo decommissioning for which the licensee is responsible, the licensee shall submit an overarching site DDP to ensure that interdependencies between the individual DDPs (planning envelopes or facilities or locations) are taken into account.	2.8 2.8 N/A N/A 2.8 N/A for PDP, relevant for execution of decommissioning, 2.9
7.1.1 **Content of the Detailed Decommissioning Plan**	A DDP for a nuclear facility with a Class I or uranium mines and mills licence shall include, as applicable: …	N/A for Preliminary Decommissioning Plan 2.8

Section in REGDOC-2.11.2	Requirement in REGDOC-2.11.2	Section in This PDP
7.2 Safety Assessment for Decommissioning	The licensee shall perform a safety assessment to identify any radiological or non-radiological hazards to workers, the environment and the public from both routine decommissioning activities and credible potential accidents during decommissioning. For a nuclear facility with a Class I or uranium mines and mills licence, the licensee shall ensure that the safety assessment: … For *in situ* decommissioning resulting in a disposal facility, location or site, a post-closure safety case (see section 5.1) shall be provided, in addition to the decommissioning safety assessment.	2.8 N/A for Preliminary Decommissioning Plan N/A
7.3 Storage with Surveillance Plan	For deferred decommissioning, Class I nuclear facility and uranium mines and mills licensees shall submit a storage with surveillance plan, in addition to the DDP, to the CNSC for acceptance. The licensee shall outline in the storage with surveillance plan any activities envisioned or planned to reduce the risks at the facility	N/A N/A
7.4 Waste Management Plan	The licensee shall prepare a waste management plan that considers the waste hierarchy, including preventing generation, reducing volume and radioactivity, reusing and recycling materials and components, and disposing of the waste. The waste management plan shall identify the waste streams together with the estimated quantities and characteristics of the waste. The waste management plan shall describe the systematic process for how the waste will be moved from the decontamination and dismantling areas to the areas for subsequent steps of waste management. The licensee shall assess the potential for generating non-radiological hazardous substances and incorporate the necessary precautions and reporting into its programs and procedures.	N/A for PDP, relevant for execution of decommissioning, 2.7 2.7
8 Execution of Decommissioning	During the execution of decommissioning, the licensee shall: • conduct decommissioning in accordance with the DDP and associated procedures • implement a decommissioning process and supporting programs to ensure safety • ensure that a methodology for issuing, modifying and terminating work procedures is established • maintain an up-to-date list of SSCs important to safety, as well as surveillance and maintenance plans for these SSCs	2.5 2.5 2.5 1.3
8.1 Storage with Surveillance	For deferred decommissioning, during periods of storage with surveillance, the licensee shall ensure that the facility, location or site is maintained in a safe configuration so that subsequent decontamination, dismantling and/or clean-up can be carried out. The licensee shall implement and maintain appropriate storage with surveillance programs to confirm that the SSCs needed to maintain safe storage are functioning as required.	1.3
8.2 Waste Management	Prior to the execution of decommissioning, the licensee shall ensure the availability of packages for radioactive waste, the disposition path of radioactive waste arising from decommissioning activities, and the ability of those disposition paths to accommodate the types and volumes of material. The licensee shall characterize and manage all remaining operational waste from the facility, location or site and all waste from decommissioning. The licensee shall ensure the traceability and maintain up-to-date records of the waste generated and managed at the facility, location or site or transferred to another facility, location or site, specifying its quantities, characteristics and destination.	2.7 2.7 2.7

Section in REGDOC-2.11.2	Requirement in REGDOC-2.11.2	Section in This PDP
9 Completion of Decommissioning	Upon completion of decommissioning, the licensee shall demonstrate that the end-state criteria specified in the DDP have been met.	2.10
	The licensee shall submit an end-state report to the CNSC for acceptance. The end-state report should be submitted no more than two years after completing the execution of decommissioning activities.	2.10
	For a nuclear facility with a Class I or uranium mines and mills licence, the end-state report shall include: …	N/A for Preliminary Decommissioning Plan
	Where decommissioning of the facility will take place in discrete stages, an interim end-state report shall be prepared when each planned interim end state is achieved. This report should describe the decommissioning work undertaken, the physical condition of the facility, the remaining hazards, the interim end state achieved, the results of surveys, the hazards and physical condition of the facility, and the remaining decommissioning tasks or work packages to be completed.	N/A
9.1 Institutional Controls	If institutional controls are required to be in place, the licensee shall prepare plans to address the completion of decommissioning and submit them to the CNSC for review.	N/A
	If institutional controls are required, the CNSC expects the following actions to be taken by the responsible party, following completion of decommissioning: • Implementation of a visual inspection plan for periodic examination of the facility, location or site to look for signs of deterioration of the facility, location or site (e.g., slumping of the ground), or erosion of the surface • Operation and maintenance of a monitoring system to detect any radionuclide release within the site boundary • Implementation of any active controls to prevent unrestricted access to the site	N/A
10 Radiological and Non-Radiological Surveys	The licensee shall perform radiological and non-radiological surveys throughout the various phases in the lifecycle to support decommissioning.	2.5
10.3 Decommissioning Surveys	Radiological and non-radiological conditions shall be monitored throughout decommissioning activities to confirm that radiation risks to workers, the public and the environment are being adequately controlled.	2.5
	Surveys shall be performed throughout decommissioning to confirm the effectiveness of decommissioning activities used to reduce radiological and non-radiological risks (e.g., removal of excess radioactive material, decontamination of process equipment and immobilization of remaining contamination).	2.5
	Surveys of hazards shall also be performed to support the safe performance of surveillance and maintenance activities during periods when decommissioning is deferred.	N/A
10.4 Decommissioning End-State Surveys	The licensee shall conduct a final end-state survey in accordance with a survey plan.	2.5

Appendix B - Compliance Matrix with CSA N294:19 and this Plan

Section in CSA N294:19	Requirement in CSA N294:19	Section in this PDP
4.1	The owner of a nuclear facility shall be responsible for planning, executing, and funding all phases of decommissioning.	1.1
4.2	Decommissioning activities shall be planned and executed in accordance with relevant regulations and standards and in keeping with relevant guides. Responsibilities for decommissioning, preparing documents, and recordkeeping shall be clearly established throughout the life cycle of a facility. This responsibility includes planning and preparing for, executing, and completing decommissioning (i.e., until the final end-state objective has been achieved, all documentation completed, and all requirements satisfied). Responsibility for the funding of the decommissioning shall be identified and financial guarantee shall be established to ensure adequate funding for decommissioning.	1.2 1.1, 1.3, 2.3, 2.9, 2.10, 2.11 1.1
4.3	The owner shall consider the requirements of CSA N286 when executing decommissioning works, including the following: (a) protecting the health and safety of workers and the public; (b) protecting the environment; (c) complying with requirements of the AHJ; (d) keeping radiation exposures as low as reasonably achievable (ALARA); (e) managing all radioactive and hazardous materials generated by the decommissioning; (f) security; and (g) safeguards.	1.2
4.4	Programs shall be developed and implemented to support decommissioning.	2.5 This pertains to the execution phase.
5.1.1.3	A financial guarantee for decommissioning shall be established to ensure that adequate funding is available at the time of decommissioning. The financial guarantee for decommissioning shall be maintained throughout the life cycle of the facility.	2.14 This is applicable for future life cycle stages.
5.1.6	The final end-state shall be considered reached when the end-state objectives as set in the DDP are verified to have been achieved (Annex F describes how to establish the end-state objectives).	2.10
5.1.7	The party accountable for decommissioning shall identify the applicable institutional control requirements following decommissioning as well as the available administrative processes in the jurisdiction in which they are located.	2.10

Section in CSA N294:19	Requirement in CSA N294:19	Section in this PDP
5.2.5	Decommissioning records shall include, as applicable, a) the DDP(s); b) public and Indigenous engagement/communication records (as per CNSC REGDOC-3.2.2); c) if required by the AHJ, an impact assessment or environmental review in accordance with applicable legislation; d) licences and permits required for the decommissioning work; e) the plans and procedures used in decommissioning; f) reports and other documents that describe i) the criteria used to define radioactive and hazardous materials and to distinguish contaminated from uncontaminated materials; ii) the criteria used to define the final contamination status of the facility; iii) the principles and models used in deriving the criteria in Items i) and ii); iv) the residual radionuclide inventory after decontamination; v) the amounts of radioactive and hazardous materials removed and the disposition method; vi) waste management and transfer records; vii) the equipment and materials removed from the facility for recycling or use elsewhere, their treatment prior to removal from the site, and the disposition method; viii) the survey methods and the types of instruments used; ix) the equipment, nuclear and non-nuclear materials, and structures remaining at the end of decommissioning; and x) land remediation undertaken, results of verification analyses as compared to criteria used or derived for soil and water quality, and the disposition of affected media; g) reports, other documents, and photographs describing findings from inspections, modifications, and repairs to SSCs; h) reports and other documents that describe unplanned or unusual occurrences; i) results and interpretations of environmental monitoring programs; j) occupational dose records; k) deviations from plans and procedures; l) quality assurance records; m) storage-with-surveillance plans; n) facility inspection, maintenance, and equipment records; o) the final radiological and hazardous materials surveys; and p) interim and final end-state reports.	2.11
5.4.2	The facility shall be characterized. See Annex G for guidance.	2.5
5.4.3	All radioactive waste generated shall be characterized as per the CSA N292 series of Standards.	2.7

Section in CSA N294:19	Requirement in CSA N294:19	Section in this PDP
5.5.1	A strategy shall be developed for the management of all radioactive, hazardous, and conventional waste that will be generated throughout the course of the decommissioning. The strategy should be based on good management practices including the waste hierarchy.	2.6.1, 2.7
5.6	A hazard assessment commensurate with the tasks to be performed shall be completed prior to decommissioning.	2.6
5.8.1	A quality assurance program shall be implemented.	1.2
6.1.1	A decommissioning strategy should be developed early in the life cycle of a facility (normally during the siting phase) and should be reviewed and updated as new information is obtained. The strategy should contain a high-level approach and rationale for decommissioning the facility, which will be further developed in decommissioning plans. The owner shall demonstrate that, under the strategy selected, the facility will be maintained in a safe configuration at all times.	1.3, 2.4, 2.9
6.1.2.2	In such cases where the end-state for in-situ decommissioning results in a waste disposal site, an applicant shall satisfy all regulatory requirements for a radioactive waste disposal facility and demonstrate safety via a safety case and post-closure safety assessment of a disposal facility. In-situ decommissioning is an acceptable practice for uranium mines and mills. Additionally, in-situ decommissioning may be considered a viable solution under exceptional circumstances (e.g., following a severe accident) or for legacy sites for which decommissioning was not planned as part of the design, and which will remain under institutional control for the foreseeable future. In order to align with international best practice, in-situ decommissioning should not be considered a reasonable decommissioning option for situations where removal is possible and practicable. Note: Legacy sites (in the Canadian context) specifically refer to research and demonstration facilities dating back to the birth of nuclear technologies in Canada for which decommissioning was not planned as part of the design.	N/A
6.2.1	For sites with more than one facility, a site decommissioning plan shall be developed to ensure that interdependencies are taken into account.	2.9

Section in CSA N294:19	Requirement in CSA N294:19	Section in this PDP
6.2.3	Cost estimates shall include all decommissioning activities from operations, during shutdown to the final release from regulatory control. The cost estimate for decommissioning shall address the cost of the following principal activities, if applicable: a) preparation for final shutdown; b) site characterization, site surveys; c) facility shutdown activities; d) additional activities for safe enclosure; e) decontamination and dismantling activities; f) processing, storage and disposal of all waste including used fuel; g) project management, engineering, and site support; h) site clean-up, landscaping, and restoration; i) long-term management of radioactive waste and used fuel; j) long-term monitoring and maintenance of the site and institutional control; k) licensing costs; and l) miscellaneous expenditures.	2.14 This is applicable for future life cycle stages.
7.1.1	Preparation for decommissioning shall include a) an assessment of the records from the previous life cycle stages and the state of the facility (e.g., baseline configuration) at the time of shutdown; b) an impact assessment or environmental review in accordance with applicable legislation, if required; c) a safety assessment for decommissioning; d) ensuring that there is a sufficient number of qualified staff to ensure safe operation during the approach to shutdown; e) further development of the PDP into the DDP; f) placing a facility in a permanent shutdown state; and g) any additional requirements specified by the AHJ.	a) 2.3, 2.5, 2.11 b) 2.5 c) 2.8 d) 2.5 e) 2.8 f) 2.5 g) 2.5
7.1.2	The owner shall ensure that processes, systems, and personnel are in place to maintain the facility in a safe state during the transition to decommissioning.	2.5
7.4.1.1	To ensure a smooth transition from operation to decommissioning, the facility shall be prepared to complete stabilization activities as soon as practical after the permanent shutdown date.	2.3
7.4.3	During the transition period between shutdown and decommissioning, surveillance and maintenance shall be conducted to ensure the health and safety of persons and the protection of the environment.	2.5
7.5.1	An assessment of the state of the facility shall be performed to provide baseline information for evaluating the hazards to be controlled during decommissioning. A thorough field survey shall be performed and supplemented by a review of existing records, as required.	2.3, 2.6 2.5, 2.11

Section in CSA N294:19	Requirement in CSA N294:19	Section in this PDP
7.5.2.1	The following hazards shall be investigated and assessed: (a) radiological hazards; (b) biologically, chemically, and physically hazardous materials; (c) hazards from concealed or hidden services; and (d) structural hazards.	2.6
7.5.2.2	Historical information shall be preserved that is relevant to the eventual decommissioning of the facility.	2.11
7.6.1	A DDP shall be developed for nuclear facilities, in accordance with Annex C and regulatory requirements, and submitted to the AHJ for acceptance.	These requirements pertain to the preparation for the Dismantling & Demolition phase. Relevant for the DDP not the PDP 2.8
7.6.2.1	The DDP shall meet the content provisions of Annex C.	These requirements pertain to the preparation for the Dismantling & Demolition phase. Relevant for the DDP not the PDP 2.8
7.6.3	If deferred decommissioning is the preferred decommissioning strategy, in addition to a DDP, a SWS plan shall be developed. If a SWS plan is standalone, it shall be submitted to the AHJ.	N/A
7.6.4	A safety assessment shall be performed to identify potential hazards to workers, the public, and the environment, from both routine decommissioning activities and credible accidents during decommissioning. The assessment shall describe the relative importance of the potential hazards and identify the methods for mitigating the risks associated with such hazards. If fissile material is involved, a criticality safety assessment and the planned actions involving fissile material shall be included. The assessment shall also address the residual risks to the public, if any, after decommissioning is completed. In-situ decommissioning may result in a waste disposal site. In such a case, an applicant shall satisfy all regulatory requirements for a radioactive waste disposal facility and demonstrate safety via a safety case and post-closure safety assessment of a disposal facility.	2.8 2.5, Table 2.6-1 2.8 2.6, 2.8 N/A

Section in CSA N294:19	Requirement in CSA N294:19	Section in this PDP
7.6.5.1	The strategy for managing all wastes from decommissioning shall include a management plan covering both the short term and, where possible, the long term.	These requirements pertain to the preparation for the Dismantling & Demolition phase. Relevant for the DDP, not the PDP 2.7
7.6.5.2	The waste management program shall cover the following processes, as applicable: a) characterization; b) classification; c) minimization; d) segregation; e) clearance; f) handling; g) volume reduction; h) treatment; i) packaging; j) storage; k) transportation; and l) final disposition. Transportation requirements and the waste receiver's acceptance criteria shall be reviewed to ensure that the waste is appropriate for shipment and acceptable to the waste receiver.	These requirements pertain to the preparation for the Dismantling & Demolition phase. Relevant for the DDP, not the PDP 2.7
8.1.2	The work to be performed during the decommissioning shall be described in a DDP.	2.8
8.1.3	The physical work to be carried out shall be defined in terms of work packages and work procedures to the level of detail required for safe, effective, and efficient decommissioning.	These requirements pertain to the execution phase and are, as such, not applicable for this PDP. 2.5

Section in CSA N294:19	Requirement in CSA N294:19	Section in this PDP
8.1.7.1	Where decontamination is being used as part of decommissioning, the following shall be identified: (a) the areas, locations, and equipment to be decontaminated; (b) the objectives of the decontamination (e.g., decontamination of equipment for salvage and reuse, decontamination of metals for recycling, decontamination of building foundations that are to remain in place, decontamination for clearance of materials to be disposed of as non-radioactive); (c) the decontamination methods to be employed; and (d) the residual level of radioactivity that is to be achieved.	2.5 2.6 2.10 These requirements pertain to the execution phase and are, as such, not applicable to this PDP.
8.1.8.1	A demolition plan shall be prepared. The equipment and structures to be dismantled or demolished shall be identified. The equipment and structures that are to remain at the completion of decommissioning shall also be identified. Procedures for dismantling and demolition shall take into account the associated hazards.	2.5, 2.6.2 These requirements pertain to the execution phase and are, as such, not applicable to this PDP.
8.1.8.2	The following factors shall be considered when selecting dismantling/demolition methods: a) availability of professional competence associated with the operations of the chosen equipment; b) the equipment should be simple to operate, decontaminate, and maintain; c) remaining structural elements shall be kept in a physically stable state; d) measures to prevent unintentional releases to the environment; e) planned discharges to the environment shall be controlled as per licence conditions and previous commitments; f) when underwater dismantling and cutting is used, provisions shall be made to process the water to promote and assist in effluent treatment; g) the effect of dismantling tasks on adjacent systems and structures and on other work in progress shall be evaluated; h) waste containers, handling systems, and routes shall be defined before the start of dismantling work; and i) federal, provincial/territorial and/or municipal requirements.	These requirements are relevant for detailed decommissioning planning and execution, as such, not applicable for this PDP. 2.5, 2.6.2
8.1.9.1	Surveys during decommissioning shall be performed to comply with (a) worker occupational safety and radiation protection programs; (b) environmental monitoring criteria; and (c) processes to release materials and equipment from the site.	2.3, 2.5, 2.6

Section in CSA N294:19	Requirement in CSA N294:19	Section in this PDP
8.1.9.2	At the completion of a decontamination or dismantling work package, a survey shall be performed, if required, to demonstrate that the planned end-state has been achieved. The results of the survey shall be documented in a report that includes a) the criteria used to define the end-state; b) the methods and procedures used to ensure that the criteria were met; and c) the measurement data, including appropriate statistical analysis and systematic approaches.	2.5, 2.10, 2.11
8.2	Where decommissioning of the facility is to take place in discrete stages, an interim end-state report shall be prepared when each planned interim end state is achieved.	2.5,2.11
8.3	A plan for surveillance, monitoring, physical protection, and maintenance of the facility during such periods shall be developed and implemented to (a) maintain the facility in a safe state; (b) control the release of materials to the environment; and (c) prevent access by unauthorized persons; and (d) mitigate infestations of vermin and other organisms.	Clause 8.3 is specific to Storage with Surveillance stage, which is N/A for a prompt decommissioning strategy.
8.4	Lands associated with a facility or a standalone site that might have been impacted by previous nuclear activities shall be remediated to the degree required to meet the end-state criteria.	2.5, 2.10
8.5	At the completion of this phase, final surveys of residual radioactive and hazardous materials shall be performed and documented to demonstrate that the final end-state for remaining equipment, structures, and the site has been achieved in accordance with the criteria specified in the DDP. The results of the final survey shall be documented in a report that includes a) the criteria used to define the end-state; b) the methods and procedures used to ensure that the criteria were met; and c) the measurement data, including appropriate statistical analysis and systematic approaches.	2.5, 2.10, 2.11
9.1	Following the completion of decommissioning, a final end-state report shall be prepared and retained. Where a decommissioning program involves completing a number of separately approved decommissioning projects, interim end-state reports shall be submitted for each project.	2.5, 2.10, 2.11

Section in CSA N294:19 Annex A	Requirement in CSA N294:19	Section in this PDP
A.2 (a)	A PDP may include the following: a description of the location of the facility, including (i) a map of the facility and its specifications; (ii) geographic information; (iii) details regarding the surrounding environment; (iv) land uses; and (v) illustrations and maps of the facility in relation to the municipality;	2.1
A.2 (b)	purpose and description of the facility, including (i) primary components and systems; (ii) building type and construction, including location of any hazardous building materials (e.g., asbestos, PCBs); (iii) building services (e.g., power, heating, ventilation, sewer, water, fire protection); (iv) laboratories and other hazardous handling areas; (v) type, quantity, and form of radioactive and hazardous materials stored, produced, or used during operation; and (vi) design features used to reduce the spread of contamination and facilitate decontamination and dismantling;	2.2
A.2 (c)	post-operational conditions, including (i) a summary of the shutdown process, including planned removal of stored inventories of hazardous materials or radioactive materials; (ii) the predicted nature and extent of contamination remaining in the primary systems and components (in list or table format with reference to applicable illustrations); (iii) the predicted nature and extent of contamination on floors, walls, work surfaces, ventilation systems, etc.; and (iv) the identification of any separate planning envelopes; and (v) an overview of the principal hazardous conditions anticipated to exist	i) 2.3 ii) 2.3 iii) 2.3 iv) N/A v) 2.6

Section in CSA N294:19 Annex A	Requirement in CSA N294:19	Section in this PDP
A.2 (d)	the decommissioning strategy, including (i) the final end-state objective; (ii) rationale for (1) the decommissioning strategy selected; (2) interim end states; (3) periods of storage with surveillance; and (4) in-situ decommissioning concepts; (iii) the requirements for long-term institutional controls; and (iv) the assessment of alternative strategies (or a rationale for why alternatives do not exist or do not warrant consideration);	2.4, 2.10
A.2 (e)	a plan of the decommissioning work, including i) a work breakdown structure; ii) a summary of the main steps for decontamination/disassembly/removal of each of the systems (preferably grouped into work packages); iii) for each work package, identification of those types of activities that could pose a significant hazard to workers, the public, or the environment; iv) the role of existing operational standard procedures for radiation protection, hazardous materials handling, industrial safety, and environmental protection in managing hazards; v) specific activities for which additional protection/mitigation procedures will be required at the detailed planning stage; vi) a summary of the final dismantlement of the structures; and vii) a conceptual schedule showing the approximate year of facility shutdown and the approximate sequencing and duration of the decommissioning work packages and, where relevant, storage periods;	i) 2.5 ii) 2.5 iii) 2.6 iv) 2.6.2, 2.7 v) 2.5, 2.6 vi) 2.10 vii) Figure 2.5-1

Section in CSA N294:19 Annex A	Requirement in CSA N294:19	Section in this PDP
A.2 (f)	radiological monitoring and survey commitments, including (i) a program for conducting periodic contamination surveys and the recording of contamination events during facility operation; (ii) a commitment to conduct detailed post-operation surveys in support of DDP development; (iii) a commitment to develop plans and protocols acceptable to the AHJ at the detailed planning stage for monitoring (1) work hazards during decommissioning; (2) personnel dosimetry; (3) environmental emissions and effluents; and (4) materials, sites, and structures to be cleared from regulatory control;	2.3, 2.5, 2.6.1, 2.6.2, 2.8, 2.11
A.2 (g)	a waste management strategy specifying (i) the approximate quantities and characteristics of radioactive and chemically hazardous wastes expected to arise from the decommissioning (tied to specific work packages, if possible); (ii) the anticipated final disposition of radioactive and chemically hazardous materials; and (iii) a commitment to segregate as much material as possible for reuse and recycling;	2.7
A.2 (h)	a commitment to prepare a DDP for regulatory approval prior to dismantling and demolition;	2.8
A.2 (i)	a commitment to periodically review and update the PDP until a DDP is prepared, in accordance with Clause 6.2.2;	2.9
A.2 (j)	the physical state of the facility at (i) the end of operations; and (ii) the start of decommissioning;	2.3, 2.5
A.2 (k)	the records required for decommissioning, including a description of the facility operational records that will be maintained to periodically update the PDP and prepare the DDP(s); and	2.11
A.2 (l)	a public consultation plan, including a public information program and avenues for public participation.	2.12
A.2 (m)	an Indigenous engagement plan as per the requirements and guidance of CNSC REGDOC-3.2.2; and	2.13

Section in CSA N294:19 Annex A	Requirement in CSA N294:19	Section in this PDP
A.2 (n)	the cost and a financial guarantee, specifying i) an estimate of the total present-value cost of the decommissioning; ii) a reasonable basis for how cost estimates were derived; and a description of how the required funds will be provided;	2.14, The Financial Guarantee is applicable for future life cycle stages.

Section in CSA N294:19 Annex I	Requirement in CSA N294:19	Section in this PDP
I.2.2	When the decision is made to permanently shut down and physically decommission the reactor, a planned process shall be followed to render the reactor to a predetermined final end state condition, release the reactor from licence control, and implement any required institutional controls.	2.5, 2.10
I.3.2	The management accountable for each life-cycle phase shall (a) consider the impact of their activities on the eventual decommissioning; (b) ensure that the reactor conforms to the design basis; and (c) preserve documents and records relevant to decommissioning.	1.2, 2.3, 2.5, 2.11
I.4.3.1	The level of planning detail builds up through the life cycle. During operation a stand-alone plan is required. Management shall perform the necessary planning, based on the results from assessments, the design and the safety analysis, to establish the objectives, the strategies and the cost estimates for the decommissioning of the reactor.	2.9
I.4.3.2	In addition to Clause 6.2.1, the plan shall include a) a description of the site, including all of the facilities on the site and adjacent to the site; b) a description of the reactor and its auxiliary facilities; c) a description of the common and interdependent SSCs and work; d) identification of i) the planning assumptions; ii) proposed end-state criteria; iii) uncertainty and degree of conservatism; and iv) the planned decommissioning strategy; e) an outline of the proposed scope of work and schedule to complete the decommissioning. This includes a description of the proposed start date, end date, and milestones; f) identification of the expected inventory of waste and surplus items that will result from decommissioning and their final disposition.	a) 2.1 b) 2.2 c) 2.2.6 d) 1.3.1, 2.10, 2.15, 2.4 e) 2.5 f) 2.7
I.5.1.1.1	The reactor shall be safely shut down and its SSCs shall be placed in a safe state in preparation for decommissioning.	2.3, 2.5

Section in CSA N294:19 Annex I	Requirement in CSA N294:19	Section in this PDP
I.5.1.1.2	During final shutdown, the following actions shall be performed: (a) Implementing the defueling, dewatering and waste management plan; (b) Establishing operating controls for the SSCs that will remain in operation during the remaining stages of decommissioning (e.g., the used fuel system); (c) Placing each SSC in a pre-defined interim end-state.	2.3, 2.5, 2.7
I.5.1.1.4	Additionally, programs in place during operations shall be reviewed, revised, and/or eliminated to ensure that requirements for the remaining stages of decommissioning are covered. Such examples include, but are not limited to, environmental monitoring, emergency response, and fire protection.	2.5
I.5.1.2.1	SWS (sometimes referred to as “storage with surveillance”) shall include the period when the reactor is under surveillance while the radioactivity decays and/or until the prerequisites for dismantling and demolition are achieved.	N/A No SWS period as prompt strategy is selected.
I.5.1.2.2	During this stage, the following actions shall be performed: (a) Conducting planned surveys; (b) Removing the nuclear fuel from the spent fuel bay to dry storage; (c) Placing the spent fuel bay and auxiliaries in a pre-defined end state for future decommissioning; and (d) Ongoing removal of radioactive waste.	N/A No SWS period as prompt strategy is selected.
I.5.2	During this stage, the reactor shall be subjected to the planned decontamination, dismantling and demolition, and any resulting materials will either be a) decontaminated to meet release criteria; or b) disposed of into a waste facility.	2.5, 2.6, 2.7
I.5.3	Site restoration shall include a) disposing of hazardous substances; b) restoring the topography (for example, by restoring the landscape); c) restoring vegetation; d) removing the licence and making the site available for other use; and e) preparing the final end-state report in accordance with Clause 9.1 and Annex E.	2.5, 2.7, 2.10