Preliminary Decommissioning Plan – Western Waste Management Facility

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Revision Summary

Revision Number	Date	Comments
R004	2022-01-13	Updated throughout to reflect current planning assumptions, WWMF Safety Report R004, and current site status. • Throughout text was revised to indicate current assumptions regarding disposal of L&ILW currently stored at WWMF and LLW arising from decommissioning • Throughout text was updated to align with the latest revision of CSA N294:19 • List of abbreviations updated • Abstract, appropriate licence condition number updated • Section 1.0, added statement that OPG is responsible for decommissioning, added paragraph regarding IAM, update to plans for L&ILW • Section 2.1, updated Figure 2-2 • Section 2.2.1, updated Figure 2-3 • Removed areal view of WWMF (2013) • Section 2.2.5, added groundwater monitoring information, minor updates to Table 2.1 • Added Section 2.2.6, Interfaces • Section 2.2.7, updated L&ILW structures and Table 2-2 to reflect current facility to 2022, added definition of waste types, updated Table 2-3 • Section 2.2.7.4, updated LLSB plans • Section 2.2.7.6, updated IC-18 plans and predictions • Section 2.2.7.8, updated to include current use of tile holes • Section 2.2.7.9, updated to include current use of trenches • Section 2.2.7.10, removed plans for further SGSBs • Section 2.2.7.11, removed plan for further RCSB • Added Section 2.2.7.12, Waste Sorting Building • Added Section 2.2.7.13, Multi Purpose Storage Buildings • Added Section 2.2.7.14, Storage Areas • Section 2.2.8, updated DSC inventories, DSB plans and Table 2-4 to reflect current facility to 2022 • Section 2.2.8.2, updated number of planned DSBs and DSC inventory and predictions • Section 2.3.1, updated to include additional information on geography, native species and fauna • Section 2.3.2.1, updated to include greater detail on stratigraphy • Section 2.3.2.3, updated to include groundwater monitoring information • Section 2.3.2.4, updated to current seismicity values • Section 2.3.3, updated • Section 2.3.3.1, updated to include information on the drainage ditch • Section 2.3.4, updated to reflect changes in L&ILW long-term management • Section 2.3.5, updates to population and economic data, information on recreational and residential use of the surrounding area added • Section 2.3.6, updates to population data, information on Indigenous Relations Program added • Section 2.3.7, information on the public communication and engagement program • Section 2.4, LLW, ILW and DSC inventories updated • Section 2.4, WWMF history and current status summary provided, subsections removed

		• Section 3.2, updated to reflect current planning assumptions • Section 3.5.1, updated to reflect current reference decommissioning strategy • Section 3.5.2, updated to reflect current reference decommissioning strategy • Section 3.6, updated to reflect current plans and projections • Section 3.7, information regarding decommissioning of BWHP and SSTF added • Section 4.0, Table 4-1 updated to reflect current plans • Section 4.1, updated to reflect current plans • Section 4.1.2.5, added Waste Sorting Building • Section 4.1.3.3, added that DOC will supply power, added Waste Sorting Building • Section 4.1.3.4, added that OPG will perform final status surveys • Section 4.1.3.5, updated Tables 4-2 and 4-3 • Section 5.1, revised to reflect current cost estimate • Section 6.0, replaced P-119 with REGDOC-2.2.1, Human Factors, removed Table 6-1 • Section 7.2.4, updated to reflect current decommissioning dates • Section 7.2.5, updated to reflect current decommissioning dates and workforce projections • Section 12.0, added Indigenous Relations Program,REGDOC-3.2.1, Public Information and Disclosure and REGDOC-3.2.2, Indigenous Engagement • Section 13.0, references added and updated as necessary • Appendix E, updated to reflect current decommissioning cost estimate • Appendix F updated to align with CSA N294:19 • Appendix G, added, ‘WWMF to Bruce Power Interface Documents and Services’

Abbreviations

Abbreviation	Definition
ALARA	As Low As Reasonably Achievable
APM	Adaptive Phased Management
BEC	Bruce Energy Centre
BHWP	Bruce Heavy Water Plant
BNGS	Bruce Nuclear Generating Station
CANDU	CANadian Deuterium Uranium
CCNS	Centre for Canadian Nuclear Sustainability
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DDP	Detailed Decommissioning Plan
DGR	Deep Geologic Repository
DOC	Decommissioning Operations Contractor
DQO	Data Quality Objectives
DSB	DSC Storage Building
DSC	Dry Storage Container
EA	Environmental Assessment
HEPA	High Efficiency Particulate in Air
HSA	Historical Site Assessment
IAC	Indigenous Advisory Counsel
IAEA	International Atomic Energy Agency
IAM	Integrated Aging Management
IA	Impact Assessment
IC	In-Ground Container
IC-HX	In-Ground Heat Exchanger Container
ILW	Intermediate Level Waste
L&ILW	Low and Intermediate Level Waste
LLW	Low Level Waste
LLSB	Low-Level Storage Building
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCR	Major Component Replacement
MODUCON	MODUlar CONtainment
MP	Members of Parliament
MPP	Members of Provincial Parliament
MPSB	Multi Purpose Storage Building
NGS	Nuclear Generating Station
NSCA	Nuclear Safety and Control Act
NWMD	Nuclear Waste Management Division
NWMO	Nuclear Waste Management Organization
OHSA	Occupational Health and Safety Act
ONFA	Ontario Nuclear Funds Agreement
OPG	Ontario Power Generation
PC	Personal Computer
PCB	Polychlorinated Biphenyl

Abbreviation	Definition
PDP	Preliminary Decommissioning Plan
RCSB	Retube Component Storage Building
RWC	Retube Waste Container
RWOS	Radioactive Waste Operations Site
RWSB	Retube Waste Storage Building
SAR	Species At Risk
SEIA	Socio-Economic Impact Assessment
SGSB	Steam Generator Storage Building
SQEP	Suitably Qualified and Experienced Persons
SS	Sampling Station
SSTF	Spent Solvent Treatment Facility
THEL	Tile Hole Equivalent Liner
TPMB	Transportation Package Maintenance Building
UFDS	Used Fuel Dry Storage
WUFDSF	Western Used Fuel Dry Storage Facility
WVRB	Waste Volume Reduction Building
WWMF	Western Waste Management Facility

Abstract

This Preliminary Decommissioning Plan (PDP) describes Ontario Power Generation's (OPG's) current plan for the decommissioning of the Western Waste Management Facility (WWMF). It has been prepared in accordance with the requirements of the Class I Nuclear Facilities Regulations [R-1] (SOR/2000-204 - Clause 3(k)) as well as licence condition 11.2 in the WWMF operating licence (WFOL-W4-314.00/2027) [R-2]. It has also been written to meet the requirements of Canadian Nuclear Safety Commission (CNSC) Guide G-219, Decommissioning Planning for Licensed Activities (June 2000) [R-3] and Canadian Standards Association (CSA) N294:19, Decommissioning of Facilities Containing Nuclear Substances [R-4]. Appendix F provides the specific requirements of the CSA standard, along with the particular section(s) of this PDP that addresses each requirement. Compliance with CSA N294 implies compliance with CNSC Regulatory Guide G-219.

This PDP covers the decommissioning activities that will be performed following the decision to shut down the respective areas of the WWMF. The WWMF is comprised of Low and Intermediate Level Waste (L&ILW) processing and storage facilities and used fuel dry storage facilities. The decommissioning will be carried out in two separate phases, the L&ILW processing and storage facilities and associated areas will be decommissioned first, followed by the Western Used Fuel Dry Storage Facility (WUFDSF) and associated areas at a later time. This does not include the management and removal from the site of the L&ILW and nuclear fuel, as all stored nuclear waste will be removed from the WWMF prior to decommissioning (with the exception of the empty Tile Hole Equivalent Liners (THELs).

The overall objective of decommissioning the WWMF is to retire the facility in a manner that ensures the safety and protection of workers, the general public and the environment. This PDP includes a decommissioning schedule and cost estimate based on planning dates and assumptions.

1.0 INTRODUCTION

OPG maintains an ongoing program to prepare for the eventual decommissioning of the WWMF, which is located on the Bruce Power site in Tiverton, Ontario. OPG is responsible for planning, executing, and funding all phases of the decommissioning.

The WWMF is comprised of what was formally known as the Western L&ILW Storage Facility or Radioactive Waste Operations Site (RWOS) 2 and the newer WUFDSF. Both areas are operated under one waste facility operating licence for the WWMF. The WWMF is a Class I Nuclear Facility, and has been operational since 1974 when the first consignment of waste was received. The WWMF is located on OPG-owned lands.

The WWMF is owned and operated by OPG for processing and interim storage of the following nuclear material:

- L&ILW from OPG's Pickering and Darlington Nuclear Generating Stations (NGSs).
- L&ILW from Bruce Power's Bruce NGSs A and B.
- L&ILW from RWOS 1 and the Spent Solvent Treatment Facility.
- Used fuel from Bruce Power's Bruce NGSs A and B.

Fuel removed from the irradiated fuel bays at Bruce NGS A and B is transferred to the used fuel dry storage facilities at WWMF and stored there in Dry Storage Containers (DSCs) until long-term used fuel disposal is available at the proposed Adaptive Phased Management (APM) repository[1]. Periodically, used fuel from Bruce NGS A and B is sent to Canadian Nuclear Laboratories in Chalk River, Ontario for analysis.

The operational lifetime and final site layout of the WWMF are largely dependent on the operational life of the NGSs. This in itself is largely dependent on future decisions taken on rehabilitation and other life extension activities of critical components of the NGSs.

The WWMF is comprised of L&ILW processing and storage facilities and used fuel dry storage facilities. The decommissioning will be carried out in two separate phases, the L&ILW processing and storage facilities and associated areas will be decommissioned first, followed by the WUFDSF and associated areas at a later time.

OPG had planned to dispose of L&ILW stored at the WWMF in a Deep Geologic Repository (DGR) at the Bruce Nuclear Site. Early in 2020, the L&ILW DGR Project was cancelled. OPG is exploring options and remains committed to permanent and safe disposal for its operational waste as well as future decommissioning waste. OPG is also participating in Natural Resources Canada's work in public engagement on the existing radioactive waste policy to ensure OPG is meeting international best practices. The Nuclear Waste Management Organization (NWMO) was asked to lead a dialogue to develop an integrated strategy for Canada's radioactive waste through close collaboration among waste owners and producers

[1] On June 14, 2007, the Government of Canada selected APM as the best plan to safeguard the public and the environment over the very long term in which used nuclear fuel must be managed [R-5].

(including OPG), Indigenous People and other interested Canadians. Any progress in regard to the policy and integrated strategy will be taken into consideration in OPG's decommissioning waste disposal strategy. This work is ongoing and is expected to be completed after the 2022 Ontario Nuclear Funds Agreement (ONFA) Reference Plan and associated 2023 CNSC Financial Guarantee update. For financial planning purposes only, OPG has assumed that the L&ILW currently stored at the WWMF and that generated due to decommissioning will be disposed of as follows:

- Low Level Waste (LLW) will be emplaced in a long-term disposal facility in Ontario, assumed to be in service by nominally 2045.

- Intermediate Level Waste (ILW) will be emplaced in a long-term disposal facility located in Ontario, nominally available by 2043.

Accordingly, OPG intends to start transferring the LLW stored at the WWMF for long-term management at a long-term disposal facility nominally in 2045 and ILW to a long-term disposal facility nominally in 2043. The used fuel dry storage facilities at WWMF will remain in operation after the cessation of power production at Bruce NGS A and B, and are assumed to be decommissioned after all the used fuel is transferred to the APM repository.

OPG maintains a systematic care, maintenance, monitoring and inspection program, and implements the surveillance and Integrated Aging Management (IAM) activities at the WWMF. These activities will be continued to ensure that the WWMF remains in a safe, sustainable, and secure state until such time that the facility reaches the currently planned final decommissioning end-state site suitable for other industrial or commercial use.

This PDP defines the areas of the WWMF to be decommissioned, as well as the general structure and sequence of the proposed decommissioning work to be undertaken. It forms a structured basis for establishing financial guarantees for the work, and a baseline approach for the future Detailed Decommissioning Plan (DDP). Ultimately, it provides the foundations of a decommissioning approach that is sufficient to protect the health and safety of humans and the wider environment from potentially negative effects due to decommissioning activities, as well as to maintain long-term security at the site.

This document describes the preliminary plan for the decommissioning of the WWMF as it exists at the time of writing, including any facility expansions planned during the 2023 to 2027 financial guarantee period. It is anticipated that this PDP will be revised periodically in recognition of the fact that decommissioning is interdependent on all other phases of the facility's lifecycle, as well as other external factors. For example, modifications to the facility design or operational activities, or developments in available decommissioning techniques and technologies will influence the final decommissioning methodology. In addition, periodic reviews of this document provide the opportunity to capture additional information, including advances in the knowledge and understanding of key issues, revised regulatory requirements and updated costing or funding information.

This document outlines the preliminary planning work that has been completed in accordance with the requirements in CNSC Regulatory Guide G-219[2] [R-3] and CSA Standard N294 [R-4]. It is not intended to serve as a detailed plan for the eventual decommissioning of the WWMF, but as a foundation/baseline document which demonstrates that the planned decommissioning is feasible with existing knowledge and technology. This PDP provides a basis for estimating the cost of the decommissioning, and includes or references:

- A description of the facilities to be decommissioned.
- A description of the decommissioning strategy that will be employed.
- An outline of the work that will be required to complete decommissioning.
- A discussion of the decommissioning cost estimate and financial guarantee.
- A proposed schedule for the decommissioning work.
- An estimated inventory of the radioactive wastes that will be generated during decommissioning.
- An outline of the potential environmental and socio-economic impact of decommissioning.
- An assessment of the radiological and conventional safety issues involved in decommissioning.

2.0 DESCRIPTION OF THE WESTERN WASTE MANAGEMENT FACILITY AND SURROUNDING AREA

2.1 Location of the Western Waste Management Facility

The WWMF is a Class 1B Nuclear Facility that is owned and operated by OPG. The WWMF is located on a portion of the Bruce Power site that is retained for use by OPG. All the facilities on the Bruce Power Site occupy 932 ha (2300 acres) on the east shore of Lake Huron, near the Village of Tiverton, midway between the towns of Kincardine (to the south) and Port Elgin (to the north). The facilities are located approximately 250 km northwest of Toronto, Ontario at a longitude of 81°35' west and latitude 44°20' north. The location of the WWMF site relative to the towns in the area is shown in Figure 2-1. The location of the WWMF on the Bruce Power Site is shown in Figure 2-2.

The Bruce Power site includes Lots 11 to 30, Lake Range, Municipality of Kincardine. The communities of Tiverton, Inverhuron, Underwood, Zeph Pine Acres and Baie du Doré are within a designated 8 km population control zone surrounding Bruce NGS A and B. New residential construction is limited in this area. The shoreline community of Inverhuron is within

[2] G-219 has been superseded by REGDOC-2.11.2, Decommissioning, which was published in January 2021. OPG has communicated the timing for preparation of a gap analysis and implementation plan to comply with REGDOC-2.11.1 with the CNSC [R-6].

4 km of the south property boundary of the Bruce Power site, and comprises about 200 year-round residents and many regular seasonal cottagers.

Highway access to the WWMF site is provided by Provincial Highway No. 21, via one of two east-to-west roads (Concession No. 2 and a Bruce County Road that was previously known as Concession 4) and private roads on Bruce Power site. There are no public roadways or railways on the site. The site was formerly serviced by railway spur line track but this was removed after the Canadian National Railway line was abandoned.

Two docking facilities for barges were constructed on the shore of Lake Huron to service Bruce NGSs A and B.

OPG has obtained title to Inverhuron Provincial Park, which adjoins the southern boundary of Bruce NGS B. A portion of the northern end of the park lies inside the exclusion radius of Bruce NGS B.

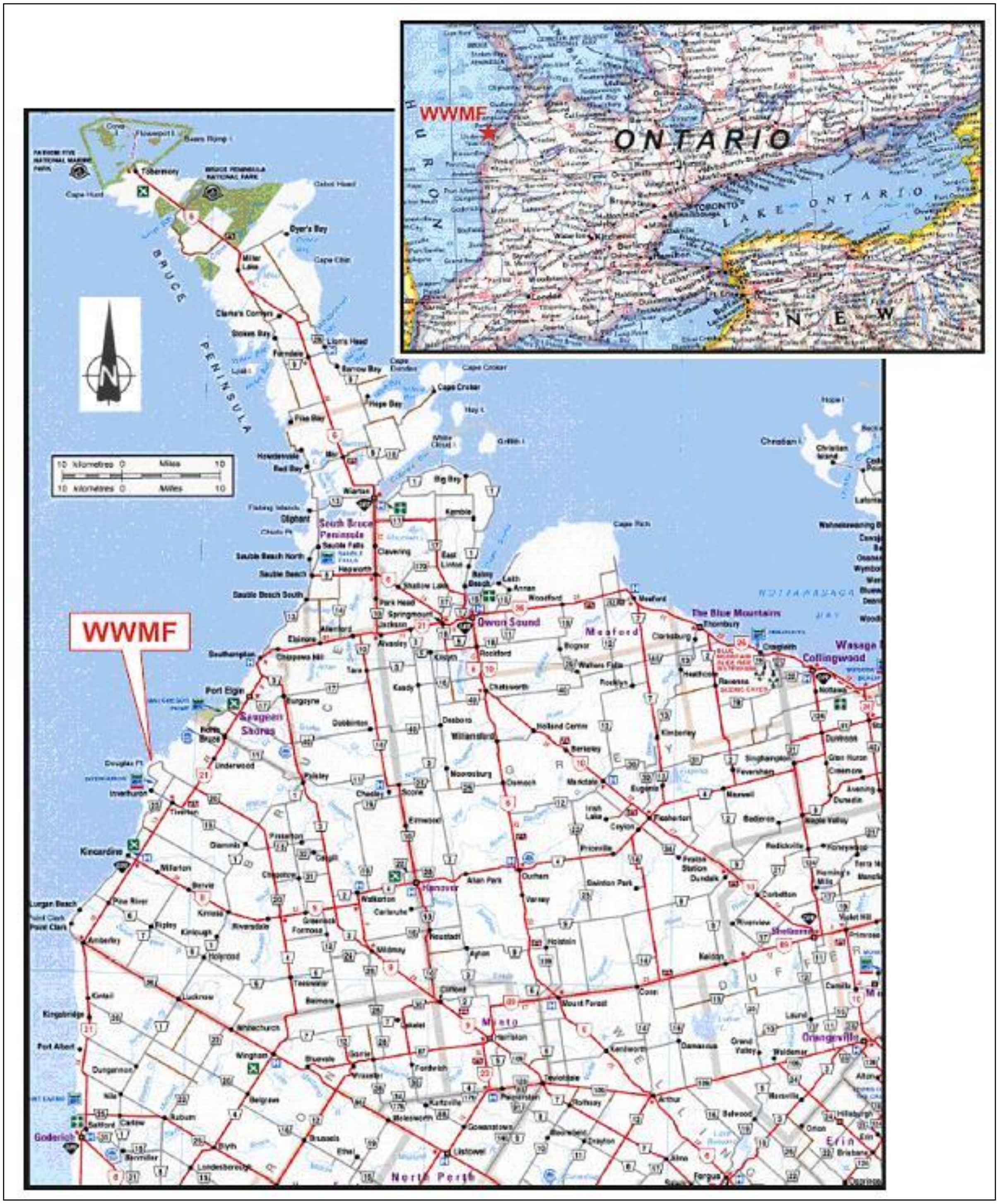


Figure 2-1: Map of Southern Ontario showing the location of the Western Waste Management Facility

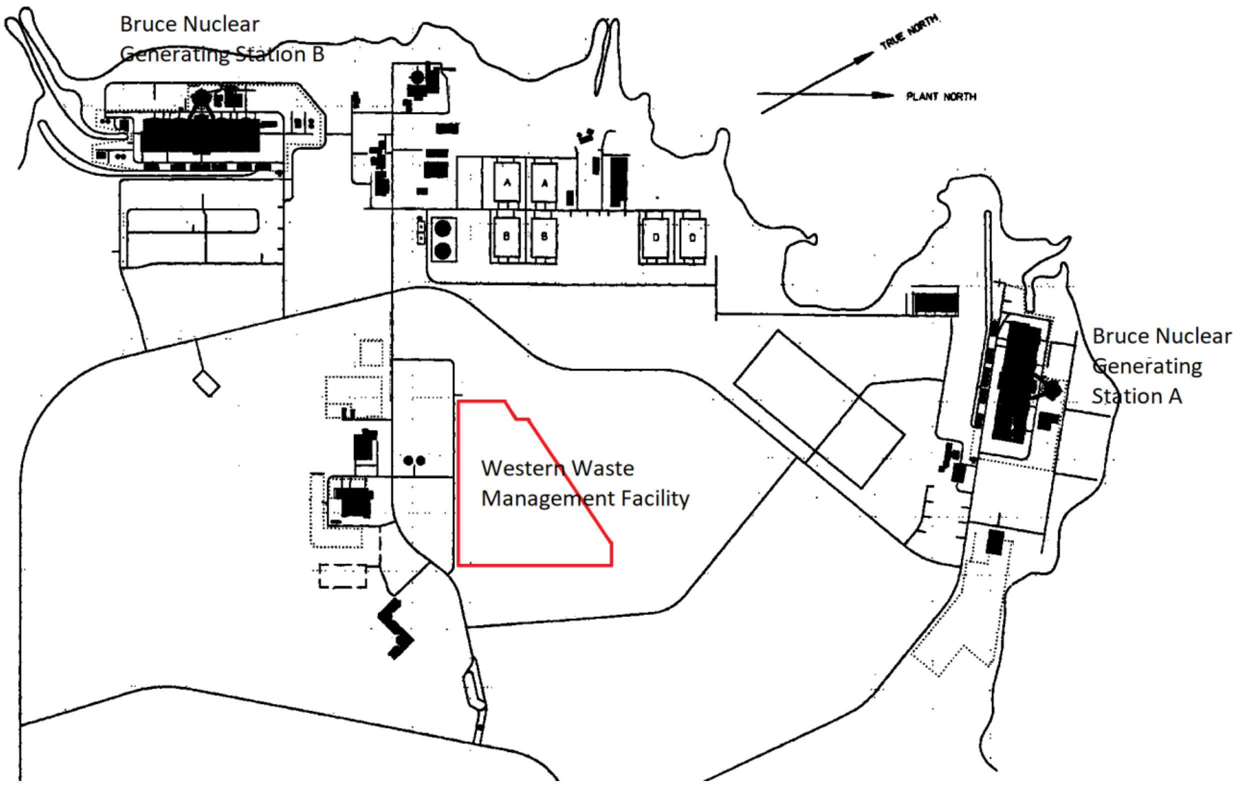


Figure 2-2: Map of the Bruce Site showing the location of the Western Waste Management Facility

2.2 Description of the Western Waste Management Facility

This section presents a brief description of the various components of the WWMF. The WWMF comprises of L&ILW processing and storage facilities, used fuel dry storage facilities and associated site services.

The WWMF occupies a 19.0 ha site. A WWMF site plan is shown in Figure 2-3. More detailed descriptions of the site are available in the WWMF Safety Report [R-7].

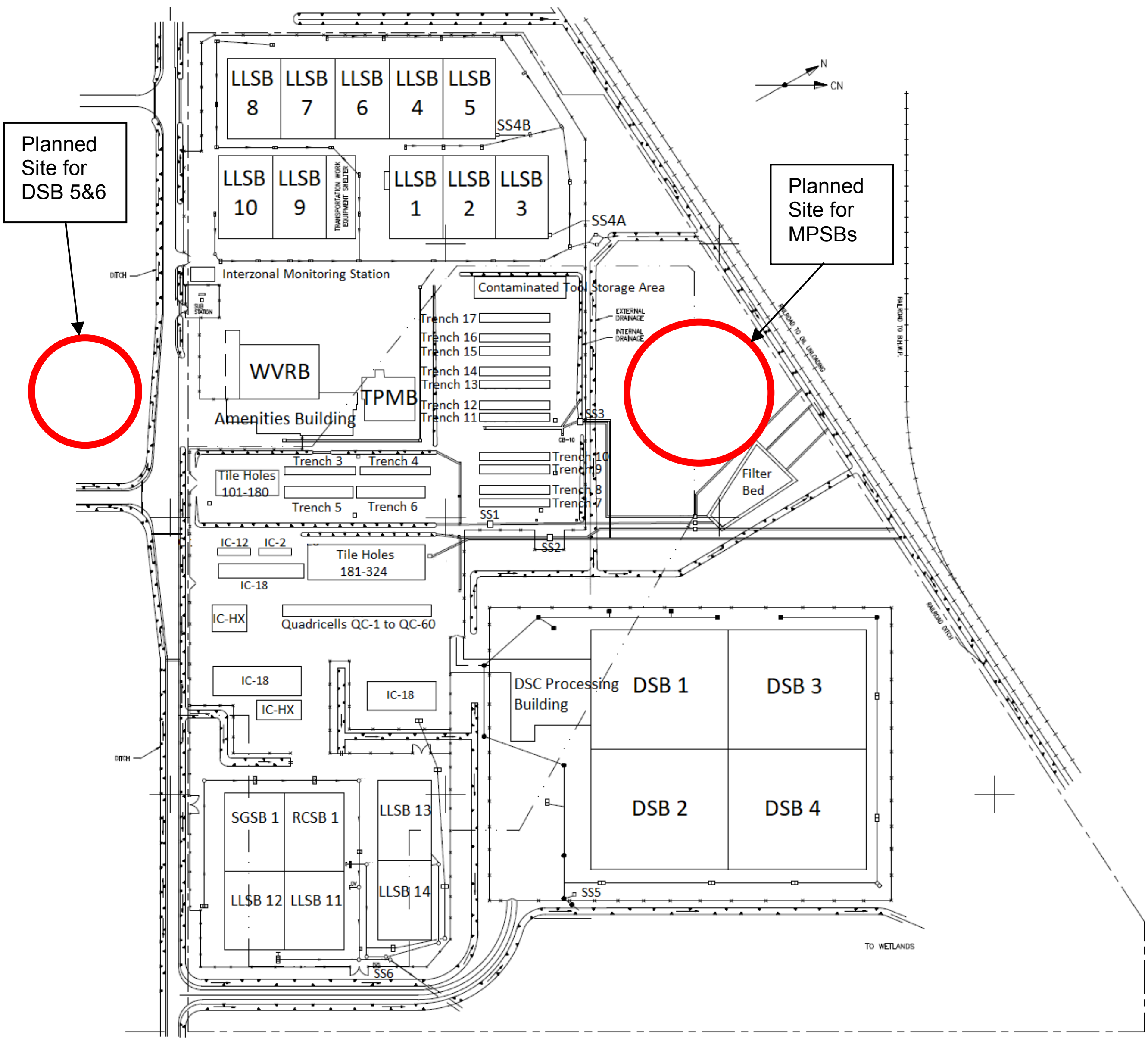
2.2.1 Access

The WWMF is licensed under the Nuclear Safety and Control Act (NSCA) and associated Regulations. The WWMF is fenced to limit access. Normal personnel access to and from the WWMF site is via the Amenities Building (see Section 2.2.7.3). Vehicular traffic travels to and from the WWMF site along the access road within the Bruce site and enters the WWMF site through gates located in the access control fence.

Vehicular traffic entering the Used Fuel Dry Storage (UFDS) area is minimal and controlled. Access control to this area is provided by a security system – further detail regarding this system can be found in section 2.6 of the WWMF Safety Report [R-7]. Access is provided for International Atomic Energy Agency (IAEA) inspectors and technicians. Routine Operations personnel access the used fuel dry storage facility through the Amenities Building and the L&ILW storage area.

In accordance with CNSC's security requirements, there is a protected area encompassing the UFDS area that is defined by a security fence. Vehicle traffic entering the UFDS area is minimal and controlled.

Loaded DSCs are transferred to the WUFDSF from Bruce NGSs A and B. Both the vehicles transporting DSCs and the DSCs themselves are monitored for contamination and decontaminated if required before leaving the station's Ancillary Services Building for transfer to the WWMF [R-7].



Note: Multi Purpose Storage Buildings (MPSBs) 1, 2 and 3, as well as DSB 5 and 6 are part of the scope of this PDP, although not shown on the site plan.

Figure 2-3: Site Plan of the Western Waste Management Facility.

2.2.2 Services

The main provisions for work control, personnel monitoring as well as washrooms, showers, change rooms and a lunchroom are available in the Waste Volume Reduction Building (WVRB, see Section 2.2.7.1) and the Amenities Building. Individual buildings such as the DSC Processing Building (see Section 2.2.8.1) and Transportation Package Maintenance Building (TPMB, see Section 2.2.7.2) also have washrooms and personnel monitoring. An interzonal monitoring station is provided between the WVRB and Low Level Storage Building (LLSB) 10 for monitoring of vehicle drivers before exit. The DSC Processing Building also has a lunchroom. Bruce Power supplies traffic management, security clearance, vehicle monitoring and facility access and working rights services on site.

2.2.3 Utilities

Electrical power for the amenities, processing and storage facilities, WWMF site lighting, sub-surface drainage pumps and associated control equipment is supplied from a nearby transformer substation on the Bruce Power site. Bruce Power also supplies telephone, public address, domestic water, fire water and sanitary sewage services on site.

2.2.4 Site Drainage

The WWMF is served by various surface and sub-surface drainage systems. The developed areas of the WWMF site are surrounded by external drainage ditches to prevent water from the undeveloped areas from entering the storage areas.

The surface runoff from the operational areas is directed to oil and grit separators prior to discharge into the adjacent railway ditch or stormwater management pond, prior to discharging into the wetland east of the WWMF.

The sub-surface drainage system services various structures and buildings associated with the L&ILW and used fuel storage areas. For the trenches (see Section 2.2.7.9) and tile holes (see Section 2.2.7.8) sub-surface drainage consists of perforated pipes adjacent to and below the bottom of the storage structures. Foundation drainage for the LLSBs, the Steam Generator Storage Building (SGSB), the Retube Component Storage Building (RCSB) and the DSC Storage Buildings (DSBs) consists of perforated pipe adjacent to the footings of the buildings (see Sections 2.2.7.4, 2.2.7.10, 2.2.7.11 and 2.2.8.2). The sub-surface drainage system for the interior of the LLSBs, the SGSB and the RCSB consists of a weeping tile system (draining into an internally-sealed sump). All of the sub-surface water is drained away from the structures and discharged to adjacent ditches.

2.2.5 Water Sampling and Monitoring

There are a total of five different subsurface sampling stations (SSs) (SS1, SS2, SS3, SS4b, and SS6) in place throughout the site for the sampling of sub-surface drainage away from main facilities, including trenches, tile holes, In-Ground Container (IC) areas, LLSBs, the SGSB and the RCSB. Each LLSB, the SGSB and the RCSB also have two sumps, one for any leakage inside the building and one for any leakage collected on the membrane below the floor. These sumps are periodically inspected, sampled and pumped out as required [R-7]. Surface water drainage from the WWMF site is monitored in the south railway ditch or stormwater management pond. Details regarding each of the sample locations and what aspects of the WWMF they monitor and details on structure monitoring are provided in Table 2-1 [R-7].

Any surface or sub-surface drainage is directed to the railway ditch located to the north of the WWMF site or to the stormwater management pond located to the east of the WWMF site. Drainage from these areas ultimately flows northeast via a series of ditches to Stream C, which discharges into Baie du Doré (Lake Huron) [R-7].

Modification or expansion of the drainage networks is required as more area of the WWMF becomes developed. Steps are taken with all new construction to ensure appropriate stormwater management design is incorporated per the Ministry of Environment, Conservation and Parks requirements.

Table 2-1: Summary of Structure and Sampling Locations

Structure Type	Number	Surface Sampling	Sub-Surface Sampling	Monitoring Details
Trenches	TRH-3 – TRH-6	South railway ditch	SS1	Internal
	TRH-7 – TRH-10	South railway ditch	SS2	Internal
	TRH-11 – TRH-17	South railway ditch	SS3	Internal
Tile Holes	TH101 – TH180	South railway ditch	SS1	Half with annular spaces
	TH181 – TH324	South railway ditch	SS2	Annular spaces
Quadricells	QC1 – QC60	South railway ditch	-	Annular spaces
In-Ground Containers	IC-2s	South railway ditch	-	Annular spaces
	IC-12s	South railway ditch	-	Annular spaces
	IC-18s	South railway ditch	-	Annular spaces
	IC-HXs	South railway ditch	-	Pressure test
LLSB	LLSB 1 – LLSB 10	South railway ditch	SS4b	Floor and subfloor/membrane drainage
MPSB	MPSB 1 – MPSB 3	South railway ditch	Catch basin manhole	Floor and subfloor/membrane drainage
Refurbishment Waste Storage	LLSB 11 – LLSB 14, SGSB 1[3], RCSB 1[4]	Stormwater management pond	SS6	Floor and subfloor/membrane drainage
TPMB	-	South railway ditch	-	Building sumps are monitored separately
WVRB	-	South railway ditch	-	Building sumps are monitored separately

[3] SGSB – Steam Generator Storage Building
[4] RCSB – Retube Component Storage Building

Structure Type	Number	Surface Sampling	Sub-Surface Sampling	Monitoring Details
Waste Sorting Building	-	TBD	TBD	-
UFDS area	-	Stormwater management pond	Stormwater management pond	-

Groundwater observation wells have also been installed around the WWMF site. These wells allow sampling of aquifers beneath the site to assess the influence of WWMF operations on groundwater quality as part of a routine groundwater monitoring program. Both the bedrock water and the middle-sand aquifer are monitored for tritium and gross beta-gamma activity.

2.2.6 Interfaces

A number of other licensed nuclear facilities are located on the Bruce Power site in the immediate vicinity of the WWMF. These include Bruce NGSs A and B (including the Central Maintenance and Laundry Facility, and the Central Storage Facility); RWOS1; and the Douglas Point Waste Management Facility. The Bruce Power Site also contains a number of technical and administration buildings. For more information on the Bruce Site, please refer to the Bruce Site PDP [R-8].

Interfaces exist between OPG operations and Bruce Power programs, structures and services. A detailed list of the OPG to Bruce Power interface documents and services relevant to the WWMF is provided in Appendix G. In summary, services provided by Bruce Power include:

- Security services
- Emergency response services
- Electricity
- Fire water and domestic water
- Sewage
- Storm water
- Traffic management
- Vehicle monitoring
- Facility access and working rights
- Public address system

When Bruce Power announces their intention to cease operation of Bruce A and B NGSs, provision of the necessary services to WWMF facilities following shutdown of the stations will be assessed and assured at that time.

This plan does not describe the decommissioning of any facility or structure on the Bruce Site that is outside of the boundary of the currently licensed WWMF area, such as the Bruce A and B Nuclear Generating Stations, the Central Maintenance and Laundry Facility, the Central Storage Facility, the Douglas Point Waste Management Facility, the Hydro One Switch Yard, etc. (see Figure 2-2). For more information on the Bruce Site, please refer to the Bruce Site PDP [R-8].

2.2.7 Low- and Intermediate-Level Waste Processing and Storage Facilities at the Western Waste Management Facility

The following buildings, structures and services comprise the L&ILW processing and storage facilities area.

- The WVRB.
- LLSBs: LLSBs 1 to 14 are now operational.
- Quadricells: 15 in total, with a capacity of 360 $m^{3.}$
- ICs: 20 IC-2s; 20 IC-12s; 306 IC18s. All of the ICs listed here are included in the scope of this PDP.
- In-Ground Heat Exchanger Containers (IC-HXs): forty-one (41) in total.
- Tile holes: 224 in total.
- Trenches: 15 in total.
- The TPMB.
- The SGSB.
- The RCSB.
- Amenities Building.
- MPSBs: MPSBs 1 to 3 are expected to be in service by 2022 and are included in the scope of this PDP.
- Waste Sorting Building.
- Storage areas: Equipment Storage Tent and Transport Work Equipment Storage Area.

There are no further developments planned for the LLSBs, trenches, tile holes, quadricells, IC-2s, IC-12s or IC-HXs.

Table 2-2 lists the L&ILW storage and processing facilities currently in place, and those expected to be in service by the end of 2027, along with a summary of their attributes.

Table 2-2: List of Structures and Buildings at the Low- and Intermediate-Level Waste Storage and Processing Facilities Area (Current and Planned to 2027)

Structure/Building		Capacity	In-Service Dates
Above-Ground Structure or Building			
LLSBs	LLSB 1	7,050 m^3	1982
	LLSB 2	7,050 m^3	1985
	LLSB 3	7,050 m^3	1988
	LLSB 4	7,050 m^3	1989
	LLSB 5	7,050 m^3	1989
	LLSB 6	7,050 m^3	1992
	LLSB 7	7,050 m^3	1999
	LLSB 8	7,050 m^3	2002
	LLSB 9	7,050 m^3	2004
	LLSB 10	7,050 m^3	2006
	LLSB 11	7,000 m^3	2009
	LLSB 12	7,000 m^3	2011
	LLSB 13	7,000 m^3 [(i)]	2013
	LLSB 14	7,000 m^3 [(i)]	2013
Quadricells	-	360 m^3	1978
SGSB	-	24 SGs	2007
RCSB	-	192 Containers [(ii)]	2007
MPSB	MPSB 1 to 3	6,500 m^3	2022
In-Ground Structures			
Trenches	TRH-3 to 6	2,080 m^3	1974
	TRH-7 to TRH-10	1,440 m^3	1976
	TRH-11 to TRH-17	2,350 m^3	1979
Tile Holes	80 Tile Holes	80 m^3	1974
	144 Tile Holes	144 m^3	1977
ICs			
IC-2 (20)	-	40 m^3	1985
IC-12 (20)	-	240 m^3	1987
IC-18 (8)	-	144 m^3	1989
IC-18 (32)	-	576 m^3	1990
IC-18 (54)	-	972 m^3	1993
IC-18 (50)	-	900 m^3	1998
IC-18 (54)	-	972 m^3	2002

Structure/Building		Capacity	In-Service Dates
IC-18 (54)	Batch #5	972 m^3	2013
IC-18 (54)	Batch #6	972 m^3	2022
IC-HXs	Phase 1	23	1991
	Phase 2	4	1993
	Phase 3	10	1996
	Phase 4	4	2001
Processing Facility			
WVRB	Original (iii)	-	1977
	Upgrades (iv)	-	2002
Radioactive Incinerator	Replacement (v)	-	2005
Box Compactor	Replacement (vi)	-	2010
Waste Sorting Building	-	1500 m^3	2022
Amenities			
Wing on WVRB	-	-	1977
Amenities Building	-	-	2001
TPMB	-	-	2004

i. As per 01098-DR-79135-00006 R000, Low Level Storage Building #13 to 16, Design Requirements.
ii. RCSB provides storage space for Retube Waste Containers. RCSB capacity will vary depending on the type of container. 192 represents the projected initial number of containers. Additional containers can still be stored.
iii. The WVRB has undergone major renovations in 2001 and 2002.
iv. The WVRB was placed back in normal operations in the second part of 2003.
v. The original radioactive incinerator operated from 1977 to 2001. The replacement incinerator has been processing waste since 2004 and is expected to be in service until 2032.
vi. The original B-400 waste box compactor was put in service in 1993 then taken out of service during the outage of the WVRB in 2001-2002. The B-1000 waste box compactor replaced the B-400 compactor in 2010. The compactor is expected to be in service until 2060, replaced in 2028 and again in 2046.

Waste processed and/or stored at the L&ILW facilities include the following:

- LLW: radioactive waste having a dose rate less than 10 mSv/h (1 rem/h) at 30 cm. The three general categories of LLW are incinerable, compactable and non-processible.
- ILW:
  - radioactive waste having a dose rate greater than or equal to 10 mSv/h (1 rem/h) at 30 cm
  - all alpha emitting waste that is not: used fuel, LLW or high thermal spent cobalt waste
  - all filters and ion exchange columns with long-lived radionuclides

- reactor core components
- bulk ion exchange resins

L&ILWs can be grouped as Type 1, 2 or 3, solid or liquid wastes based on their radiological, chemical and physical characteristics, as defined in Table 2-3. Handling liquid radioactive waste requires additional precautions and is largely limited to temporary storage of low activity hydraulic oils or similar liquids awaiting incineration.

Table 2-3: Parameters Defining Types 1, 2 and 3 Solid and Liquid Wastes

Type	Solid Waste Definition	Liquid Waste Definition
Type 1	Solid wastes with a contact dose rate less than or equal to 2 mSv/h, before any volume reduction process.	Liquid wastes with a beta/gamma activity concentration less than or equal to 3.7×10^8 Bq/m^3.
Type 2	Solid wastes with a contact dose rate less than or equal to 0.15 Sv/h but greater than 2 mSv/h (2-150 mSv/h), before any volume reduction process.	Liquid wastes with a beta/gamma activity concentration less than or equal to 3.7×10^{12} Bq/m^3 but greater than 3.7×10^8 Bq/m^3.
Type 3	Solid wastes with a contact dose rate greater than 0.15 Sv/h (150 mSv/h), before any volume reduction process.	Liquid wastes with a beta/gamma activity concentration greater than 3.7×10^{12} Bq/m^3.

2.2.7.1 Waste Volume Reduction Building

The WVRB (formerly the Waste Volume Reduction Facility or WVRF) supports the management of low-level radioactive wastes by providing facilities for waste receiving, handling, compaction, and incineration prior to storage.

The WVRB structure is fabricated from structural steel beams, columns and a poured concrete floor, bearing on reinforced concrete foundations, which rest on glacial till. The lower portion of the external walls is constructed of precast panels and the upper portion is frame covered by colored insulated metal sheeting. Main division walls are constructed of hollow concrete block, and shielding walls are constructed of 85 percent solid concrete block. Secondary division walls are light partitions of either steel or hollow concrete block. A picture of the WVRB is shown in Figure 2-4 and the layout of the building is shown in Figure 2-5. Figure 2-6 shows an isometric drawing of the radioactive waste compactor located in the WVRB.

The descriptions and functions of the various areas and systems of the WVRB can be found in Appendix A.

Figure 2-4: Waste Volume Reduction Building

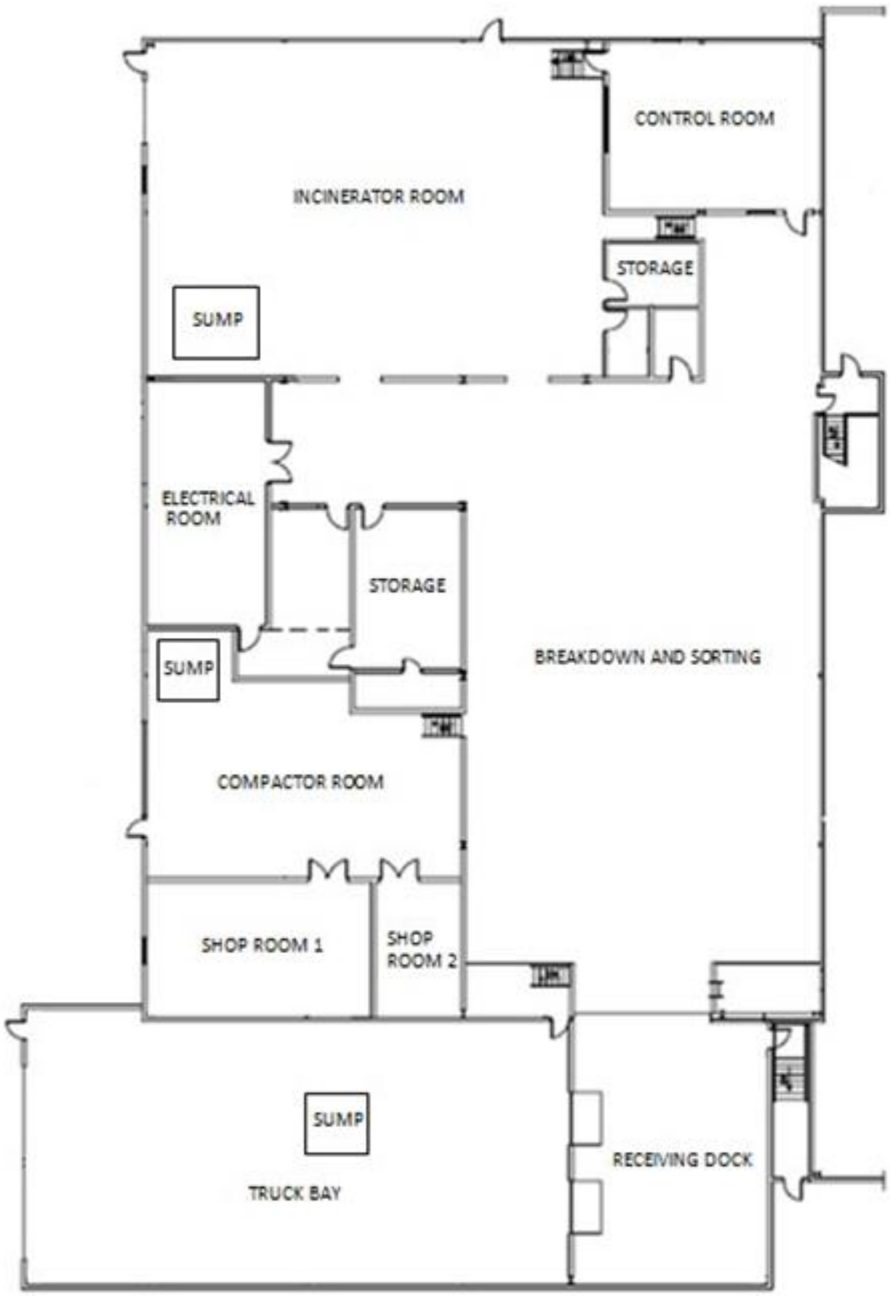
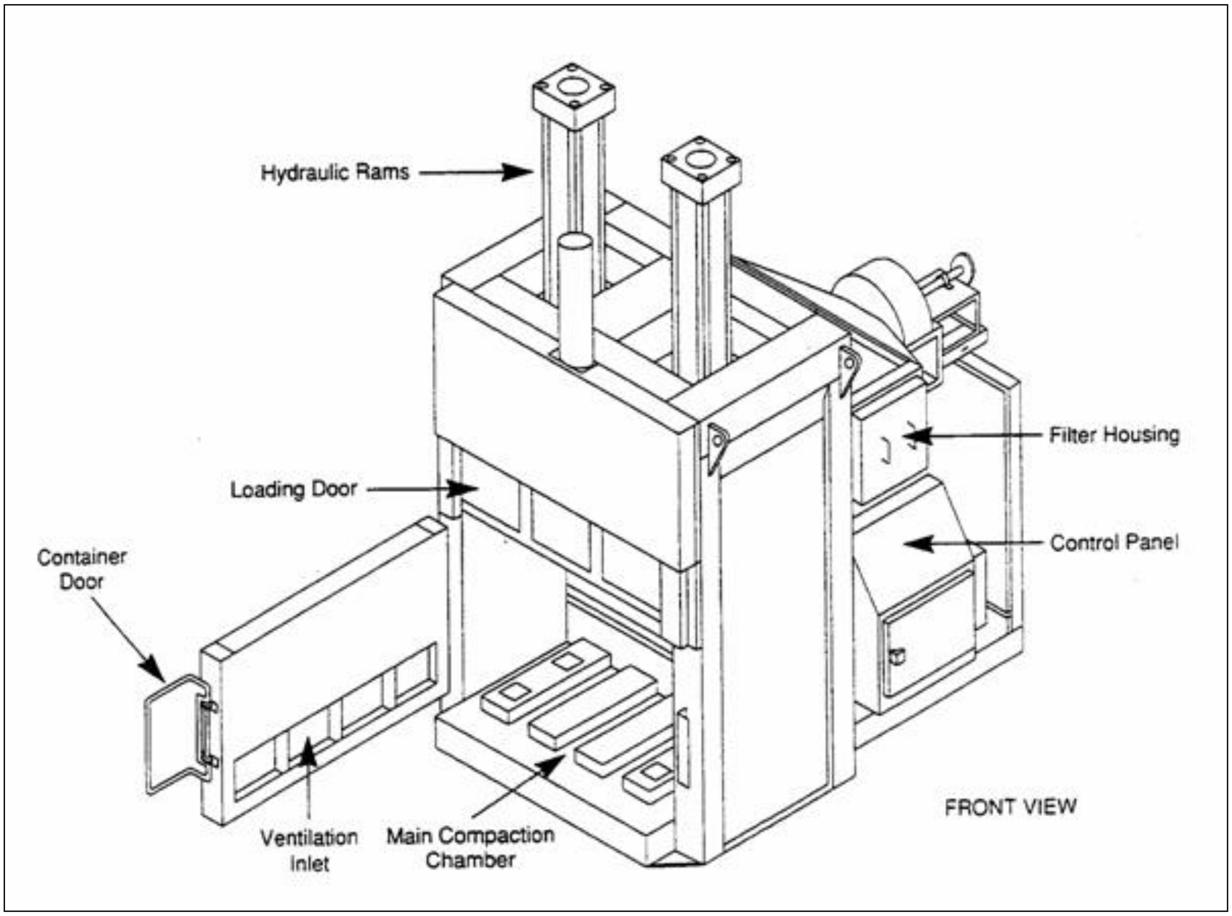


Figure 2-5: Layout of the Waste Volume Reduction Building



Note: image included for illustrative purpose only and does not necessarily represent the actual model currently installed.

Figure 2-6: Radioactive Waste Compactor

2.2.7.2 Transportation Package Maintenance Building

The TPMB consolidates many of the maintenance activities at WWMF into one location. For example, the maintenance, testing and inspection of radioactive material transport packages, and maintenance activities for L&ILW management equipment are carried out at the TPMB. The building houses two truck bays which allow for maintenance work on radioactive transportation packages, as well as control maintenance and mechanical maintenance workshops. The TPMB was placed in-service in 2004, with a building footprint of approximately 32 m x 30 m.

Descriptions of the areas and systems in the TPMB along with their functions can be found in Appendix B. A picture of the TPMB is shown in Figure 2-7.

Figure 2-7: The Transportation Package Maintenance Building

2.2.7.3 Amenities Building

The Amenities Building is approximately 1,200 m^2 (960 m^2 new construction; 240 m^2 renovation of the pre-existing structure), providing entry space, office space, locker and shower facilities, and lunchroom facilities for the WWMF. The Amenities Building includes the renovation of the smaller, original amenities facility attached to the WVRB.

The location of the Amenities Building on the WWMF site is shown in Figure 2-3. The Amenities Building currently services the L&ILW storage and processing and UFDS activities.

The office, cafeteria, and associated areas, designated as Zone 1, are heated and air conditioned by a central air handling system located in a Zone 1 mechanical room. Locker rooms and associated areas, designated as Zone 2, are heated and air conditioned by an independent air handling system located in a Zone 2 mechanical room. The Amenities Building includes a decontamination area with a sink, provided with a separate active drainage system. The active drainage from the decontamination area sink is discharged into the existing WVRB active drainage system.

2.2.7.4 Low-Level Storage Buildings

There are 14 LLSBs that provide storage capacity for LLW (see Figure 2-8). The waste stored in LLSBs typically comprises of Type 1 waste and some Type 2 waste (see Table 2-3). The buildings are constructed from prefabricated, pre-stressed concrete panels joined in an overlapping configuration to prevent radiation streaming between the panels. The superstructure consists of concrete roof support columns with prefabricated, pre-stressed concrete wall panels and a concrete roof. The LLSB floor is constructed of poured concrete. The approximate outside building dimensions are 50 m long by 30 m wide by 8 m high, thereby giving each building a nominal storage capacity of 7,000 m^3. The buildings are not heated but they are provided with services such as fire protection, ventilation, lighting and drainage.

A water collection system is provided to collect both floor and sub-floor drainage. Drainage lines are directed to the appropriate sump(s), which are in place to manage leakage from either inside the building, or leakage collected on the membrane below the floor. Periodic sampling of the sumps ensures that any contaminated water collected by the floor or leaking through the floor of the LLSB is detected. Water in the sumps is sampled and analyzed before it is taken for treatment and discharge as required. Sump effluent shown to be below acceptable activity levels is discharged to the site sewage system. Effluent exceeding acceptable levels is sent by tanker to the Bruce Power Active Liquid Waste Management System.

All radioactive wastes in an LLSB are packaged to minimize the spread of contamination and are stored in containers that are generally stackable. All units are placed to maximize storage space utilization.

Figure 2-8: Low-Level Storage Buildings

2.2.7.5 Quadricells

The above-ground quadricells (see Figure 2-9) provide storage for ILW – typically Type 3 wastes such as ion exchange resins (see Table 2-3). The quadricells entered service in October 1978. Fifteen (15) quadricells are placed “back-to-back” in a line to form an assembly that covers an area 6.2 m wide by 83.2 m long. Each of the quadricells has a total useful storage capacity of 24 m^3. The four, 6 m^3 cylindrical cells within a quadricell are each designed to store two bulk resin containers or equivalent packages.

Each cell consists of a retrievable cylinder fabricated from a precast reinforced concrete shell with an integral bottom. The inner surface of the concrete shell is finished with a protective coating. A layer of bentonite clay in the bottom of the cell will absorb any free liquid that escapes from the resin container. A separate concrete shielding lid is attached to the cell by four anchor bolts. The internal view of a typical quadricell can be seen in Figure 2-10.

The quadricells are full and sealed shut, with no plans to build further cells in the future. The four cells are contained within a cubic, reinforced concrete structure that has a floor and a concrete cap. The quadricells are built on a reinforced concrete pad poured on compacted foundation material.

Figure 2-9: Quadricell Assembly

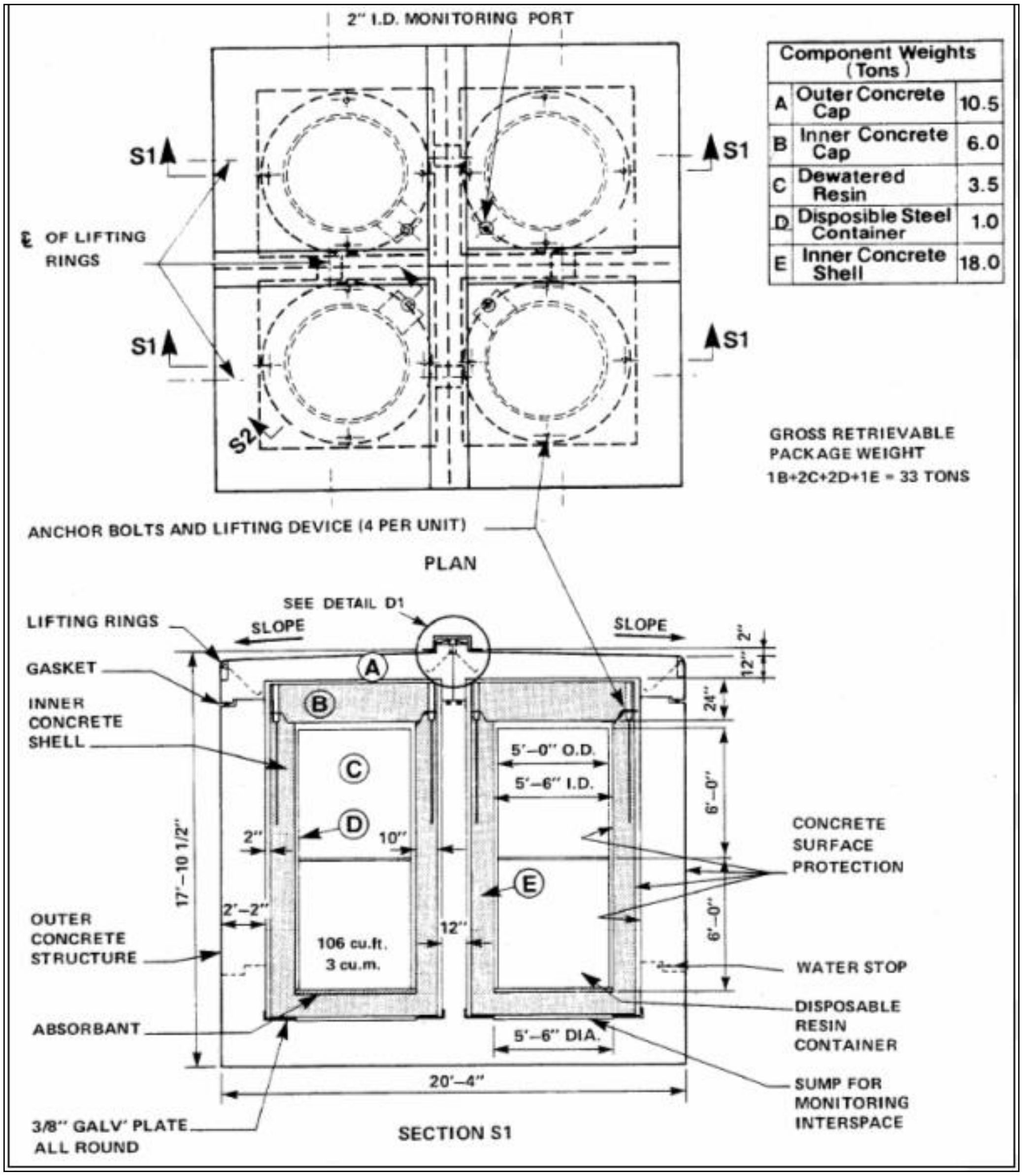


Figure 2-10: Internal View of a Quadricell

2.2.7.6 In-Ground Containers (IC-2, IC-12 and IC-18)

The ICs are designed to store ILW (Type 2 and 3 wastes – see Table 2-3). They have a minimum design life of 50 years. The IC design utilizes the natural shielding provided by the surrounding till. The possibility of radioactive material entering the environment is minimized by the provision of two steel barriers separated by a monitored annulus space as shown in Figure 2-11. The diameter and depth of the ICs can be altered to suit any special waste storage needs. There are three standard sizes with storage capacities of 2 m^3, 12 m^3 and 18 m^3.

Twenty (20) 2 m^3 ICs (IC-2s) entered service in December 1985. The IC-2s are cylindrical structures possessing an inner and outer liner; both constructed from welded carbon steel pipe. The liners are placed in a cylindrical hole made by vertical auguring of the soil. The annular space between the augured hole and outer liner is backfilled with a concrete material that encases the liner. There is an interspace between the inner retrievable liner and the outer fixed liner. This interspace between the inner and outer liner is provided for routine water detection and dose rate monitoring as required.

A monitoring pipe is attached to the inner liner and runs to the bottom of the annulus space between the two liners. It is connected to a leak tight pipe plug on the cover plate to allow for water detection and removal. After loading, the inner liner is backfilled with concrete. This concrete serves as permanent shielding for the waste components. After filling with concrete, the cover plate is installed. The inner liner is provided with lifting lugs to make the monolithic assembly fully retrievable. When the wastes have decayed, the monolithic structure can be lifted out and a new inner liner can be inserted. The outer liner is fitted with a welded flange to permit a steel cover plate to be bolted to the container.

Twenty (20) 12 m^3 ICs (IC-12s) that entered service in March 1987 were intended to be replacements for the quadricells. The IC-12s are cylindrical structures. The IC-12 liner is constructed from spiral-welded carbon steel pipe. The inside of the liner is coated with a coal-tar epoxy to prevent corrosion. The liner is leak tested before it is placed in a hole, augured into the ground. Any space remaining between the wall of the hole and the liner is filled with a concrete material that encases the liner. The liner is fitted with a welded flange to permit a steel cover plate to be bolted to the container. A sampling pipe is placed in the concrete encasing to provide access to the space between the waste containers and the liner for periodic sampling. If water is detected the pipe can be used for its removal. Containers of waste are placed directly into the IC-12 liner. After the waste is loaded, a shielding plug is inserted inside the liner and the cover plate is bolted in place. The waste containers may be retrieved and placed in over-packs and inserted back into the IC-12 if they do not meet the 50-year design lifetime requirement. To date, no such liners have been installed.

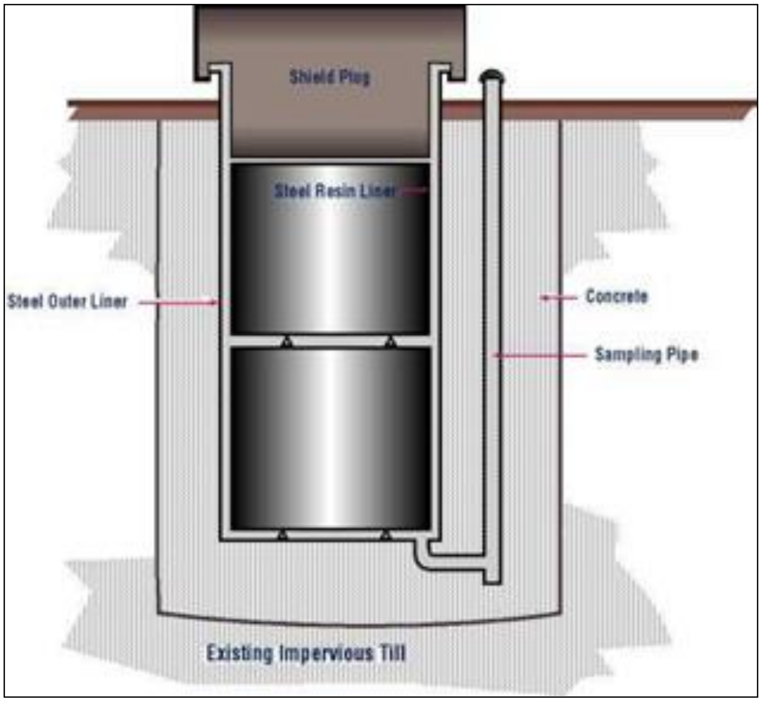


Figure 2-11: Typical Cross Section of an In-Ground Container

There are currently 252, 18 m^3 ICs (IC-18s) in service at the WWMF. OPG is building 54 additional IC-18s, designated Batch #6, that are expected to be in service by the end of 2022. It is expected that another 54 IC-18s (Batch #7) will be build by the end of this financial guarantee period. Only these 360 IC-18s are included in the scope of this plan.

The IC-18s are similar in design to the IC-12s except that they are deeper. Containers of waste are placed directly into the IC-18 liner. The waste containers may be retrieved, placed in over-packs, and inserted back into the IC-18 if they do not meet the 50-year design lifetime requirement. Once the waste has been placed into the container a concrete cover is placed over the container opening to provide radiation shielding and weather protection, see Figure 2-11 and Figure 2-12. Additional shielding can be placed over the top of the waste in the container if required.

Some IC-18 containers hold Tile Hole Equivalent Liners (THELs), which are being used as replacements for the original concrete tile holes for storage of ILW. THELs are smaller in diameter than the IC-18, and seven THELs are used to subdivide an IC-18 into storage cells using an array of pipe inserts. All empty THELs are expected to be left in place awaiting decommissioning and are the only exception to the assumption that all operational waste will be removed from the site prior to decommissioning. At the time of WWMF decommissioning 349 THELs are expected to be present in IC-18s.

The ICs will be removed during decommissioning. There is potential for some of these containers to have degraded over time. It is therefore necessary to develop a strategy to manage such conditions to minimize the risk of contamination escaping and entering the local environment. This strategy will be generated as part of the DDP, and will reflect data provided from the environmental samples taken from the sampling pipes of each container. Similar approaches will be required for other in-ground structures such as trenches and in-ground heat exchangers.

Figure 2-12: Cover Plates and Shield Plugs of IC-18 In-Ground Containers

2.2.7.7 In-Ground Heat Exchanger Containers

In the past, IC-HXs have provided storage for scrap radioactive heat exchanger tube bundles from the moderator, primary heat transport and auxiliary systems from OPG nuclear stations. Used heat exchangers are no longer stored in these containers; instead, they are stored in LLSBs.

Prior to acceptance at WWMF, the stored heat exchangers were dewatered, seal-welded and leak tested. The stored scrap heat exchanger tube bundles were enclosed in containers that have a minimum design lifetime of 50 years. Some of these containers are the actual in-service heat exchanger shells; some others are new shipping containers. Devices are attached to the containers to permit subsequent pressure testing. The container is pressure tested prior to burial to verify leak tightness. The outer surfaces of all containers are coated with epoxy for corrosion resistance.

The heat exchangers form their own waste containers and there are 41 heat exchangers currently stored in augured holes. The augured holes vary in depth up to 10.7 m and in diameter up to 3.7 m in order to suit the various sized containers. A layer of well-graded loose limestone is placed in the bottom of the hole. The container is placed on top of the limestone. Once the container is leveled, the hole is backfilled with crushed limestone. Depending on the package size, more than one scrap radioactive heat exchanger tube bundle can be stored in a single IC-HX. The filled hole is capped with a 102 mm thick asphalt cover (see Figure 2-13). The IC-HX containers will be removed during waste retrieval, prior to decommissioning.

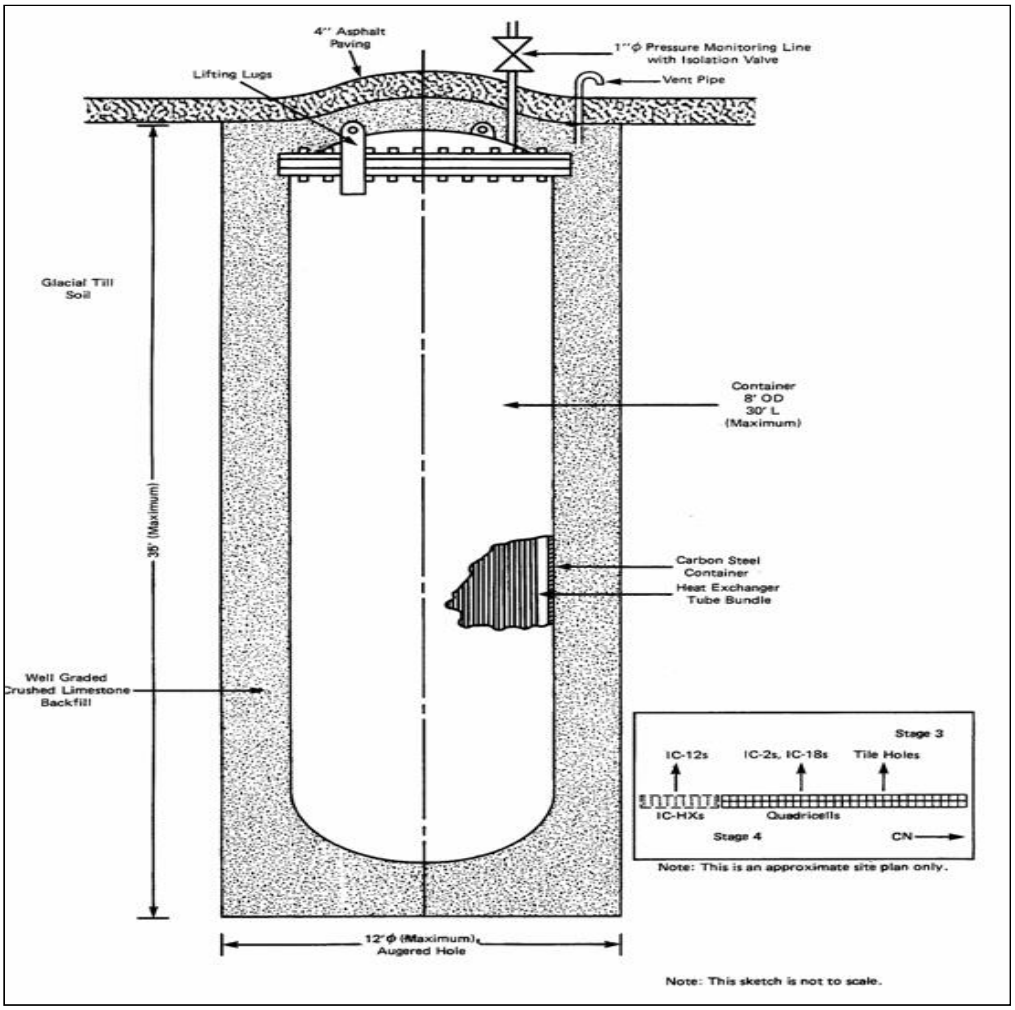


Figure 2-13: A Typical IC-HX Arrangement

2.2.7.8 Tile Holes

Tile holes are an early-1970s design for the storage of Type 3 ILW (see Table 2-3). There are a total of 224 tile holes of two slightly different designs on the WWMF site. Type 3 wastes are now stored in THEL IC-18s. There are no plans to build further tile holes, however, occasionally tile hole space is required to store wastes too large for the THEL IC-18s. When this becomes necessary the tile hole liner is moved to a trench or LLSB/MPSB and an existing tile hole is reused.

Eighty (80) tile holes entered service in March 1974, each of which has a capacity of 1 m^3. These tile holes stand upright on a reinforced concrete base slab (see Figure 2-14(a)). They are 3.5 m high and constructed from standard precast 0.61 m inner diameter concrete pipe. The outside of the tile holes was waterproofed with emulsified asphalt. A 500 mm inner diameter steel cage with lifting lugs was installed in all of the existing tile holes to provide retrievability. A layer of concrete was poured into the bottom of each tile hole to anchor the retrieval cage. After the waste was put in place, the tile holes were filled with concrete to form a monolithic structure. The completed structure was covered with a galvanized steel lid to prevent ingress of water.

Over time, 37 of the tile holes were retrofitted with steel liners, as leakage to the surrounding soil was suspected. The retrieval cage that had already been installed was removed to allow installation of the liner. In these tile holes the liner and contents form a removable monolithic block. In response to a recognized potential for leaks to occur, a precautionary localized site investigation around the affected tile holes will need to be undertaken to establish the nature and extent of any contamination present. More importantly, the sampling data will confirm any need for remedial activity, and contribute to the development of an optimized approach. Such a sampling regime reflects best practice, as it takes a precautionary approach in identifying and managing any potential contamination issues. It is therefore envisaged that this approach will be applied to other sites to ensure that it can be confirmed with a known degree of confidence that the site is free from significant levels of residual contamination. Data produced from these sampling plans are expected to support future applications for release of the site from regulatory control. This is particularly relevant if the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) approach is utilized. By using an approach such as MARSSIM to develop a sampling plan, subsequent results will be statistically robust and capable of demonstrating compliance with any dose or risk-based assessments as part of an application release from regulatory control. Plans will be developed in line with the DDP.

One hundred and forty-four (144) tile holes entered service in June 1977. These tile holes (see Figure 2-14(b)) are precast reinforced concrete units having one integrally-cast end. Lifting lugs are engineered into the upper end of each tile hole. The tile holes have an internal diameter of 69 cm and a depth of 3.5 m. The precast units were coated with emulsified asphalt and placed on a reinforced concrete base. All of the 1977 tile holes were fitted with retrievable steel liners fabricated with a welded end plate. The liner has a coal tar epoxy exterior finish. It rests on steel spacer pads on the bottom of the tile hole.

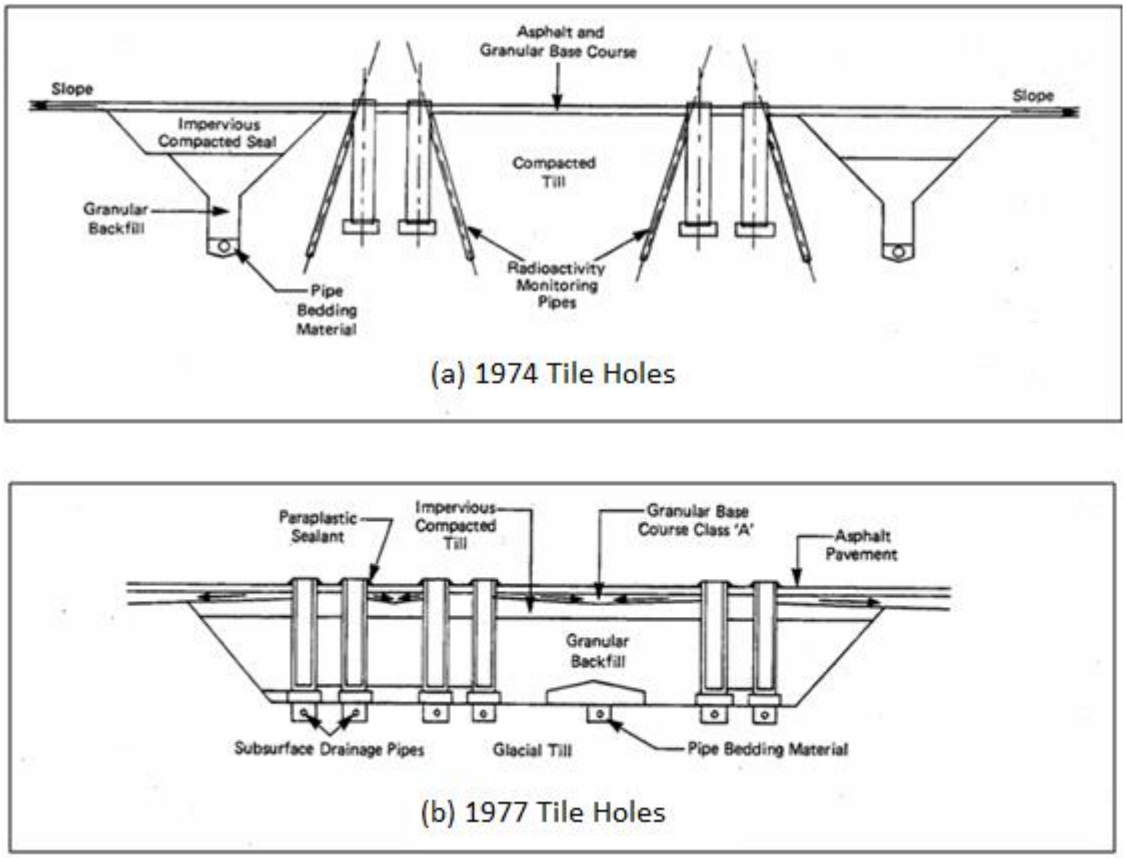


Figure 2-14: Typical Tile Hole Arrangements

2.2.7.9 Trenches

There are two types of trenches: a narrow-type and a wide-type. The narrow trenches are 40.26 m long, by 3.81 m wide and 3.05 m deep. The wide trenches are 38.35 m long by 6.86 m wide and 3.05 m deep. Both narrow and wide trenches are designed to provide storage for Type 1 and 2 wastes (see Table 2-3). Most Type 1 and 2 wastes are currently being stored in other structures, such as LLSBs or IC-18s. Trenches are now used mostly for non-routine waste, such as old shielding flasks, or Type 2 wastes above the LLSB dose rate limit. When necessary, trench waste can be removed and placed in LLSBs to free up trench space. There are no plans to build new trenches.

There are two widths of trenches, wide and narrow. There are currently two wide trenches (TRH-5 and TRH-6), divided into 6 sections. The wide trenches entered service in December 1974 for the storage of all Type 1 and Type 2 waste. They are also used to store older waste (20-30 years) held in carbon steel drums. Some drums contain incinerator ash, compacted LLW and non-processible LLW. A small percentage of the carbon steel drums contain ILW or hot particles. There is approximately 1,000 m^3 of non-processible LLW contained within polyethylene bags (which show no sign of deterioration). Cardboard and plywood boxes have also been used within the trenches to contain non-processible LLW. There are approximately 55 of these boxes in total.

There is also a total of 13 narrow trenches in service. The first pair (TRH-3 and TRH-4) entered service in December 1974, the next four (TRH-7 through TRH-10) entered service in March 1976 and the latest seven (TRH-11 through TRH-17) entered service in May 1979. They are divided into 3 sections. The narrow trenches provide adequate versatility for waste storage and have certain advantages over the wider trenches. Some of these are: easier handling and placement of wastes; easier handling of trench covers due to their smaller size; and better control of precipitation ingress due to a smaller area of trench being uncovered during the loading operations. Trenches are shown in Figure 2-15 and Figure 2-16.

Figure 2-15: Trenches

Both types of trenches are constructed of concrete. The exterior of the walls and the joints were waterproofed with emulsified asphalt before the excavation was backfilled. The joint between the concrete wall and the surrounding asphalt is periodically re-caulked with a sealant.

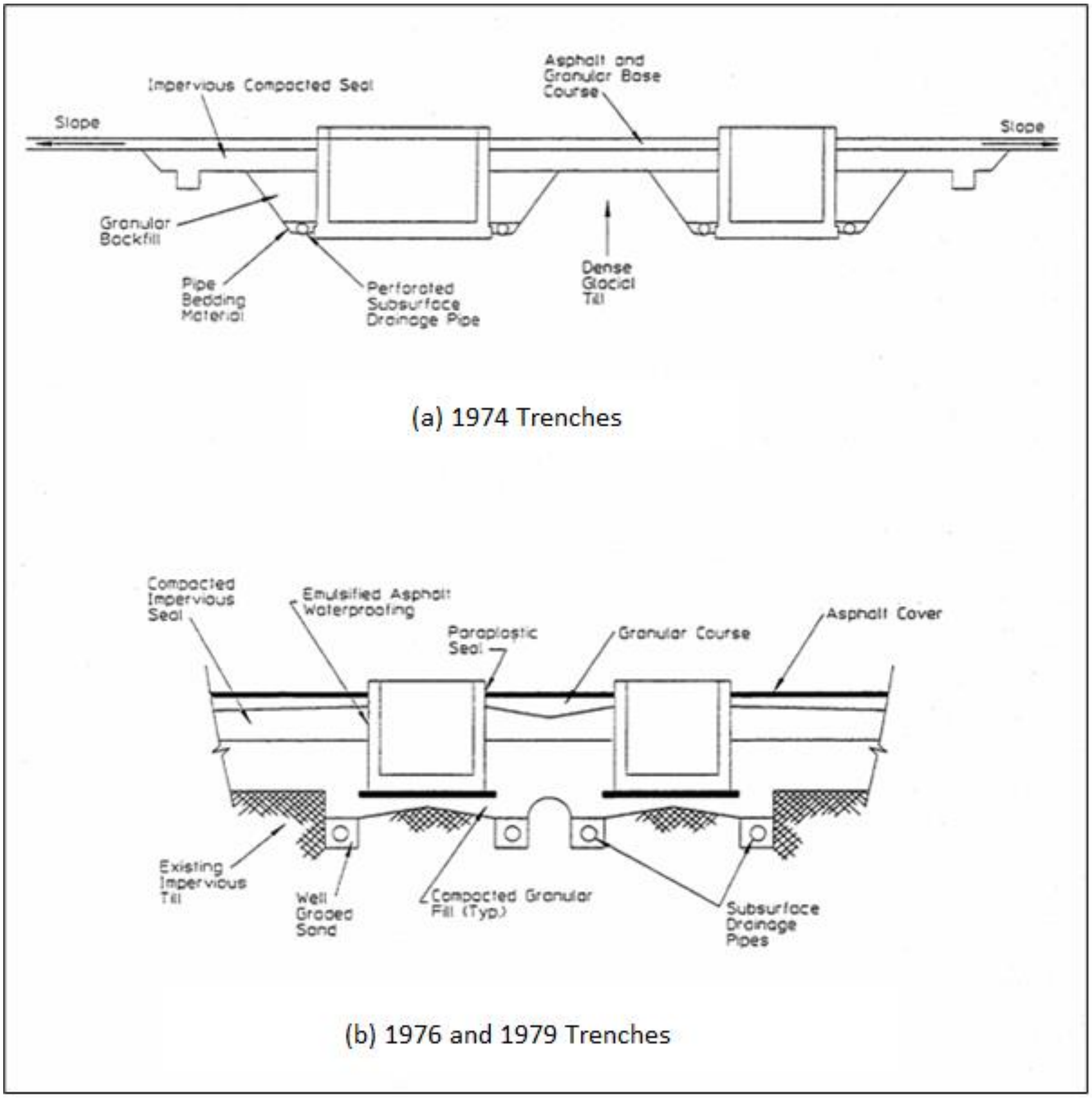


Figure 2-16: Typical Trench Arrangements

2.2.7.10 Steam Generator Storage Building

The SGSB went into service in January 2007, providing storage space for up to 32 used steam generators (the original steam generators from Bruce Nuclear reactor units 1 and 2 and Major Component Replacement (MCR) projects in units 6 and 3) and similar wastes from steam generator replacement of Bruce reactor units. Sealed steam generators are stored in the SGSB, which is identical in design to the RCSB. The SGSB is adjacent to the RCSB and the two buildings share a common wall.

The SGSB structural design utilizes prefabricated, pre-stressed concrete panels. The superstructure consists of concrete roof support columns with 360 mm thick prefabricated concrete walls and a 100 mm concrete roof. The concrete wall panels are joined in an overlapping configuration to prevent radiation streaming between the panels. The SGSB floor is poured concrete. The approximate dimensions the SGSB are 44 m long by 33.4 m wide by 8 m high for the main part of the building.

The building is provided with services such as lighting, drainage, public address and telephone communication for emergency and operating communication. Ventilation is provided for vehicle exhausts. A waterproof membrane barrier is provided beneath the structure to permit collection and sampling of moisture passing through the floor slab. An internal drainage system with monitoring capability is provided to collect and allow for monitoring of any free water associated with the building. In addition, an external sub-surface drainage system is provided around the building foundations.

The sub-surface drainage system drains through the SS6 sample location prior to discharge to a stormwater management pond along the east side of the WWMF.

Steam generators are expected to be free from any external contamination but may have some elevated radiation fields present on the exterior. Some other types of non-processible waste may also be stored in SGSBs. The layout of the SGSB is shown in Figure 2-17, and the SGSB floor plan is shown in Figure 2-18.

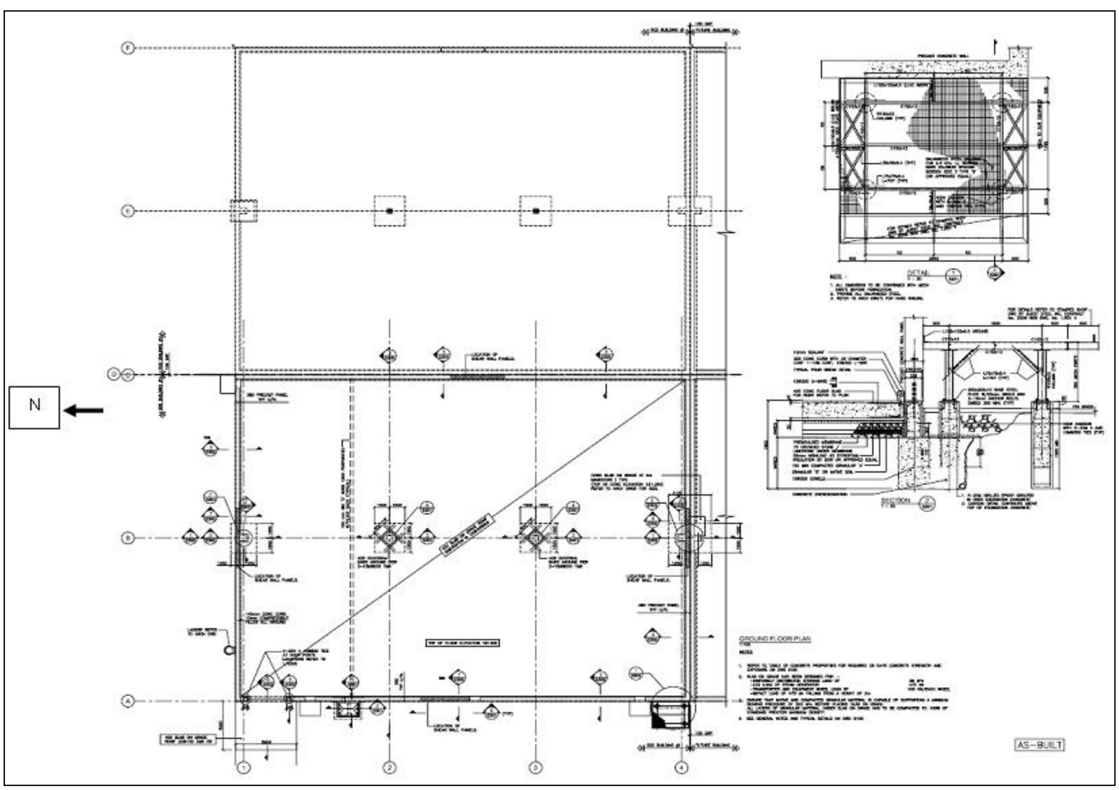


Figure 2-17: Layout of the Steam Generator Storage Building

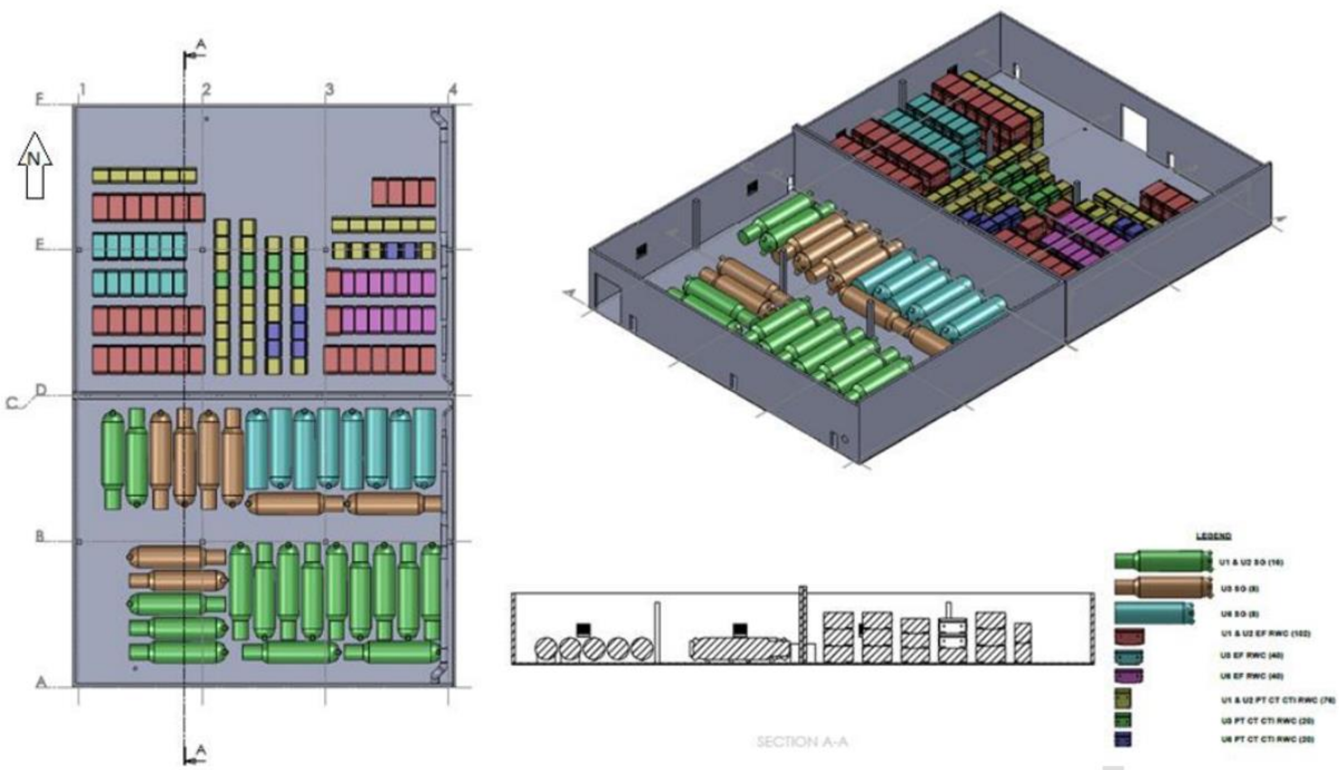


Figure 2-18: Floor Plan of the Steam Generator Storage Building

2.2.7.11 Retube Component Storage Building

The RCSB[5] went into service in 2006, and provides storage capacity for retube component waste containers from the refurbishment of Bruce A reactor units 1 and 2, MCR for units 3 and 6. Retube components are stored using 'disposal ready' concrete and stainless steel lined containers. The design, construction materials and expected radioactive source term of Retube Waste Container (RWC) contents are significantly different for MCR RWCs and units 1 and 2 RWCs. Unit 1 and 2 RWCs are made of stainless steel encased concrete and are welded closed. The MCR RWCs are made entirely of carbon steel and each container is closed with a lid, and secured by screws with an elastomeric seal. A picture of an MCR RWC is shown in Figure 2-19. MCR RWCs are considered safety-related equipment [R-9].

[5] This building is also interchangeably referred to as the Retube Waste Storage Building (RWSB).

Figure 2-19: Photograph of a Major Component Replacement Retube Waste Container

The RCSB currently stores 178 RWCs from Bruce Nuclear units 1 and 2. The existing RWCs will be rearranged to accommodate the storage of 120 additional RWCs from MCR for units 3 and 6. This is sufficient capacity for the volume of refurbishment waste resulting from the completion of retube campaigns at Bruce A units 1 and 2 and MCR at units 3 and 6 [R-10]. Some other types of non-processible waste may also be stored in RCSBs.

The RCSB structural design utilizes prefabricated, pre-stressed concrete panels similar to the LLSBs. The superstructure consists of concrete roof support columns with 360 mm thick prefabricated concrete walls and a 100 mm concrete roof. The concrete wall panels are joined in an overlapping configuration to prevent radiation streaming between the panels. The RCSB floor is poured concrete. The approximate dimensions of the main part of the building are 44 m long by 33.4 m wide by 6.3 m high. Internal and external fixed lighting is provided.

The building is also provided with services such as ventilation, communications and drainage. Ventilation is provided for vehicle exhausts. Public address and telephone systems are available for use during operation and emergencies. A waterproof membrane barrier is provided beneath the structure to permit collection and sampling of moisture passing through the floor slab. An internal drainage system with monitoring provision sufficient to assay any free water associated with the building is available. In addition, an external sub-surface drainage system is provided around the building foundations. This drains through sample location SS6 prior to discharge to a stormwater management pond along the east side of the WWMF.

A layout of the RCSB is shown in Figure 2-20.

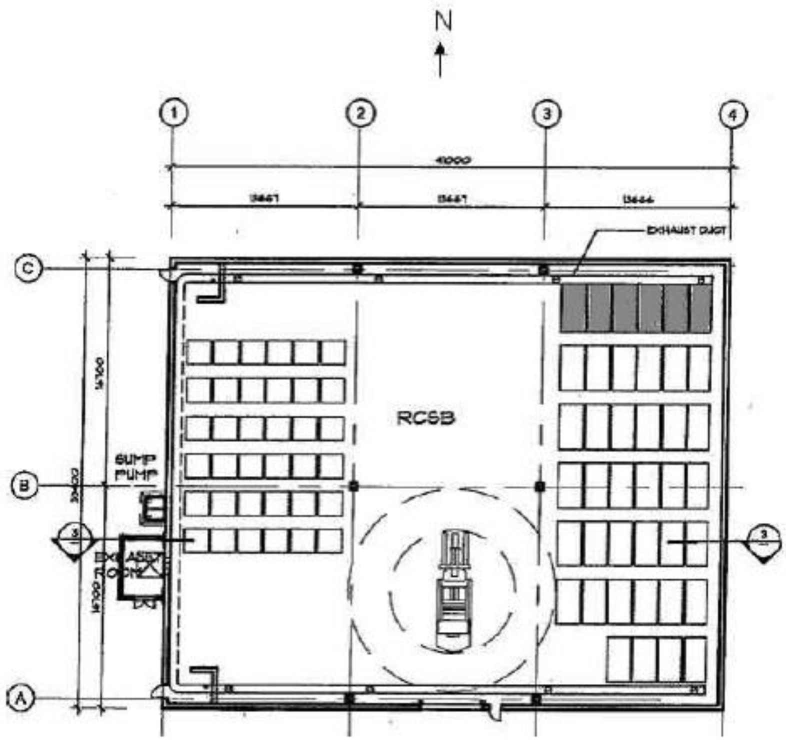


Figure 2-20: Layout of the Retube Component Storage Building

2.2.7.12 Waste Sorting Building

The Waste Sorting Building is currently under development, with an expected in-service date of 2022. The building footprint is approximately 45 m by 42 m and will be located immediately north of the WVRB, west of the TPMB. The building will comprise, but will not be limited to, three sorting stations, a staging area for bins and lids, loading bays, and a forklift door/ramp. The building will include a super-compaction system, as well as over-packing and grouting systems to process both historic stored wastes and new non-incinerable wastes.

2.2.7.13 Multi Purpose Storage Building

Three MPSBs are expected to be in service by 2022. MPSBs are each designed to provide a minimum of 7000 m^3 of safe storage of combustible and non-combustible L&ILW. The storage space will be similar to the existing LLSBs, RCSB and SGSB with physical dimensions of approximately 44.05 m long, 33.40 m wide and minimum clear ceiling heights of 6.3 m. MPSB walls, roof and structural beams will be made of precast concrete. The MPSB floor will be reinforced concrete slab. Active floor drains throughout the MPSBs will be connected to the active drainage system. Any collected liquid inside of the MPSBs will be drained to an external sump pit through the active drainage system.

2.2.7.14 Storage Areas

A Transport and Work Equipment Shelter with electrical outlets is provided along the north side of LLSB 9. This provides weather protection and plug-ins for vehicles such as cranes, tractors and trucks used on site.

2.2.8 Western Used Fuel Dry Storage Facilities

The WUFDSF provides storage space for used fuel generated by Bruce Power nuclear reactors. As of the end of 2020, there were 1678 DSCs (644,352 used fuel bundles) in storage at the WUFDSF.

The WUFDSF is located within the boundaries of the WWMF site and currently consists of a DSC Processing Building and four DSC Storage Buildings (DSBs). A picture of the WUFDSF area is shown in Figure 2-21, with the DSC Processing Building on the left and DSBs on the right. Detailed descriptions and functions of the areas, systems, and components of the used fuel dry storage facilities area are provided in Appendix C.

The used fuel dry storage facilities area was placed in service in October 2002 and received the first DSC from Bruce Power in February 2003. A second dry storage building was added in 2007 with two new storage buildings (DSB 3 & 4) added in 2012. DSBs 5 and 6 are expected to go into service in 2021, providing an additional approximately 11,000 m^2 of storage space. Table 2-4 below lists the above facilities and summarizes their attributes.

Table 2-4: List of Structures and Buildings at the Western Used Fuel Dry Storage Facilities Area (Current and Planned)

Structure/Building	Building Number	Capacity	In-Service Dates
DSC Processing Building	N/A	~25 DSCs[1]	2002
DSB	1	500 DSCs each, 384 used fuel bundles per DSC	2002
DSB	2		2007
DSB	3		2012
DSB	4		2012
DSB	5		2021
DSB	6		2021

[1] There is no licence limit on the capacity of the DSC Processing Building

Figure 2-21: Western Used Fuel Dry Storage Facility Area

2.2.8.1 Dry Storage Container Processing Building

The DSC Processing Building is an industrial type building made of concrete block walls with metal cladding exterior. It is equipped to: receive, inspect and prepare new DSCs before they are transferred to the station to be loaded with fuel; to seal weld, leak test and inspect DSCs after they are loaded with used fuel at Bruce A or Bruce B and before being transferred to the Storage Building.

The 15 m high DSC Processing Building has two stories. The ground floor accommodates the DSC processing area, active ventilation and electrical rooms, and maintenance area including tool room and stores. In addition, washrooms and a designated coffee area are also provided on the ground floor. Office space, washrooms, and a janitor's room are provided on the mezzanine level. An x-ray system was previously located on the mezzanine level, and has since been replaced by a Phased Array Ultrasonic Testing system. The mezzanine permits a view of the DSC processing area on the ground floor.

Used fuel from the Bruce A or Bruce B irradiated fuel bays is loaded into DSCs underwater. The exterior surfaces of DSCs are decontaminated and then the loaded DSCs are transported to the DSC Processing Building where they are prepared for long-term storage. DSC processing involves lid closure by welding, weld inspection, drying, inert gas fill and helium leak testing prior to transport to the Storage Building. No loose contamination is permitted either on the exterior surfaces of DSCs, or on accessible surfaces such as floors in the DSC Processing Building. Spot decontamination operations, which may be carried out in the DSC Processing Building, are not expected to generate liquids.

Figure 2-22 shows the floor plan of the DSC Processing Building.

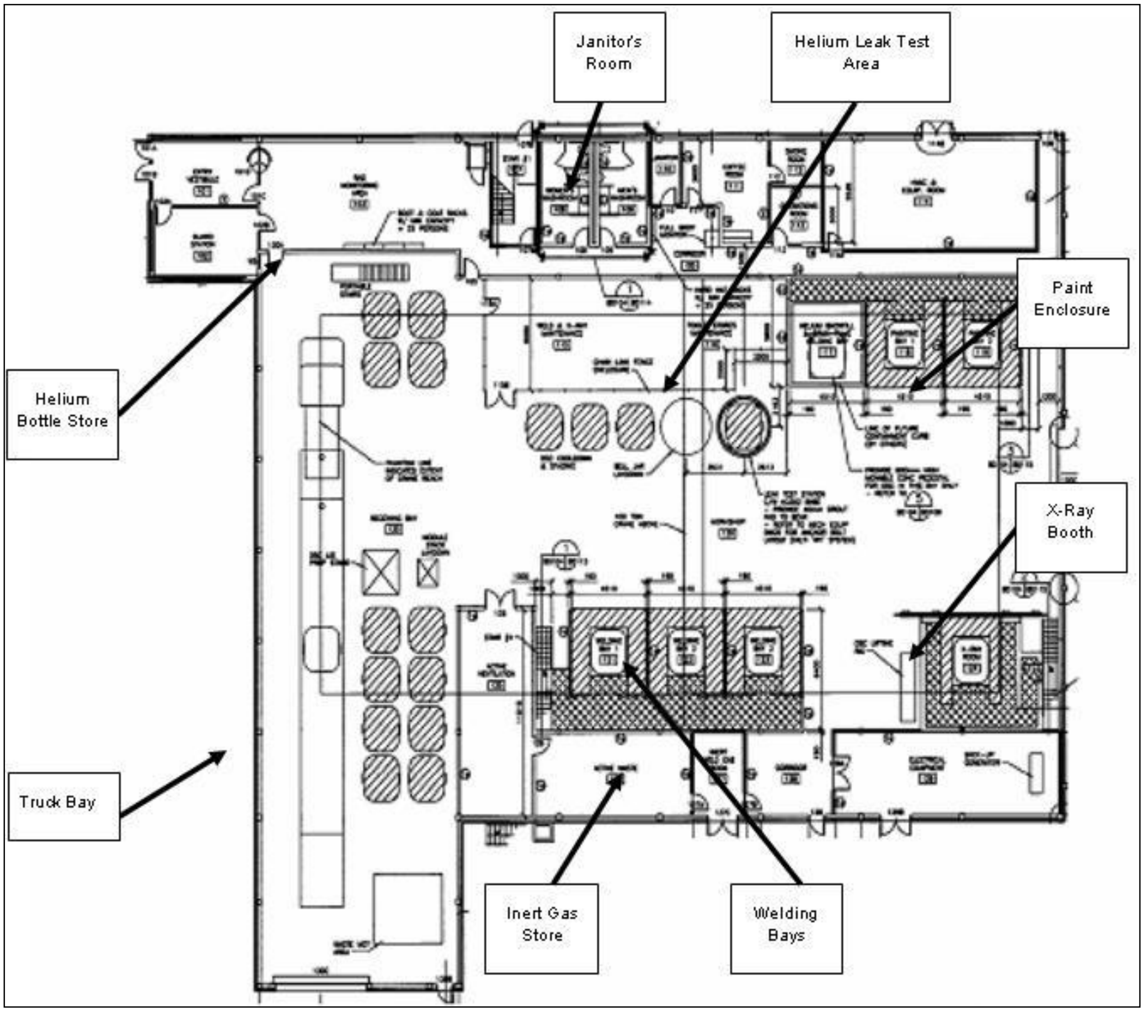


Figure 2-22: Layout of the Dry Storage Container Processing Building

2.2.8.2 Dry Storage Container Storage Building

There are currently 4 DSBs, with two more expected to go into service in 2021 and adequate space for up to 10 buildings. Construction of DSBs will be staged as additional storage space is required to ensure that the expected requirements for future storage are met.

Each Storage Building has an area of approximately 5,278 m^2, and a nominal storage capacity of 500 DSCs. This nominal figure takes into account that not all space will be used for DSC storage. For example, some space will be used for general (non-DSC) storage. Given these additional space requirements, it is expected that the total storage capacity is more likely to be 465 DSCs each.

The DSB walls consist of 0.20 m thick precast concrete panels from ground level to a 4.2 m height. Vertical louvers and metal cladding are installed at upper wall elevations. The reinforced concrete floor slabs are designed to accommodate heavy wheel load traffic and the weight of the loaded DSCs. The floors are constructed for long service to retain surface alignment and provide a hard, smooth and durable surface. Although liquids are not normally used in the DSBs, floors are graded to provide drainage to floor drains. The DSC storage arrangement inside a DSB is shown in Figure 2-23.

Figure 2-23: Inside a Dry Storage Container Storage Building

2.2.8.3 Dry Storage Containers

DSCs are large, free-standing, reinforced concrete containers, with an inner steel liner and an outer steel shell, for the storage and on-site transfer of used CANadian Deuterium Uranium (CANDU) nuclear fuel. An internal view of a DSC is provided in Figure 2-24. DSCs will be removed from the storage areas prior to the start of decommissioning.

The DSCs are subject to routine inspections by OPG staff. These inspections are valuable, as they facilitate the early identification of signs of container degradation, which could develop into a pathway for contaminants to escape into the local environment. If corrosion is observed, the affected area is cleaned up and recoated with the specified touch-up paint or repaired as required [R-7].

As of the end of 2020, a total of 1678 DSCs have been successfully and safely stored at the DSC storage facility. At facility end of life, this figure is expected increase to 4,181 DSCs in a total of 10 DSBs.

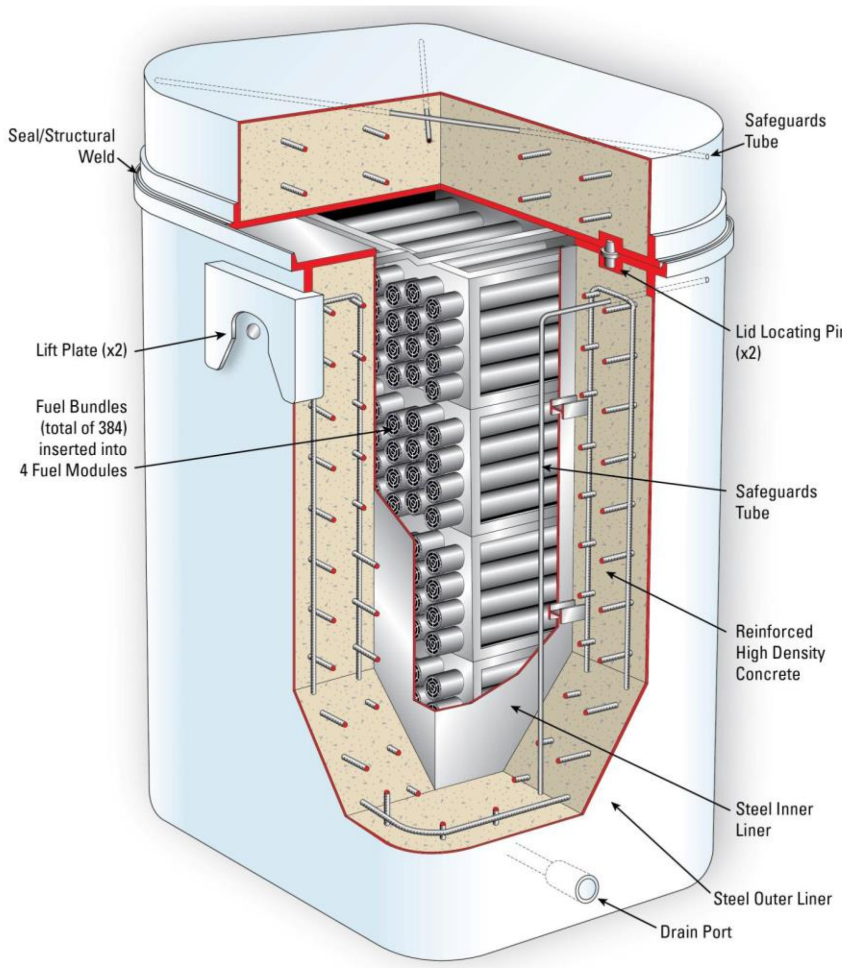


Figure 2-24: Internal View of a Dry Storage Container

2.2.9 Building Components – Hazardous Materials

No hazardous materials have been used as building materials at the WWMF.

2.2.10 Hazardous Materials Stored in the Western Waste Management Facility

Certain hazardous materials, other than radioactive waste are used in the WVRB, TPMB and the DSC Processing Building. A summarized list includes:

- Compressed gas – for the incinerator, radiation monitors and welding operations;
- Chemicals (such as abrasives, solvents, lubricants, adhesives, welding rods and paints) - for general maintenance activities; and
- Janitorial supplies – for cleaning WWMF facilities.

Further detail on the types of hazardous material, their quantities and storage locations is provided in Appendix D.

2.3 Description of the Environment

2.3.1 Natural Environment

The topography in the area of the Bruce Power site is classified as smooth to gently undulating. The land rises gradually from the lake water level (176.4 m) to an elevation of about 195 m above mean sea level approximately 3.2 km inland. Beyond that point, the ground rises steeply to about 221 m above mean sea level and then more slowly to about 244 m above mean sea level over the next 3.2 km [R-11].

Lake Huron is the major water body near the Bruce Power site. Although there are extensive networks of small rivers and creeks feeding into Lake Huron in the region, there are no major rivers near the site. There are two small drainage courses running east to west adjacent to the Bruce Power site. Underwood Creek empties into the Baie du Doré north of the site and the Little Sauble River empties into Inverhuron Bay south of the site. Historic land use changes redirected a former tributary of the Little Sauble River, named Stream C, through the Bruce site to drain into the southwest corner of Baie du Doré [R-7]. Runoff from the WWMF drains into ditches that lead into a wetland east of the site and, eventually to Stream C. Stream C provides important fish and mammal habitat and flows all year-long. Surveys of Stream C, taken since 2017, demonstrate high water quality and fish habitat in the stream [R-12]. The drainage ditch downstream of the wetlands on the eastern part of the site and Stream C has been declared a fish habitat by the Department of Fisheries and Oceans. Baie du Doré is a spawning ground for some species of fish and is deemed a ‘provincially significant wetland’.

There is a narrow strip of beach shingles and sand along the shore of Lake Huron. Beyond this strip, the land is considered poorly drained bog plain due to the flatness of the land and the lack of any surface drainage system.

The operating area of the WWMF site is highly developed with most of the non-building area covered in asphalt. The following descriptions of the natural environment generally refer to the undeveloped parts of the WWMF site, the downstream drainage area and other areas nearby.

The Douglas Point swamp, located within the eastern boundary of the Bruce Power site and extending further east to the former lake shoreline, supports a high diversity of vegetation and provides habitat for deer and waterfowl that frequent the site. The Douglas Point swamp has been designated as an environmentally significant wetland area [R-7].

The Douglas Point headland is a natural geographic transition point along the whole eastern Lake Huron shoreline. The shoreline configuration changes at Douglas Point from smooth shoreline (to the south) to rough (to the north). There are no major embayments along the whole eastern shoreline of Lake Huron to the south of Douglas Point. Baie du Doré is the first protected embayment, the next one being 40 km north (Chiefs Point Bay) at the base of the Bruce Peninsula.

Four hundred and ten (410) vascular plant taxa have been identified on the Bruce Power site [R-7] and associated lands. Three provincially rare plant species were identified along the Baie du Doré shore. The general Bruce site region is characterized by: sugar maple; beech, red and white ash; yellow birch; red, white and bur oaks. Frequently, hemlock, white pine and balsam fir occur within the tolerant hardwood types and eastern cedar is present in swampy depressions [R-7]. Two plant Species at Risk (SAR) were recorded within the vicinity of the site [R-13]. The butternut plant, which has been observed around the site, is listed as Endangered under the *Ontario Endangered Species Act* of 2007 [R-14] and the Federal *Species at Risk Act* of 2002 [R-15].

Five different frog species were identified in 2020, of which the Spring Peeper, an early breeding frog, was the most common and abundant species. There was one observation of a Spotted Salamander, which is not listed as a SAR. Overall, taking into consideration the expected natural variation in amphibian abundance and diversity, the diversity of species and trends through time of frog populations in the local area is very good and has remained consistent across monitoring sites and years. Focused turtle monitoring campaigns were not completed in 2020, however incidental observations were made of Snapping Turtle, Midland Painted Turtle, and an additional turtle species. Five different snake species were observed in 2020, of which the Eastern Ribbonsnake is a listed SAR in Ontario and Canada with a conservation status of Special Concern [R-16].

Smallmouth Bass nesting surveys to monitor local bass populations have occurred annually since 2009 (Bruce A and Bruce B discharge channels) and 2010 (Baie du Doré). These areas provide excellent Smallmouth Bass nesting habitat as there is abundant spawning conditions present (adequate depth, gravel/sand substrate and shelter from prevailing winds/wave action) [R-16].

Overall, surveys in 2019 and 2020 have demonstrated that there are diverse populations of local and migrant waterfowl and shorebirds inhabiting the lands nearby Bruce Power, with the highest density in Baie du Doré. Canada Geese and Double-Crested Cormorant were the most abundant birds observed in 2020. Birds of prey are abundant in the waterfowl survey areas. A total of 97 Bald Eagles (currently listed as a SAR in Ontario), a single Merlin, and a single Broad-Winged Hawk were observed in 2020. Overall, across the whole Bruce nuclear site, counts have increased in the last four years indicating an increase in the abundance of the local overwintering Bald Eagle population. Of the breeding birds observed, the most prevalent species were the Red-Eyed Vireo and American Goldfinch. There were also observations of four bird SAR (3 showed evidence of breeding): Eastern Wood Pewee, Wood Thrush, Eastern Meadowlark, and Bobolink. Two Sedge Wren were observed and this bird is not locally common [R-16]. The Bruce nuclear site and the surrounding areas continue to provide prime habitat for large flocks of migrating shorebirds and waterfowl. The wetland habitat of Baie du Doré and the surrounding area also continue to be important habitat, including wintering [R-7].

With the exception of the Virginia opossum (which is a species found in southern areas of Ontario and in the U.S.), observations did not reveal the presence of an unusual or significant wildlife species [R-7]. Black bears have been spotted on site. Incidental observations of mammals within the Bruce site include beaver, eastern cottontail rabbit, coyote, grey squirrel, snowshoe hare, striped skunk, weasel and white-tailed deer [R-7]. Numerous locations with active crayfish burrows are located throughout the Bruce Power site [R-7].

2.3.2 Geophysical Environment

2.3.2.1 Soils

The soils on the site consist of a surface layer that contains organic material, beach shingle and poorly graded sand and gravel. The surface layer is generally less than 300 mm thick. Beneath the surface layer, the overburden stratigraphy beneath the WWMF site consists of five principal units. In descending order from the ground surface, these units are [R-7]:

- Surface sand and gravel
- Weathered silty glacial till
- Upper unweathered glacial till
- Middle sand/layered till
- Lower unweathered silty glacial till

The overburden stratigraphy is complex with drift thicknesses ranging between 14 and 19 m. The complexity within the overburden stratigraphy is attributed to the laterally discontinuous middle sand/layered till unit. This unit is comprised of well sorted fine to medium sand that at several locations coarsens and is interbedded with thin horizontal layers of silty till (layered till). The geometry of the layered till/middle sand unit is irregular, varying in thickness and elevation. A maximum thickness of 8 m exists below LLSB-3, thinning outwards in all directions.

With few exceptions, the glacial till units are laterally continuous, although thicknesses may vary from 0.3 to 13 m. The upper till surface consists of a weathered horizon, with sub-vertical fractures varying in thickness from 0.6 to 2.9 m. Beneath the western sections of the WWMF site, the upper and lower unweathered till units are identified by their separation by the middle sand/layered till unit. In the central and eastern portions of the WWMF site, the two till units merge. In these areas, the two till units cannot be distinguished other than by a slight textural variation in clay content. Within the massive till deposits occasional seams of clay, sand, and sand and gravel occur. Based on the available data these isolated inter-till lenses are not considered to be laterally extensive or hydrogeologically significant. As indicated by a pump test, the lower unweathered till unit may be absent at several locations, creating ‘windows’ through which the middle sand directly overlies carbonate bedrock surface.

Stratigraphy of underlying layers is now confirmed before construction of any new buildings or structure on site.

2.3.2.2 Bedrock

The bedrock underlying the Quaternary deposits is formed by the Middle Devonian Amherstburg Formation of the Detroit River Group. The bedrock surface beneath the Bruce Power site dips 2 percent in an easterly direction. The upper few meters of the bedrock surface are fractured and highly weathered [R-7]. Below this surface-weathered zone, subsurface investigations and excavations indicate generally stable rock conditions [R-11].

2.3.2.3 Groundwater

Groundwater movement within the area is generally toward Lake Huron. The groundwater level is close to the surface. Two groundwater aquifers exist in the area. One is at the base of the loose sand/gravel layer overlying the dense till layer or bedrock. The other is in the bedrock, which generally has a moderate permeability.

The principal hydrostratigraphic units beneath the WWMF are:

- Middle sand unit: The middle sand unit forms a semi-confined aquifer beneath the WWMF that discharges into the underlying carbonate bedrock. It occurs principally beneath the Stage 3E and 5 areas of the WWMF where it forms the uppermost aquifer. Groundwater flow in this area is sub-horizontal to the north central part of the WWMF site east with estimated average linear groundwater velocities between 1 and 50 m/year. Through monitoring data provided by wet well WSH321, elevated levels of tritium in the waters within this aquifer have been found. OPG has performed extensive investigations, confirming that the tritium originates from wastes stored in the LLSB 1-10 complex.

- Carbonate bedrock unit: The carbonate bedrock beneath the WWMF is part of a confined regional aquifer complex. Groundwater flow within the aquifer is horizontal and oriented to the northwest. Groundwater discharge occurs at the Lake Huron shoreline approximately 1.4 km from the WWMF. Groundwater flow rates range between approximately 10 and 140 m/year [R-7]. These estimates are consistent with calibrated three-dimensional flow system modeling.

- Upper and lower silty till units: The relatively impervious upper and lower unweathered silty glacial till units form local aquitards that separate the aquifers beneath the L&ILW storage area. The upper till unit is subdivided into an upper weathered unit and a lower unweathered unit. The weathered portion of the upper till is fractured, although the fracturing has not been found to significantly affect ground water flux. Average linear ground water velocities estimated within the silty till units are relatively low, of the order of 0.01 to 0.12 m/year, downwards. These estimates were found to be consistent with the presence of detectable tritium in the till.

Both the bedrock water and the middle-sand aquifer are monitored for tritium and gross beta-gamma activity through the WWMF groundwater monitoring program. OPG has committed to become compliant with the requirements of CSA N288.7 on groundwater protection programs and the corresponding Section 4.5 of REGDOC-2.9.1 by December 31, 2021.

2.3.2.4 Seismicity

Southwestern Ontario lies within the tectonically stable interior of the North American continent. This stable interior region of North America is characterized by low rates of seismicity. Most recorded events up to December 2010 have a Richter magnitude of less than 3.0 magnitude (M), with rare occurrences of larger events within a 150 km radius of the Bruce nuclear site. The local magnitude scale is the Nutti magnitude (mN), which is an extension of the Richter scale, used for reporting of seismic activity in regions of North America to the east of the Rocky Mountains [R-11].

Forty one (41) seismic events have been detected within 120 km of the site from 1985 to July 2021. The event with the greatest magnitude of M4.3, was felt in Owen Sound in 2005, at a focal depth of about 11 km [R-17].

Monitoring of regional seismicity by the Geological Survey of Canada and by OPG's Southern Ontario Seismic Network since 1991 has confirmed the historical record, indicating no significant activity on fault systems potentially affecting the Bruce nuclear site. Aside from the 2005 event in Owen Sound, regional seismic monitoring has recorded only low-level seismic activity (on the order of 1 to 3 on the Richter scale) along the structure that extends from Georgian Bay into Lake Huron. The current and historical monitoring data confirm that the Bruce nuclear site is located in a seismically quiet area [R-7].

2.3.3 Aquatic Environment

Lake Huron is the major water body near the Bruce Power site. Although there are extensive networks of small rivers and creeks feeding into Lake Huron in the region, there are no major rivers near the Bruce site. The nearest river is the Little Sauble, a small river. There are two small east-to-west drainage courses entering the lake adjacent to the Bruce site. Underwood Creek empties into the Baie du Doré to the north and the Little Sauble River, which forms the southern boundary of Inverhuron Provincial Park, empties into Inverhuron Bay to the south. To the west and northwest, Lake Huron stretches uninterrupted for approximately 128 km. The nearest land across the lake is Port Hope, Michigan, USA, 98 km southwest of the Bruce site [R-7].

2.3.3.1 Drainage

Parts of the WWMF site have already been extensively developed, or have had some preliminary development related to surface water drainage. External ditches around the WWMF site perimeter and internal storm water drainage have been provided.

At present, the west and central portion of the WWMF site drains into a drainage ditch that runs along an abandoned railway spur line north of the WWMF site. The railway ditch is approximately 5 m wide across the top of the bank, with a wetted width of approximately 3 m, and a mean water depth of 0.15 m. The railway ditch receives drainage from a small catchment area and functions as an intermittent stream. There is a noticeable flow in the railway ditch although the volume appears to be quite small. For most of its length, the drainage ditch is well naturalized with cattails predominating. Natural herbaceous vegetation, trees and shrubs that have established themselves over the years have stabilized the side slopes of the ditch. The east portion of the WWMF site drains into a stormwater management pond.

Both the railway ditch and the stormwater management pond discharge into a wetland area to the east of the site. Downstream from the wetland, the drainage ditch continues along the edge of the abandoned railway spur line until it empties into Stream C. The Department of Fisheries and Oceans has declared this ditch and the wetland as a fish habitat.

The ditch services a limited area. The length of the ditch from the WWMF site to the wetland is approximately 530 m.

2.3.3.2 Fish

Lake Huron is used locally for sport and commercial fishing. The modestly warmer water from the cooling water discharges from the Bruce generating stations provides year round sport fishing opportunities. The Baie du Doré wetland adjacent to the Bruce site provides habitat suitable for fish spawning and rearing.

Annual commercial fish harvests from the three basins of Lake Huron averaged nearly three million pounds between 2014-2018, representing about 14 percent of Ontario's Great Lakes harvest [R-18]. In 2019 and 2020, the harvest from Lake Huron was approximately 1.9 million pounds and 1.7 million pounds, respectively [R-19].

2.3.3.3 Lake Water Levels

The reference point for measuring Great Lakes water levels, chart datum for Lake Huron is 176.0 m above sea level. The mean water level in Lake Huron at Goderich is at an elevation of 176.4 m [R-11]. The approximate daily maximum and minimum mean levels have been reported at 177.2 m and 175.6 m, respectively [R-20]. However, seiches built up by atmospheric pressure differentials across Lake Huron may cause the lake level to vary up to 0.6 m from the extreme levels reported.

2.3.4 Current Use of the Adjacent Lands

The Bruce nuclear site is located within the Municipality of Kincardine in Bruce Country. The 932-hectare Bruce nuclear site has been undergoing development on a continuous basis since the initial clearing of land in 1960 for the building of the Douglas Point NGS. The site, with the exception of certain retained lands, was leased to Bruce Power by OPG in May 2001. The entire Bruce site is fenced and access is restricted and controlled by Bruce Power security personnel.

Within the Bruce nuclear site boundary, existing land uses consist of buildings, structures and transportation access required to operate and support the NGSs, and OPG's various waste operations. Though the first NGS built at the Bruce nuclear site, Douglas Point, has ceased commercial operations, it is still a CNSC-licensed facility. The Bruce Heavy Water Plant (BHWP) and the Spent Solvent Treatment Facility (SSTF), which were both located on the Bruce nuclear site, have been shut down and decommissioned (see Section 3.7).

Buildings and structures on the Bruce site include a variety of low rise office, warehouse, maintenance, and storage facilities, as well as structures designed specifically for the technical functions required for the generation and transmission of electricity. A fire fighting training area and a firing range used by security personnel for training are also located on the site. About one half of the property remains covered with vegetation ranging from open fields to second growth woodland. There are no other land uses within the Bruce nuclear site boundary [R-7].

There are 394,065 ha of land in Bruce County. Land use in the surrounding area falls into two general classifications. Along the shoreline, the land is a vacation area while inland it is primarily used for agriculture. Of the agricultural land, 68% is used for crop production (primarily grain and oilseed) and about 21% is used for pasture [R-11].

A non-residential boundary surrounds the Bruce nuclear site. Land use adjacent to the site is consistent with the rural development within the township, consisting of agriculture, recreation and rural residential development. OPG owns a considerable amount of land adjacent to the site, creating a non-resident buffer consisting of mainly unoccupied bush and/or swamp and, to the south, the Inverhuron Provincial Park.

A privately owned industrial development of 240 ha is located 2 km east of the Bruce nuclear site at the Bruce Eco Industrial Park, previously referred to as the Bruce Energy Centre (BEC). Lake Huron is used locally for sport and commercial fishing, as well as recreational swimming and boating. Cottages, campgrounds, beaches and marinas are located along the shoreline. The lake provides the water supply for the adjacent municipalities.

A significant number of wind turbines are located in the Bruce County. However, these wind turbines have no major implication on the operation of the WWMF [R-11].

Note: The L&ILW DGR was planned for construction directly adjacent to the WWMF site. Early in 2020, after more than a decade of OPG research, public consultation, and federal regulatory hearings, the Saugeen Ojibway Nation members voted 'No' to the L&ILW DGR project. OPG upheld its 2013 commitment not to proceed without Saugeen Ojibway Nation support and discontinued the project.

2.3.5 Local Communities

The population of nearby communities in 2016 is presented in Table 2-5 [R-21]. Today's diverse community has a population of over 63,000 and the main industries are energy, tourism and agriculture. The 2016 census data shows a slightly increasing population in the vicinity of the Bruce Nuclear Generating Station (BNGS); the rate of change of the population was 3.0% during the period (2011 to 2016).

In 1999, Tiverton, Bruce Township, Kincardine and Kincardine Township were amalgamated to become the Municipality of Kincardine. In addition, as of 1st January 1999, Port Elgin, Saugeen Township and Southampton were amalgamated to become the Municipality of the Town of Saugeen Shores.

The permanent population in the Town of Saugeen Shores is expected to increase by nearly 50 percent or 17,000 people over the 20-year planning period (2021 to 2041) [R-11]. A slight increase in the number of seasonal residents in the Town is also expected, and there is potential for significant growth in the Town's tourist population [R-22].

On January 1, 1999, the Townships of Arran and Elderslie, the Villages of Paisley and Tara and the Town of Chesley became the Corporation of the Municipality of Arran-Elderslie. The Municipality of Arran-Elderslie is located in southern Bruce County, along the eastern boundary separating Grey and Bruce. The Municipality contains some of the best farmland the County has to offer [R-23].

The Township of Huron-Kinloss was created in January 1999 through the amalgamation of the Township of Huron, the Township of Kinloss, the Village of Lucknow and the Village of Ripley. The Township is primarily an agrarian community; yet substantial urban type development is located along the shore of Lake Huron. In the geographic centre of the Township is the (former) Village of Ripley and along its south border is the (former) Village of Lucknow. The community of Ripley, one of two urban centers within the municipality, provides a range of retail and commercial services [R-24].

The Municipality of Brockton in Bruce County, Ontario was formed on January 1, 1999. As of 2016, the population was 9,461. It includes the former township of Brant, former township of Greenock and the community of Walkerton. Brockton's name was formed as an acronym of the three merged municipalities (Brant, Greenock and Walkerton). Since 1900, the community has remained relatively stable in size; however, the industrial base has changed from an agricultural-based local economy with related manufacturing to a more diversified local economy based on manufacturing and government administration [R-25].

Table 2-5: Population of Nearby Communities

Community	2016 Population	Area (km^2)	Population Density (P/km^2)
Kincardine	11,389	538.02	21.2
Arran-Elderslie	6,803	460.13	14.8
Huron-Kinloss	7,069	440.63	16.0
Brockton	9,461	565.41	16.7
Saugeen Shores	13,715	170.97	80.2

The economy of Bruce County is diverse, and includes agriculture, tourism, recreation, services, small manufacturing, and some resource extraction. Bruce County has approximately 3750 farms that generate more than $255M in gross sales annually [R-7]. Agriculture operations include growing corn, soybeans, string beans, canola and winter wheat. County farms also produce beef, lamb, pork, elk, bison and emu. In addition, Bruce County is home to horse breeding and training as well as wine production. Agriculture is complimented with a variety of support and processing industries, making the agriculture sector not only a significant economic activity for Bruce County, but an important contributor to overall farm production in Ontario.

The largest industry in the County is tourism, contributing about $327M annually from 2.5 million visitors in 2019. Bruce County is recognized for its diverse natural beauty with over 850 km of Great Lakes shoreline, the Saugeen River and many other inland lakes and rivers. The tourism industry in Bruce County employs more than one in seven of the working population. Local service clubs, agriculture societies and community non-profit groups organize over 700 events annually that attract tourists.

Bruce County has a thriving manufacturing, retail and service industry, which contributed significantly to Ontario's total Gross Domestic Product of $848B in 2020 [R-26]. The manufacturing sector of the economy employs approximately 2,215 people in Bruce County. The majority are employed by small manufacturing businesses with fewer than ten employees. The largest manufacturing sector by labour force is the utilities industry, with approximately 4,530 employees [R-27]. One of the major industrial developments within Bruce County is the BEC. This 800 acre (240 ha) industrial and agricultural park was established in 1986 by a consortium of private companies together with OPG and the Ontario Energy Corporation, and is located immediately southeast of the Bruce Power site. The BEC was designed as an industrial eco park where waste and by-products of one industry could become the feedstock for a neighboring industry. The area is now referred to as the Bruce Eco Industrial Park. As of June 2021, eleven companies operate in the Bruce Eco Industrial Park [R-28].

The waters of Lake Huron are used for sport and commercial fishing. Sport fishing, in the lake itself as well as the tributary streams and lake bays, is increasing with the growth in tourist activity and the improvement of beach facilities. The commercial fishery production varies from year-to-year; almost all of the catch is exported to the northeastern United States. Lake Huron also provides the municipal water source for several of the municipalities along the shore.

Cottages, resorts, beaches and marinas are located along the shoreline focused around the communities of Kincardine and Port Elgin. Within a 5 km radius of the Bruce site, there are approximately 60 homes (permanent and seasonal cottages) located around the Scott Point area, and approximately 450 permanent and seasonal residences (only about 200 are permanent) located in Inverhuron. Farm and non-farm residents are also dispersed along concession roads. Hunting is a popular activity in the area surrounding the Bruce Site. Typically, hunters from the local population and some hunters from outside the area hunt within 5 km of the Bruce Site [R-11].

The south Bruce County area enjoys a full range of services and facilities, including health and education facilities. The South Grey Bruce Health Centre (Kincardine Hospital) provides in- and out-patient services. Along with a number of public secondary and elementary schools, the area has one of two nuclear teaching facilities in Ontario, which trains Bruce Power staff in operation, maintenance and safety aspects of CANDU reactors.

Following the Fukushima incident in 2011 and resulting shutdown, the Bruce nuclear site is the largest energy production centre in the world. Since the early 1980s, major construction activity has declined and the level of employment on the site has varied. Although the site's dominance in the local economy has decreased, operations at the Bruce nuclear site remain the major economic influence in the area. The Bruce nuclear site is Bruce County's single largest employer. In 2021, employment at the Bruce nuclear site included approximately 4,000 Bruce Power employees. Approximately 150 people are employed at the WWMF site. Approximately 90 percent of the workers employed at the Bruce nuclear site live in Bruce County, and more than 75 percent of employees reside in the Municipality of Kincardine or the Town of Saugeen Shores.

Contracts are issued to businesses across Canada and internationally for a wide variety of goods and services that are required at the Bruce nuclear site. Although an important source of revenue, most local suppliers to the Bruce Power site are not dependent on the site for the majority of their annual revenues. The majority of local business operators credit the Bruce Power site as contributing positively to local economic stability and growth, largely in terms of employment and the spin-offs associated with employee spending. The population growth in certain townships and the resulting positive effects on these communities can be attributed to Bruce Power's plans for extending the operating lives of the BNGS reactor units.

OPG pays taxes to the local municipality for the WWMF site. In 2019, municipal taxes related to UFDS and L&ILW management were approximately $1,077,747.

2.3.6 Indigenous Communities

The traditional territory of the Ojibway in the Saugeen region covers the watersheds bounded by the Maitland River to the south and the Nottawasaga River east of Collingwood on Georgian Bay. The area includes the Bruce Peninsula, all of Grey and Bruce Counties, and parts of Huron, Dufferin, Wellington and Simcoe Counties. The Bruce Power site is located within this traditional territory. The Saugeen Ojibway Nation is the collective name for the two Indigenous communities with reserve lands in the area. The Chippewas of Saugeen First Nation and the Chippewas of Nawash Unceded First Nation share the same Indigenous and treaty rights, including rights to fish commercially in the waters around the Bruce Peninsula.

The Chippewas of Saugeen First Nation is located adjacent to the town of Southampton, about 30 km north of the Bruce site. In April 2021, the population of this reserve was estimated at 797, many within the traditional territory in Bruce County [R-29].

The Community of Chippewas of Nawash First Nation is located on the east shore of the Bruce Peninsula, north of the Town of Wiarton. In April 2021, the population on this reserve was estimated at 721 [R-30], many within the traditional territory in Bruce County.

Métis peoples in Ontario are distinct Indigenous people with a unique history, culture, language and territory that: includes the waterways of Ontario, surrounds the Great Lakes and spans what was known as the historic Northwest. The Métis people do not comprise one settlement; rather they are mobile regional communities that are not tied to a land base. The Métis people have traditionally lived alongside the Saugeen Ojibway Nation, hunting, fishing, harvesting and trading. According to the 2016 Census information from Statistics Canada, 690 Métis persons reside in Bruce County [R-31] and 1005 reside in Grey County [R-32]. The Métis people participate fully in the community, and are integrated into the regional population.

Indigenous people make significant use of Lake Huron for traditional and commercial harvesting of fish. The Indigenous' economies also rely on tourism, agriculture, construction, cottage rental and native craft manufacture and sale. Both the Saugeen and Nawash have developed a wide range of community services. They obtain water from on-reserve wells, from the lake or nearby communities. Their ongoing use of their traditional lands and waters includes personal and communal commercial harvesting of traditional foods and medicines.

The WWMF site has been assessed several times for the potential to contain Indigenous heritage resources, including during the tree removal for the UFDS area. No evidence of habitation or burial sites activity was encountered in the UFDS area.

OPG Nuclear has an active Indigenous relations program, supported by an Indigenous Relations policy that focuses on:

- Community relations and outreach;
- Building support with communities;

- Employment and business contracting opportunities; and
- Settlement of past grievances.

Building positive, community-minded relationships with Indigenous communities is important to OPG NWMD with respect to both current operations and decommissioning planning.

2.3.7 Community Relationships

The Bruce site has enjoyed a long, mostly positive working partnership with the local communities since the 1970s. The significant impact on the surrounding communities that resulted from a large construction workforce and construction-related activities when the site was initially developed was recognized at that time and impact grants were institutionalized in 1975. Grants continued to the end of 1998. Since then, liaison committees have been established and issues have been resolved within a joint planning approach. Many employees from the Bruce Power site have been active in civic affairs over the last 30 years, contributing to the local community.

The Bruce site conducts integrated communications and regular community liaison activities. The purpose of the external communications program is to maintain and improve community relationships and build general community awareness of the nuclear operations. The program includes communication for the purposes of education, outreach, corporate citizenship and emergency preparedness. A range of communications vehicles are used, including: regular newsletters distributed to the local communities; tours; open houses; regular meetings and presentations; and displays at the Bruce Nuclear Information Centre.

OPG also carries out these types of communications and liaison activities, building awareness of the separate OPG waste management operations. The Manager of Site Corporate Relations and Communications is responsible for managing the public communication and engagement activities for WWMF with support from VP senior leadership from both the OPG Nuclear Waste Management Division (NWMD) and the stations.

Key activities of this program include:

- Regular briefings to local community advisory committees;
- Quarterly NWMD operation performance reports, published, posted and issued to key stakeholders;
- Update briefings to community key stakeholders, such as local Members of Parliament (MP), Members of Provincial Parliament (MPP), Medical Officers of Health and the Ministry of the Environment, Conservation and Parks;
- Meetings and communications to area Indigenous communities;
- Participation and partnership in local community festivals and events;
- Participation in provincial and regional business associations, economic development committees, and citizenship and environmental committees;

- Public programming on site and in the community hosted by OPG that communicates our values as an organization in safety, environmental stewardship and good corporate citizenship;

- Integration with Nuclear Waste Management Organization (NWMO) public affairs plans, initiatives and community engagement;

- Facility tours to key stakeholders and organizations;

- Newsletters, project information packages and up-to-date website;

- A public information line and e-mail address for public inquiries.

OPG's Centre for Canadian Nuclear Sustainability (CCNS) is focused on community and stakeholder communications and relationships specifically related to decommissioning. The CCNS communication program is integrated into OPG's existing public information program and focuses on research and development, innovation and collaboration in decommissioning. It holds meaningful interaction with CCNS partners, committees, Indigenous communities and the broader community through a variety of channels including social media, Neighbours Newsletter, community presentations and events. The CCNS also has its own website, www.theccns.com, which provides online information to the general public about CCNS projects and opportunities to engage with the CCNS team.

The CCNS has also launched an Indigenous Advisory Council (IAC) that provides advice and insight to the CCNS on how Indigenous communities, organizations and businesses can bring Indigenous values and content into the centre's mandate.

OPG Nuclear has an active Indigenous Relations program, supported by an Indigenous Relations policy that focuses on:

- Community relations and outreach;

- Building support with communities;

- Employment and business contracting opportunities; and

- Settlement of past grievances.

Both the Chippewas of Saugeen and the Chippewas of Nawash First Nations have described their traditional territories to include the land and waters surrounding the Bruce site, extending in both directions along the Lake Huron shoreline, out into the lake, and inland. They have also indicated their continuing use of their traditional lands and waters.

Through joint processes between the Indigenous community and OPG, issues have been resolved with respect to lands affected by the expansion of WWMF to accommodate the WUFDSF concerning the protection of and access to the Indigenous people's burial ground located within the Bruce site. In the early 1970's Ontario Hydro identified an "Indian Burial Ground" within the Bruce Power Site. As a result of a joint council meeting of the Chippewas of Saugeen, in 1998, it was resolved that the site be known as "Jiibegmegoong" (Spirit Place). OPG reached an agreement with the Indigenous people on the on-going care of the burial ground within the Bruce site and access to the ground for ceremonies. Fishery issues regarding the Lake Huron whitefish population (a traditional food) are also being addressed through joint studies in order to create a common scientific understanding. If necessary, these studies will help to create a foundation from which to develop an ongoing monitoring plan for the future.

2.4 History and Current Status

The L&ILW storage area at the WWMF has been receiving radioactive waste since 1974. It has since gradually been developed in stages as additional waste storage space has been required. In 1974, the original L&ILW storage area consisted of a series of trenches and tile holes. A small trailer provided limited amenities at the site.

In 1977, the WVRB was constructed to enable waste volume reduction and provide amenities for staff working at the WWMF. Additional trenches and tile holes were built. In 1978 the quadricells were built to store bulk resin and reactor core components.

From 1982 to 2013, 14 LLSBs were constructed to meet LLW storage needs. From 1985 to 2013 the area designated for ICs was developed in phases to meet ILW (resin, filters, core components and heat exchangers) storage needs. There are currently hundreds of ICs on site (see Table 2-2).

In 2001, an Amenities Building was constructed, and the TPMB was built in 2004 providing space for maintenance of transportation packages and for other WWMF maintenance needs (see Section 2.2.7.2).

In 2002, the used fuel dry storage facilities were added to the WWMF. The WUFSDF now includes the DSC Processing Building and four DSBs. DSB 5 and 6 are expected to be in service in 2021.

A roughly rectangular area of land located north of the trenches has been allocated for future storage of refurbishment wastes. This area is within the existing licensed area for the WWMF and is adequate in size to meet the forecasted need [R-39].

The L&ILW processing and storage facilities and the used fuel dry storage facilities currently operate under one licence for the WWMF. At the end of 2020, there were 92,686 m^3 of LLW, and 9578 m^3 of ILW stored at the WWMF. As of the end of 2020, the expected number of used fuel bundles stored at the WUFDSF at the facility end of life is 1,605,504. As of the end of 2020, a total of 1678 DSCs have been successfully and safely stored at the DSC storage facility. At facility end of life, this figure is expected increase to 4,181 DSCs in a total of 10 DSBs

Two additional DSBs (DSB 5 and DSB 6) are currently under construction, expected to go into service in 2021. Three MPSBs are also planned, expected to go into service by 2022.

3.0 PRELIMINARY DECOMMISSIONING PLAN

3.1 Applicable Legislation, Standards and Regulatory Guidance

To ensure that all operations carried out as part of the decommissioning program are carried out to the required standards, it will be ensured that all work is undertaken in accordance with the requirements of applicable legislation and regulations.

The following list details some of the current legislation applicable to OPG's decommissioning activities. It is important to note that whilst the list is accurate at the time of writing, it is likely that a number of items will be updated, amended, or replaced at a later time. As a result, it is necessary that the list is carefully reviewed during future revisions of the decommissioning plan.

Key legislation and other regulatory controls include:

- NSCA;
- Environmental Assessment Act, R.S.O. 1990, c. E. 18 (Ontario)[6] [R-33];
- Environmental Protection Act, R.S.O. 1990, c. E. 19 (Ontario);
    - R.R.O. 1990, Regulation 347: General – Waste Management
- Ontario Water Resources Act, R.S.O 1990, c. O.40;
- Occupational Health and Safety Act (OHSA), R.S.O. 1990, c. O.1 [R-34];
- National Pollutants Release Regulations; and
- Canadian Impact Assessment Act [R-35], if applicable.

CSA standards and regulatory guidance documents that are applicable for decommissioning of the WWMF include:

- CSA N286: Management System Requirements for Nuclear Facilities [R-36];
- CSA N292.5: Guideline for the Exemption or Clearance from Regulatory Control of Materials that Contain, or Potentially Contain, Nuclear Substances [R-37];
- CSA N294: Decommissioning of Facilities Containing Nuclear Substances [R-4];
- CSA N393: Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances;

[6] The Canadian Environmental Assessment Act (CEAA) 2012 [R-33] has been superseded by the Canadian Impact Assessment Act [R-35].

- Regulatory Guide G-206: Financial Guarantees for the Decommissioning of Licensed Activities[7] [R-38]; and
- Regulatory Guide G-219: Decommissioning Planning for Licensed Activities[8] [R-3].

OPG will also consider the recommendations and guidance from the IAEA relevant to decommissioning. At this stage, specific IAEA standards and other guidance documents are referenced in this PDP, as applicable, whereas a complete list will be provided closer to the time of preparing for decommissioning.

3.2 Planning Assumptions

Planning for the eventual decommissioning of the WWMF is an ongoing process and planning assumptions can be expected to evolve over time. The scope of this PDP includes all buildings and structures currently planned until 2027 (see Table 2-2 and Table 2-4).

The following assumptions, 1 through 12, describe the assumed initial conditions at the commencement of decommissioning. Note: These activities are not considered to be part of WWMF decommissioning, thus details are outside the scope of this Plan, and are covered elsewhere. WWMF decommissioning will begin after these activities have been completed and the buildings, structures and processes have been permanently shut down:

1. The long-term disposal facilities for L&ILW and used fuel are assumed to be available and all L&ILW and used fuel in DSC are assumed to be removed from the WWMF prior to decommissioning.
2. The LLW storage facilities are assumed to be shut down by the end of 2060 (i.e., LLSBs).
3. The ILW storage facilities are assumed to be shut down by the end of 2060 (i.e., refurbishment waste storage).
4. The WUFDSF is assumed to be shut down by 2089.
5. OPG staff will remove all L&ILW and used fuel from the site waste storage and used fuel dry storage facilities prior to the shutdown of these facilities at WWMF.
6. LLW from the WWMF will be transferred on a campaign basis to a long-term disposal facility for LLW starting, nominally, in 2045. Waste storage buildings/structures will be shut down as the waste is emptied from them.

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[7] G-206 has been superseded by REGDOC-3.3.1, Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities, which was published in January 2021. OPG has communicated the timing for preparation of a gap analysis and implementation plan to comply with REGDOC-2.11.1 with the CNSC [R-6].

[8] G-219 has been superseded by REGDOC-2.11.2, Decommissioning, which was published in January 2021. OPG has communicated the timing for preparation of a gap analysis and implementation plan to comply with REGDOC-2.11.1 with the CNSC [R-6].

7. ILW from the WWMF will be transferred for emplacement in a long-term disposal facility for ILW starting, nominally, in 2043.

8. During shutdown, the L&ILW storage buildings/structures will be surveyed for radioactive contamination and decontaminated if required. Any residual contamination will be identified and removed to ensure that it does not present a safety hazard to staff or the public.

9. Hazardous wastes that do not form part of the WWMF's structures, systems or components will be removed prior to shutdown – and are therefore not included as part of the decommissioning activities.

10. All used fuel will be transferred from the WWMF to the APM DGR prior to decommissioning. Operations to remove used fuel from the site for transferral to a used fuel repository are assumed to start no earlier than 2043. All used fuel will be transferred from the WUFDSF to the APM repository by 2091, prior to decommissioning of the WUFDSF area of WWMF. There is potential for the fuel to be transferred from irradiated fuel bays directly to the APM repository.

11. The removal and transfer activities (of used fuel and DSCs) and their associated costs are outside the scope of this plan. They are accounted for in the OPG Used Fuel Storage Cost Estimate [R-40].

12. Once the used fuel is removed from the site, the WUFDSF will be available for decommissioning. At that time, the only remaining radioactivity is assumed to be potential contamination of ventilation systems and minor surface contamination of the processing and storage buildings.

The following assumptions regarding activities that will be carried out as part of the decommissioning have been made in preparation of this PDP:

13. OPG will perform a site characterization to validate assumptions regarding the remaining levels of radioactivity on the site, and undertake the necessary remedial actions as required.

14. Decommissioning of the L&ILW storage and processing facilities area will begin in 2067.

15. Decommissioning waste from the WWMF will be disposed of in a long-term LLW disposal facility. This disposal facility is assumed to be available prior to the start of dismantling and demolition activities.

16. Other wastes that are hazardous as well as radioactive, if any, will also be disposed of in an appropriate licensed facility.

17. "Clearance levels" will be developed (based on CSA Standard N292.5) to permit 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 in accordance with the principles of the waste management hierarchy. This is discussed in more detail in Section 4.1.3.5.

18. The decommissioning of the structures at the WUFDSF will begin in 2092 [R-41].

19. OPG will retain ownership of each of the site areas throughout the course of decommissioning.

20. In-ground waste storage structures that cannot be easily removed and sub-surface drainage and monitoring wells will be surveyed for contamination and decontaminated if required. Consistent with international practices, they will be dismantled to a nominal depth of 1 m (or 3 feet) below grade, backfilled with clean concrete rubble and/or soil and graded over. This depth allows for the placement of both gravel for drainage and topsoil for erosion control through vegetation. It should be noted that ground contamination surveys may be required to accurately determine the true excavation depth required to ensure that all respective screening levels are met.

21. Underground piping and utility lines will be de-energized, capped and abandoned in situ. OPG will investigate the requirements for capping the underground piping and utility lines while meeting the requirements of provincial and/or national regulations at the time of dismantling/demolition.

22. Above-ground structures will be surveyed for contamination, decontaminated if required and then dismantled and demolished. Contaminated concrete surfaces will be decontaminated via scabbling, vacu-blasting and/or other surface decontamination techniques. Where contamination is found at depth, chipping or cutting techniques will be used. Secondary radioactive wastes produced as a result of decontamination operations (including radioactively contaminated building rubble that could not otherwise be decontaminated) will be shipped to a long-term disposal facility for LLW. Contaminated metals will be disposed of similarly if attempts to decontaminate them are unsuccessful. It is anticipated that the decontaminated demolition material will preferentially (in accordance with the waste management hierarchy) be crushed, graded and reused on site as infill, or sent to an appropriately licensed municipal waste landfill site for permanent disposal.

23. A Decommissioning Operations Contractor (DOC) – a company or consortium – will perform all work during the dismantling, demolition and restoration period. OPG will provide the necessary oversight during this time period.

24. The respective site areas will eventually be made available for other OPG uses.

Many of the above assumptions are based on the required long-term disposal facilities for L&ILW and used fuel APM becoming available prior to the shutdown of the WWMF. In the event that consensus and subsequent commissioning of these repositories do not occur within these timescales, there are numerous potential consequences that should be considered. For example:

- The structural integrity of existing structures may not be guaranteed for an extended (unknown) period. If wastes are not disposed of within the timeframes specified within the design intent, degradation of storage containers and other structures may occur. Contingency strategies will need to be considered, such as extended storage periods or alternative disposal options.

- Alternatively, external pressures (e.g., from unexpected environmental changes or pressure from the government or public) may result in it becoming necessary to dispose of wastes ahead of schedule. If adequate facilities are not in place, significant cost implications may be incurred.

It is therefore envisaged that, in future revisions of this PDP, strategies for managing such scenarios are developed, taking into account unexpected changes in the availability of a long-term storage repository (or other resources).

A number of other licensed nuclear facilities are located or planned on the Bruce Power site in the immediate vicinity of the WWMF. These include Bruce NGSs A and B, the Central Maintenance and Laundry Facility, the Douglas Point Waste Management Facility and RWOS 1. The Bruce Power Site also contains a number of technical and administration buildings. Although the WWMF is located within the existing Bruce Power site boundary, the life cycle plans for the WWMF and the aforementioned licensed nuclear facilities and technical and administration buildings are on different schedules. Decommissioning of these facilities may not be carried out at the same time as decommissioning of the WWMF. Decommissioning plans for these other licensed facilities lie outside the scope of this plan.

3.3 Scope of the Preliminary Decommissioning Plan

This plan describes the decommissioning of the WWMF which covers the facilities constructed up to December 2022 as well as currently planned expansions from 2023 to 2027. This includes all buildings and structures listed in Table 2-2 and Table 2-4 as well as the WWMF site and site drainage system including the filter bed and valves located just outside of the fenced area.

This plan does not describe the decommissioning of any nuclear facility that is outside of the boundary of the currently licensed WWMF area (see Figure 2-2). This PDP does consider how the decommissioning of the WWMF may impact the surrounding environment (as described in Section 2.3).

In accordance with the requirements of CSA N294:19, this plan will be subject to periodic review to ensure that any future changes in the facility or scope of decommissioning are incorporated. This would include:

- Changes in site conditions
- Changes to the decommissioning objectives or strategy
- Advances in decommissioning technology
- Modifications to the WWMF
- Updated cost and funding information

- Revised regulatory requirements
- Revised records requirements

3.4 Objective of the Decommissioning

The objective of the decommissioning is to permanently retire the WWMF from service in a manner that aims to ensure protection of the health, safety and security of workers, the public and the environment. Decommissioning involves restoring the site to an agreed end state to achieve release from CNSC regulatory control. After decommissioning, OPG will retain ownership of the property and the site will be available for other OPG uses.

3.5 Decommissioning Strategy

OPG's reference strategy for the WWMF is prompt decommissioning, based upon the fundamental assumption that the stored wastes will be removed to other, permanent waste management facilities when these facilities become available, prior to the commencement of decommissioning.

The WWMF is comprised of L&ILW processing and storage facilities and used fuel dry storage facilities. The decommissioning will be carried out in two separate phases, the L&ILW processing and storage facilities and associated areas will be decommissioned first, followed by the WUFDSF and associated areas at a later time. Decommissioning of the L&ILW processing and storage facilities, used fuel processing and storage facilities and the associated areas of the site will begin promptly following their respective shutdowns. The WUFDSF and associated areas will be dismantled concurrent with the Bruce NGSs to take advantage of economies of scale.

3.5.1 Decommissioning Strategy for the Low- and Intermediate-Level Waste Area

For planning purposes, the reference decommissioning strategy for the first phase of decommissioning, the L&ILW processing and storage facilities, is based on the following assumptions:

- L&ILW from OPG and Bruce Power NGSs will continue to be shipped to the WWMF for processing and storage until long-term disposal facilities are in service. The L&ILW accumulated at the WWMF up to then will be removed from storage on a campaign basis and transferred to the long-term disposal facilities between 2043 and 2060.
- After the long-term disposal facility for LLW is placed in service, operational LLW from OPG and Bruce Power NGSs will be processed and transferred directly to the facility.
- ILW will be transferred for emplacement in a long-term disposal facility for ILW starting, nominally, in 2043.
- Decommissioning of the WWMF L&ILW processing and storage facilities will commence after transfer of the interim stored L&ILW from WWMF to the long-term disposal facilities, nominally in 2067.

- Site restoration will take place, nominally in 2068.
- Release from regulatory control is expected to take place in 2069.

When storage buildings/structures are emptied of waste, they will be surveyed for residual loose contamination and decontaminated as required. These buildings/structures will then remain closed until all of the L&ILW processing and storage facilities and the associated area of the site are completely shut down. Traces of radioactive material (including tritium), such as fixed contamination on equipment and structures, may remain on the site after the stored radioactive wastes have been removed from the site.

Once all of the L&ILW processing and storage facilities are shut down, there is little advantage in deferring the start of the decommissioning work since small amounts of residual radioactivity are expected to remain on the site.

The reference strategy assumes that decommissioning of the L&ILW processing and storage facilities and the associated area of the site will begin after the last of the stored radioactive waste has been processed. The decommissioning work will continue until the site area occupied by the L&ILW processing and storage facilities including the land upon which the facilities sit, is in a condition that will permit its release from further regulatory control by the CNSC.

3.5.2 Decommissioning Strategy for the Used Fuel Storage Area

Detailed planning for the second phase of decommissioning, the WUFSDF and associated areas of the WWMF site, would begin after a decision is reached to cease storing DSCs containing used fuel on the site, and to release the sites for other uses.

For planning purposes, the reference decommissioning strategy for the WUFDSF is based on the following assumptions:

- DSCs containing used fuel will continue to be processed and/or stored at the WWMF until 2089 with shipments to the used fuel repository starting no earlier than 2043.
- All used fuel will be removed from the site to the APM used fuel repository by nominally 2089.
- Decommissioning of the WUFDSF will take place in 2092.
- Site restoration will take place in 2093, but could be delayed into 2094 for alignment with activities at the neighbouring BNGS.
- Release from regulatory control is expected to take place in 2095.

Since all of the used fuel will be removed from the WUFDSF prior to decommissioning, little residual radioactivity is anticipated to remain on the site. There will therefore be no need to defer dismantling of buildings and structures. In general, international practice and policy for decommissioning of used fuel storage facilities is to begin decommissioning as soon as reasonably practicable following completion of their operational life. It is, however, assumed that the WUFDSF and associated area of the WWMF site will be dismantled concurrent with the Bruce NGSs, to take advantage of economies of scale.

3.6 Predicted Characteristics of the Western Waste Management Facility at Decommissioning

No significant radiological or chemical hazards are expected to be present in the waste processing and storage buildings on site at the time of decommissioning. However, small amounts of residual contamination may remain. Any contamination remaining in buildings will be detectable using practical survey techniques, similar to those used to monitor the facility for contamination during routine operations. Hazardous materials are stored and may be present in the WVRB, the TPMB and the DSC Processing Building (see Appendix D).

At the time of decommissioning, the WWMF will consist of the following facilities and areas (current facilities and those planned to facility end of life):

- The WVRB, including the radioactive waste incinerator, box compactor, material handling equipment and control room;
- 14 LLSBs.
- 3 MPSBs.
- 15 quadricells.
- Equipment Storage Tent.
- Transport and Work Equipment Storage Area.
- One SGSB.
- One RCSB.
- Two wide trenches and 13 narrow trenches. There is a potential for some trenches to have degraded over time. A strategy will be developed to address the potential anticipated presence of contamination and minimize the risk of contamination spread to the local environment.
- 224 tile holes. Leakage to the surrounding soil is suspected for 37 tile holes, which were subsequently retrofitted with steel liners. A localized site investigation around the affected tile holes will be required to determine the nature and extent of any contamination present.
- 20 IC-2s. There is a potential for some of the ICs to have degraded over time. A strategy will be developed to manage this potential challenge in order to minimize the risk of contamination spread to the local environment.

- 20 IC-12s. There is a potential for some of the IC-12s to have degraded over time. A strategy will be developed to manage this potential challenge in order to minimize the risk of contamination spread to the local environment.
- 360 IC-18s, approximately 17% containing THELs, 83% containing spent resin. There is a potential for some of the IC-18s to have degraded over time. A strategy will be developed to manage the THELs and the potential degradation of containers in order to minimize the risk of contamination spread to the local environment.
- 41 IC-HX spaces. There is a potential for some IC-HX containers to have degraded over time. A strategy will be developed to manage this potential challenge in order to minimize the risk of contamination spread to the local environment.
- One Amenities Building.
- One TPMB.
- One Waste Sorting Building.
- One DSC Processing Building.
- 10 UFDSBs.
- WWMF site.
- The site drainage system including the filter bed and valves located just outside of the fenced area. Some residual contamination is anticipated.

It is assumed that there will be no contaminated soil requiring remediation within the WUFDSF area. It is also assumed that there will be 1000 m^3 of contaminated soil within the L&ILW facilities area: 40% is expected in common areas; 50% is expected near the tile holes; and 10% is expected near the ICs.

3.7 Canadian and International Decommissioning Strategies and Experience

There is a growing body of experience related to the decommissioning of nuclear facilities both in Canada and overseas. Much of the international experience relates to decommissioning facilities that are far more complex and present greater hazards than the WWMF. Therefore, Canadian experience, which is more relevant to decommissioning of the WWMF, has been included in this section.

Some domestic experience is directly relevant to this plan, including work performed at: the Tunney's Pasture Isotope Processing Facility; Whiteshell Laboratories; Chalk River Laboratories [R-42]; and the Defense Research Establishment Suffield [R-43]. Experience gained during the course of this work has been considered in the development of this plan. The experience gained during the decommissioning of some other small nuclear facilities in Canada has also been considered, including: research reactors, fuel fabrication plants, and research laboratories. Also considered are reports of decommissioning work performed in other countries and guidance from international agencies such as the IAEA [R-44], the Organization for European Co-operation and Development and the Nuclear Energy Agency [R-42].

OPG has successful decommissioning experience at both the BHWP and the SSTF, which are both located on the Bruce Nuclear site.

The Bruce HWP was in continuous operation from April 1973 until March 1998, for the purpose of producing reactor-grade heavy water [R-42]. After it was no longer in operation, the BHWP decommissioning project was carried out in accordance with a DDP, remediation plan, an Environmental Assessment (EA) and follow-up program. Demolition began in October 2004 and was completed in 2006. The buildings were demolished using standard demolition techniques. The debris was removed from the site for recycling or disposal. Bioremediation of oil-contaminated soil in the effluent lagoons was required and began in 2006. About 25% of the soil was bioremediated to below the end-state criteria and was used as clean backfill in the immediate area. Any soil that did not meet the end state criteria was disposed of off-site at a licensed facility. The radiological end state was that no nuclear substances would remain within the BHWP facility boundaries and the remaining structures, equipment and grounds were free of significant radiological contamination. In order to demonstrate that this end state criterion was met, a final radiological survey was performed in 2012 using the MARSSIM methodology. This survey found no radioactive contamination on the BHWP site and a licence to abandon the facility was granted by the CNSC in 2014 [R-45][R-46].

From May to December 2018, OPG completed decontamination of all radiologically contaminated piping in the SSTF. As decontamination progressed, each room or section was systematically surveyed and sampled for radiation in accordance with the MARSSIM methodology. A Site Survey and Characterization report was prepared and approved by OPG in March 2019. This report concluded that radioactivity levels in the SSTF were below the site unconditional release criteria. The demolition of the above ground structure occurred in November 2019, while the underground infrastructure was removed in February 2020. Demolition was completed in accordance with a comprehensive demolition plan that described the steps and actions that would be taken to permanently decommission the facility and outlined the different activities related to removal, packing, transportation and disposal of different decommissioned materials. Continuous survey and monitoring were carried out during dismantling and demolition to identify any hazardous materials present. The CNSC concluded that OPG satisfactorily demonstrated that the SSTF was free of any contamination above the regulatory limits. This resulted in CNSC acceptance of OPG's request to remove the SSTF from licensing control [R-47][R-48][R-49][R-50].

The decommissioning experience reviewed indicates that the strategy adopted for the decommissioning of the WWMF is technologically feasible and that the work can be completed in a manner that protects the health, safety and security of workers, the public and the environment.

4.0 DESCRIPTION OF PLANNED DECOMMISSIONING ACTIVITIES

This section describes the major activities that will be performed during the course of the decommissioning work. The actual sequence of the work may differ from the order presented here for preliminary planning purposes. This section does not present detailed procedures for each activity. These procedures will be included in the DDP that will be prepared prior to commencing any decommissioning work.

The anticipated major project milestones for decommissioning the WWMF are shown in Table 4-1. Any modifications associated with end of life or facility shutdowns may impact these dates.

Table 4-1: Planned Project Milestones Relevant to the Decommissioning of the Western Waste Management Facility

Nominal Date*	Event
Low and Intermediate Level Waste Processing and Storage Facilities	
2060	• All stored L&ILW removed from storage at the WWMF • Shutdown of L&ILW storage facilities
2064	• Application for Licence to Decommission the L&ILW facilities and area submitted to the CNSC
2067	• CNSC approval to begin decommissioning of L&ILW facilities received (Licence to Decommission) • Begin decommissioning of the L&ILW processing and storage facilities and associated area of the WWMF site
2068	• Decommissioning of the L&ILW processing and storage facilities and associated area of the WWMF site complete • Complete site surveys • Complete site restoration of the L&ILW processing and storage facilities area
2069	• Release from regulatory control
Used Fuel Dry Storage Facility	
2089	• All used fuel removed from the facility • Shutdown of Used Fuel Dry Storage Facility/Area. Shutdown of the WUFDSF and associated area of the WWMF site • Begin planning for decommissioning of the WUFDSF and associated area
2092	• Licence to perform decommissioning activities received; begin decommissioning • Complete site surveys
2093	• Begin site restoration of the WUFDSF area
2095	• Release from regulatory control

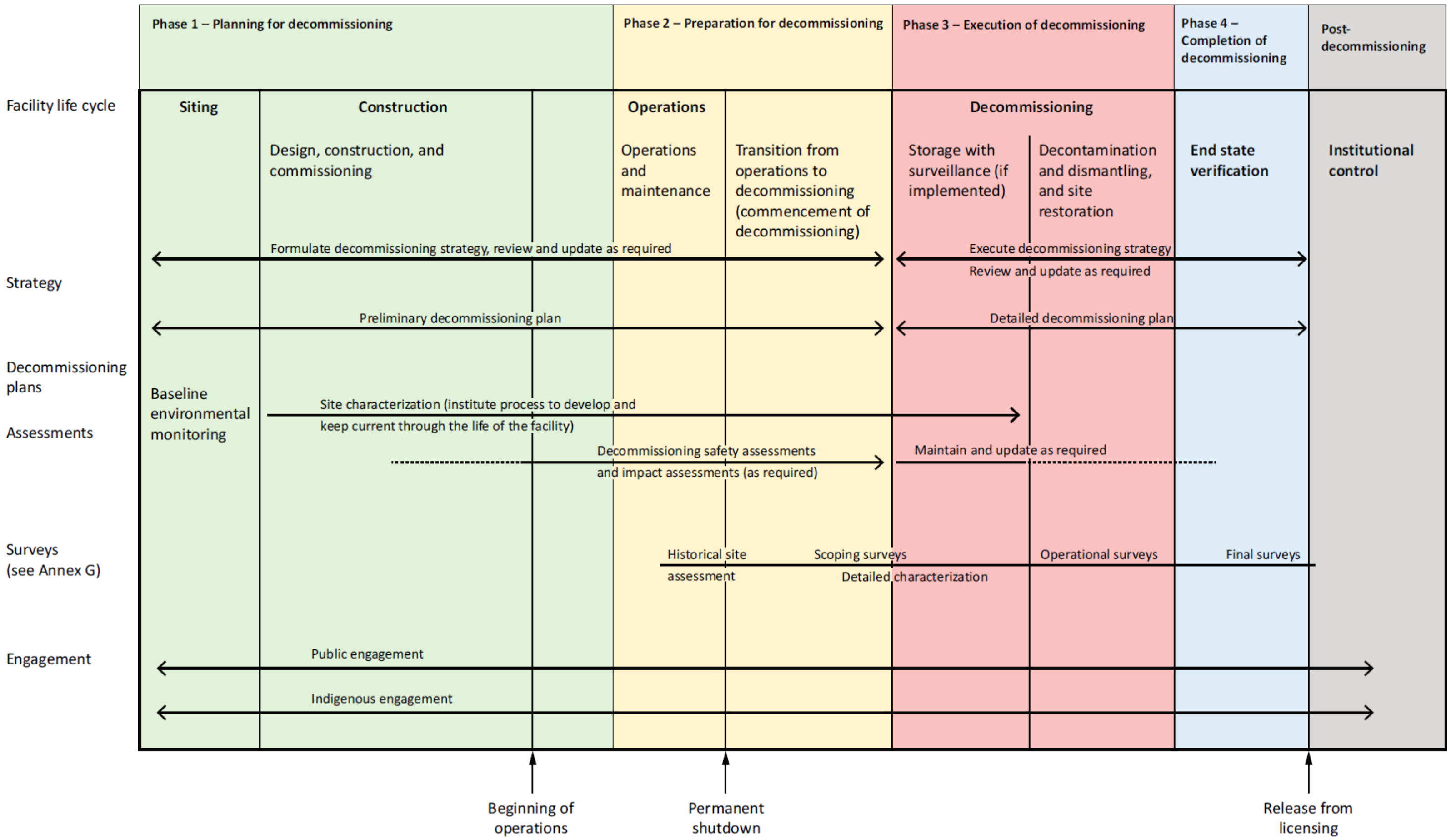
*For financial planning purposes only. Any modifications associated with the end of life dates for other nuclear facilities and in-service dates for the long-term disposal facilities may impact the WWMF decommissioning dates.

4.1 Decommissioning Phases

Although decommissioning of the L&ILW processing and storage facilities and associated area and the WUFDSF and associated area will start at different times (nominally 2067 and 2092 respectively), the decommissioning phases for each facility and associated area will be the same.

The decommissioning work for each facility and associated area will be divided into the following four main phases in accordance with CSA N294:19 [R-4] (see Figure 4-1):

- Planning for Decommissioning;
- Preparation for Decommissioning;
- Execution of Decommissioning; and
- Completion of Decommissioning.



Time interval shown denotes the applicability of the plans and not the time when they are developed

Legend:

.... identifies when the activity may be performed

—— identifies when an optional activity may be performed if required

Figure 4-1: Phases of Decommissioning

The key requirements of CSA N294:19 [R-4] are summarized in the following subsections. The key phases of decommissioning will be more closely reviewed within the DDP.

4.1.1 Planning for Decommissioning

According to CSA N294:19, planning for decommissioning begins at the siting/design phase (or as early as possible) and continues throughout the lifecycle of the facility. A decommissioning strategy and a PDP are developed in this phase. The WWMF is currently considered to be in 'Phase 1 – Planning for Decommissioning', per CSA N294:19 [R-4].

Tasks completed as part of this phase will include (but are not limited to):

- Determine the regulatory and licensing requirements;
- Develop and periodically update the decommissioning strategy, including assessment of optimal techniques and technologies. Planning considerations such as regulatory requirements, stakeholder input, potential environmental impacts, safety and availability of a final waste disposal facility will be taken into account in the development of a decommissioning strategy;
- Develop and periodically update a PDP;
- Develop a record management system to ensure that all sources of information that affect decommissioning can be readily identified and retrieved;
- Review the history of the facility (operational and maintenance records) and assess any potential impacts on the decommissioning; and
- Notify the CNSC of intent to shut down the facility.

4.1.2 Preparation for Decommissioning

Preparation for decommissioning begins with the decision to cease operations and begin decommissioning. This phase normally includes the further development of the initial decommissioning plan into a DDP and securing the necessary regulatory approvals, as required.

Tasks completed as part of this phase will include (but are not limited to):

- Obtain the necessary regulatory approvals (see Section 4.1.2.1);
- Remove stored radioactive materials including L&ILW and/or used fuel as applicable (see Section 4.1.2.2);
- Remove hazardous materials (see Section 4.1.2.3);
- Place the facility in a safe shutdown state (see Section 4.1.2.4);

- Review the history of the facility (operational and maintenance records) and assess any potential impacts on the decommissioning;
- Assess the state of the facility after shutdown;
- Perform a safety assessment to determine which decommissioning operations could pose a potentially significant hazard to operators, members of the public and the environment;
- Perform an environmental assessment, if required;
- Review and update (if required) the decommissioning strategy;
- Develop a DDP (see Section 4.1.2.5);
- Develop a waste management plan for waste generated during decommissioning; and
- Develop and implement a public engagement program.

4.1.2.1 Regulatory Approvals

When the decision to decommission the WWMF is made, OPG will notify the CNSC of their intention to decommission the facility. OPG staff will prepare an application for a licence to perform decommissioning activities at the WWMF that contains the information required by the Class I Nuclear Facilities Regulations along with any other required and/or appropriate information. The DDP will form part of the application for a licence to perform decommissioning activities. OPG will obtain a licence to perform decommissioning activities at the facility, as required by the Class I Nuclear Facility Regulations, before any decommissioning work begins.

In addition, OPG and/or the DOC will obtain all of the other required permits and licences from federal, provincial and municipal agencies before any decommissioning work begins. A full list of the required permits and licences will be included in the DDP.

4.1.2.2 Removal of Stored Radioactive Materials

The radioactive waste stored at the WWMF, including L&ILW and/or used fuel as applicable, will be removed from the facility prior to the beginning of the decommissioning.

Removal of the L&ILW will begin following opening of the long-term disposal facilities for LLW and ILW. The ILW includes some tile holes, in which the waste is encased in the concrete structure of the tile, and IC-HXs. The only exception is that empty THELs will remain on site inside IC-18s. These empty THELs will be included as part of the decommissioning waste. It is expected that once ILW stored in ICs has been retrieved, it will be immediately loaded into shielded sacrificial overpacks in preparation for transfer to the long-term disposal facility for ILW.

Removal of the used fuel will commence after the APM repository for used fuel is in operation.

Note: Removal of the stored radioactive waste is outside the scope of this decommissioning plan, which assumes that all stored waste will be removed prior to the commencement of facility decommissioning (see Planning Assumptions, Section 3.2).

4.1.2.3 Removal of Hazardous Materials

Hazardous waste that is not part of WWMF systems, structures or components will be removed prior to decommissioning. Note: Removal of these hazardous wastes is outside the scope of this decommissioning plan, which assumes that all stored waste will be removed prior to the commencement of facility decommissioning (see Planning Assumptions, Section 3.2).

Most of the asbestos and Polychlorinated Biphenyls (PCBs) that were on the site have already been removed. Removal of any remaining stored hazardous materials will be completed following removal of the stored radioactive waste. As shown in Appendix D, the only inventory of hazardous materials remaining will be located in the WVRB, the TPMB and the DSC Processing Building in small quantities that can easily be removed. Non-radioactive hazardous waste will be disposed of at approved disposal facilities. Section 4.1.3.5 details the steps that may be taken if conditions at the time so require.

4.1.2.4 Shutdown of Waste Storage Facilities

After the stored waste is removed, several activities will take place in order to shut down the waste storage facilities, including:

- Perform surveys for residual loose contamination on buildings and structures and decontaminate as required.
- De-energize the fire protection and electrical systems in the LLSBs.
- Remove hazardous material from facility areas.
- Replace weather covers and plugs over tile holes, ICs, IC-HXs, trenches and quadricells to avoid water seepage during any dormancy period prior to decommissioning.
- Characterize the site and develop a Historical Site Assessment (HSA) following the MARSSIM process [R-51].

4.1.2.5 Detailed Decommissioning Plan

A DDP will be prepared before any decommissioning execution work begins. The appropriate methods and technologies available for use at the time of decommissioning will be reviewed and, where applicable, these will be adopted and described in the DDP. Only when the licence to perform decommissioning activities has been issued can steps be taken to mobilize the finalized methods and technologies.

The DDP will describe the actions that will be taken to permanently retire the facility from operation in a manner that ensures the health, safety and security of workers, the public and the environment. The DDP will establish the criteria (clearance levels) that will be used to determine if material is suitable for uncontrolled release from the site. It will also establish the clearance levels that will be used to determine if the site itself is suitable for release from further regulatory control. The content of the DDP will follow the regulatory requirements at the time of decommissioning. Currently, the content requirements for the DDP are contained in N294:19 [R-4].

The DDP will be developed in accordance with the principles of the waste management hierarchy (Figure 4-2), whereby decommissioning techniques that minimize waste generation as far as possible are favoured. Where reuse or recycling is not possible, items requiring disposal will be reduced in volume prior to consignment for conventional waste disposal for clean waste or to the long-term disposal facilities for LLW to optimize the loading capacity of the disposal space.

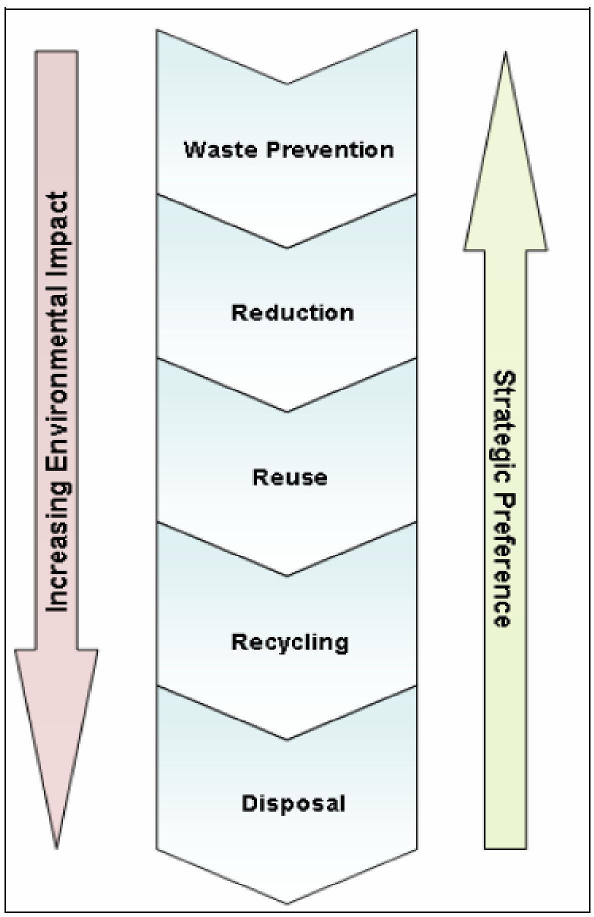


Figure 4-2: Summary of the Key Principles of the Waste Management Hierarchy

The DDP will describe the 'Decommissioning Planning Envelopes' which will be integrated into an overall plan to ensure the work is done efficiently with safety being the top priority. Decommissioning Planning Envelopes at WWMF will include:

- L&ILW storage and processing facilities and associated site area:
  - LLSBs;
  - MPSBs;
  - Quadricells;
  - SGSB;
  - RCSB;
  - Trenches;
  - Tile holes;
  - IC-2s, IC-12s and IC-18s;
  - IC-HXs spaces; and
  - Associated and adjacent site area.
- WVRB including the Amenities Building and adjacent site area.
- TPMB and associated site area.
- Waste Sorting Building.
- Used Fuel Dry Storage Facilities and associated site area:
  - DSBs;
  - DSC Processing Building; and
  - Associated site area.
- WWMF site drainage and monitoring system and other utilities.

Key activities that will be considered within the DDP for each envelope include but are not limited to:

- Post-operational surveys (after L&ILW, used fuel and hazardous materials have been removed);
- Site planning;

- Review of the operational history, including incidents or accidents that could affect decommissioning;
- Identification of the final radiological, physical and chemical end-state objectives;
- Decontamination of systems and structures;
- Review and update the applicable decommissioning strategy;
- Dismantling of systems and structures;
- Identification of potential environmental effects and mitigation measures;
- Update the decommissioning cost estimates and any financial guarantee arrangements;
- Identification of the applicable programs (e.g., human and organizational factors, quality assurance, emergency response, etc.);
- Undertake public consultations;
- Post-decommissioning surveys; and
- Develop a waste management plan.

Each decommissioning envelope will be addressed separately. Activities in some decommissioning envelopes may take place concurrently, or they may occur at different times, depending on the decommissioning strategy for that envelope.

4.1.3 Execution of Decommissioning

Execution of the decommissioning will be carried out in two separate phases, the L&ILW processing and storage facilities and associated areas will be decommissioned first, followed by the WUFDSF and associated areas at a later time. Execution of decommissioning will begin with the implementation of the decommissioning plan after all necessary regulatory approvals have been obtained. The activities under this phase include the execution of the physical work (i.e., decontamination and dismantling of the facility).

The activities listed below can be performed with currently available technology, but the required procedures to complete the tasks will depend on the technology available at the time of decommissioning. Tasks that will be completed as part of the execution of decommissioning include, but are not limited to:

- Perform post-operational surveys (see Section 4.1.3.1 for further details);
- Prepare and mobilize (see Section 4.1.3.2 for further details);

- Decontaminate and dismantle systems and structures (see Section 4.1.3.3 for further details);
- Restore the site (see Section 4.1.3.4 for further details);
- Manage the waste generated (see Section 4.1.3.5 for further details); and
- Perform surveys of the buildings, structures and areas in the decommissioning planning envelopes (see Section 4.1.3.6 for further details).

Decontamination, dismantling, and waste management may occur simultaneously. Surveys for radioactive and other hazardous materials will be performed throughout the dismantling work, culminating in a final survey.

4.1.3.1 Post-Operational Surveys

Surveys will be performed once the stored waste is removed to identify, characterize and quantify any radiation fields and radioactive contamination remaining in each building, structure and site area.

4.1.3.2 Preparation and Mobilization

This initial phase of the project is intended to prepare the site for subsequent decommissioning and dismantling work. Detailed procedures for the dismantling operations will be prepared to align with the As Low As Reasonably Achievable (ALARA) principle for the protection of personnel and address the continued protection of health and safety of the public and the environment. The work performed during the preparation and mobilization phase of the project will include, but is not limited to:

- Selecting a DOC to assume responsibility for decommissioning the WWMF. DOC staff will be provided with the required training by OPG. Based on the identified requirements and needs for dismantling and demolition, appropriate subcontractors will be identified and selected to support the various project deliverables.
- Performing a hazardous materials survey to confirm the location and identity of any hazardous materials that are stored on the site.
- Developing procedures for occupational radiation exposure control, emergency programs, industrial safety, control and release of liquid and gaseous effluents and processing of radioactive waste including: filter media; metallic components; and non-metallic components generated in dismantling.
- Cleaning all facility areas to remove any remaining loose contamination in order to meet the pre-established clearance levels; removing and processing any remaining liquid and solid wastes.
- Disposing of any remaining furniture, cleaning products, paints and other hazardous materials that will not be required during the decommissioning.

- Preparing any required site support and storage facilities.
- Installing or restoring any site services (electric power, domestic and service water, sewage, active and inactive drainage, fire protection, etc.) that will be required during the dismantling work.
- Disconnecting and isolating remaining site services that are not required.
- Providing staff with the required training.

4.1.3.3 Decontamination and Dismantling of Systems and Structures

This phase involves the removal of all contaminated equipment and components from the WWMF, and the decontamination or removal of all concrete and metal. Decontamination and dismantling will be carried out by the DOC, who will provide any power supply required. Decontamination and dismantling must be undertaken using safe and effective methods that will be determined during the development of the DDP. Decontamination and dismantling work will be conducted in accordance with OPG's Radiation Protection Program [R-52].

Little radioactive contamination is expected at this facility. Components such as active ventilation filters and DSC vent hoses may show some contamination. However, these items are replaceable and would be disposed of prior to decommissioning. As the facility ages, the nature and extent of any radiological contamination will be monitored. If it is found to be significant, this will be included in future revisions of the PDP.

A. Low-Level Radioactive Waste Storage Buildings

Surveys will be performed in order to locate any radioactive material that may contaminate building equipment or structures. The entire floor system, including the concrete slab, the underlying sand and the impermeable membrane will be included in the surveys. Any materials or equipment that are identified as being above the approved clearance levels will be decontaminated, dismantled, and removed. Concrete found to be above the approved clearance levels will be removed by planing, scarifying or drilling and spalling. A major limiting factor that will impact the choice of decontamination technique is the level of tritium contamination present. This radionuclide can be difficult to remove with certain techniques, and therefore a thorough understanding of the contamination fingerprint will be required when identifying the best available technique. Metal found to be above the approved clearance levels will be cleaned or cut away from the structure. Temporary structures may be constructed over selected areas to prevent the spread of any contamination that may be released during the decontamination work. Other contamination control techniques, such as local ventilation, contamination control areas, and so forth will be implemented where appropriate.

The ventilation and electrical systems will be removed from each building. The above ground structure of each building will be demolished and the concrete pad that the building sits on will be removed. Portions of the internal drainage system of each building that are within a nominal 1 m depth will be excavated. Any sub-floor or drainage system components that are found to be above the approved clearance levels and lie below the nominal removal depth will be decontaminated if required and left in-situ. Any residual sub-surface sump structures found to be above the approved clearance levels will also be decontaminated and sealed with an approved backfill material.

B. Trenches

The trench covers will be removed and the inner surfaces of the trenches will be surveyed for radioactive contamination. Any concrete found to be above the approved clearance levels will be removed by planing, scarifying or drilling and spalling. Temporary structures may be constructed over selected areas to prevent the spread of any contamination that may be released during the decontamination work.

Surveys will be conducted to determine if outside surfaces of the trenches and the soil or groundwater around the trenches have become contaminated above the approved clearance levels. Any external trench sections found to be above the approved clearance levels will be separated by concrete cutting and transferred to the central dismantling area. The construction of temporary facilities in support of decommissioning activities (e.g., for the provision of controlled, contained conditions for carrying out dismantling and other material processing operations) is not anticipated. The existing buildings, including the WVRB, trailers, and the empty LLSBs/MPSBs will provide adequate space to conduct and support decommissioning activities. In the event that such a facility is required and not available, a readily decontaminable (e.g., through the use of strippable coatings) temporary structure such as a Rubb Tent or MODUlar CONtainment (MODUCON)[9] unit would be utilized. The pavement surrounding the trenches will be dug up and any pavement sections and soil found to be above the approved clearance levels will be removed. At the processing area, contaminated trench sections will be further cut into smaller pieces if required, and removed for disposal.

For trenches free from external contamination, the inner surfaces will be decontaminated if required and left in place. The soil around the trenches will be excavated to allow for removal of the concrete wall to the nominal removal depth. The excavated concrete will be crushed and the debris will be used as fill or removed for disposal. The surrounding soil will be surveyed and any soil found to be above the approved clearance levels will be removed either through standard excavation, other remediation techniques as considered appropriate, or by vacuuming if contamination is present in very small and localized quantities.

C. Tile Holes

Those tile holes, put in service in 1974, that are complete monoliths will be retrieved as they are and sent for further processing or disposal during the waste retrieval period. Such waste retrieval activities are not part of decommissioning. During decommissioning, the surrounding backfill material will be surveyed for contamination. Any soil found to be above the approved clearance levels will be removed by via standard excavation techniques, other remediation techniques as considered appropriate, or through vacuuming if the extent of contamination is sufficiently small and localized.

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[9] A MODUCON system developed to provide effective containment around plant or equipment to prevent the spread of radioactive, toxic, or otherwise harmful material. It is typically assembled from glass reinforced plastic panels, and can be coated with a wide range of strippable/tie-down coatings to meet project requirements.

The backfill material surrounding the remaining tile holes will be surveyed for contamination. If the outer surfaces of the tile holes are found to be above the approved clearance levels, the compacted till or granular backfill around these tile holes will be loosened and excavated to expose the tile holes. The surrounding pavement will be dug up and any pavement sections and soil found to be above the approved clearance levels will be removed for disposal. The tile holes will be lifted out and taken to a central dismantling area. The contents of the tile holes will be encapsulated in concrete to form a solid monolithic block. For tile holes with liners the wastes can be removed independently of the concrete tile. This applies to 37 of the tile holes put into service in 1974 and all 144 of the tile holes put into service in 1977. For the remaining 43 tile holes put into service in 1974, it will be necessary to fracture the grout joints between the tile and base slab to allow for the removal of the tile hole and its contents as one monolith. At the central dismantling area, the surface of the tile holes (i.e., the precast concrete pipe sections and base slabs) will be decontaminated by planing, scarifying, or drilling and spalling. The tile holes will then be demolished and crushed; the clean concrete will be used as fill on site. Any concrete found to be above the approved clearance levels will be removed for disposal. The excavated concrete will be crushed and the debris will be used as fill or removed for disposal. The surrounding soil will be surveyed and any soil found to be above the approved clearance levels will be removed through standard excavation techniques, other remediation techniques as considered appropriate, or by vacuuming if the levels of contamination are sufficiently small and localized.

D. Quadricells

The bentonite clay in the bottom of each cell will be removed, surveyed and packaged for disposal. The inner surface of each cell will be surveyed in order to locate any radioactive contamination that may remain. Contamination in the protective surface of the concrete will be removed by planing, scarifying, or drilling and spalling.

The individual cells will be removed from the structure and taken to a central dismantling and processing area where the surfaces will be surveyed and any surface area contamination found above the approved clearance levels will be removed by planing, scarifying, or drilling and spalling. The concrete cells will be demolished and the clean debris will be used as fill or removed for disposal.

The outer surface of the quadricell and the surrounding area will be surveyed and any soil found to be above the approved clearance levels will be removed. The remaining concrete structure of the quadricells and the concrete pad under the quadricells will be surveyed and any fixed contamination found to be above the approved clearance levels will be removed by scarifying, or drilling and spalling. The quadricells will be demolished in place and the clean debris will be used as fill or removed for disposal. The soil under the concrete pad will be surveyed to determine if any contamination above the approved clearance levels has escaped from the cells. Any contaminated soil will be removed through standard excavation techniques, other remediation techniques as considered appropriate, or vacuuming if the levels of contamination are sufficiently small and localized.

E. In-Ground Containers (IC-2, IC-12, and IC-18)

The inner surfaces of the empty ICs and sampling pipes will be surveyed and any fixed contamination found to be above the approved clearance levels will be removed from the inner steel liner and sampling pipe. The soil around the ICs will be excavated to allow for removal of their steel/concrete structure to the nominal removal depth. The excavated steel and concrete will be separated. The concrete will be crushed and the debris will be used as fill or removed for disposal. The steel will be sent for recycling or disposal. The residual sub-surface IC structures will be left in place and sealed with an approved backfill material.

The surrounding soil will be surveyed and any contaminated soil will be removed through standard excavation techniques, other remediation techniques as considered appropriate, or vacuuming if the levels of contamination identified are sufficiently small and localized.

F. In-Ground Heat Exchanger Containers

In-ground heat exchanger containers will be removed prior to shutdown of the site. The crushed limestone within the space left by the heat exchangers will be surveyed in order to locate any radioactive contamination above the approved clearance levels that may remain. Any limestone granules found to be above the approved clearance levels should be suitable for removal by vacuuming.

G. Steam Generator Storage Building

Decontamination and dismantling of the SGSB will be similar to the processes described for LLSBs.

H. Retube Component Storage Buildings

Decontamination and dismantling of the RCSBs will be similar to the processes described for LLSBs.

I. Waste Volume Reduction Building

Surveys will be performed in order to locate any radioactive material that may contaminate the WVRB equipment or structures. Building services will either be disconnected and de-energized or restored as required. Equipment that is identified as being above the approved clearance levels will be decontaminated, dismantled and removed. This potentially includes the incinerator, compactor and waste bins. Concrete found to be above the approved clearance levels will be removed by scarifying, or drilling and spalling. Metal found to be above the approved clearance levels will be cleaned or cut away from the structure. Temporary structures may be constructed to prevent the spread of any contamination that may be released during work on contaminated systems or structures. Other contamination control techniques, such as local ventilation, contamination control areas and so forth will be implemented where appropriate.

After all the equipment and radioactive contamination have been removed, the above ground structure of the WVRB, including the stacks, will be demolished and the concrete pad beneath the building will be removed. The utility lines below the nominal removal depth will be de-energized, capped and abandoned in place.

Due to the nature of the work carried out within the WVRB, there is a potential for contamination to be present within the building. OPG will perform the necessary surveys and develop a decontamination plan as appropriate to manage any residual levels of contamination.

J. Transportation Package Maintenance Building

Surveys will be performed in order to locate any radioactive material that may contaminate the TPMB equipment or structures. Building services will either be disconnected and de-energized or restored as required. Equipment that is identified as being contaminated will be decontaminated, dismantled and removed. Concrete found to be above the approved clearance levels will be removed by planing, scarifying, or drilling and spalling.

After all the equipment and radioactive contamination have been removed, the above ground structure of the TPMB will be demolished and the concrete pad beneath the building will be removed. The drainage sump will be surveyed, decontaminated if necessary, and the structure and any service line connections will be dismantled. The residual sub-surface sump structure will be sealed with an approved backfill material.

K. Amenities Building

Decontamination and dismantling of the Amenities Building will be similar to the processes described for the TPMB.

L. Waste Sorting Building

Decontamination and dismantling of the Waste Sorting Building will be similar to the processes described for the TPMB.

M. Multi Purpose Storage Buildings

Decontamination and dismantling of the MPSBs will be similar to the processes described for the LLSBs.

N. Dry Storage Container Processing Building

All equipment, furniture, and supplies in radiologically zoned areas will be surveyed and decontaminated as necessary prior to clearance for non-radiological use, recycling, or disposal. The active ventilation system will be dismantled and depending on the feasibility of decontamination, disposed of as LLW.

It is expected that remaining inventories of non-radioactive hazardous materials, such as small quantities of unused paint supplies and remaining chemical waste will be disposed of in accordance with the applicable Ministry of Environment and Climate Change regulatory requirements in force at the time of decommissioning. Non-radioactive hazardous materials will be disposed of at approved disposal facilities.

Interior structural surfaces will be surveyed to identify areas requiring decontamination. The characterization survey will determine the nature and extent of contamination present, for the purposes of hazard assessment as well as to facilitate and control decontamination work.

Decontamination activities may involve the following steps:

- Removal of equipment and material found to be above the approved clearance level from the DSC processing building;
- Removal of surface concrete found to be above the approved clearance level for controlled disposition; and
- Removal, packaging, and disposal of contaminated piping, ducts, and components of the DSC processing building systems.

On completion of the decontamination work, a final clearance survey will be carried out by OPG. Office space that is not radiologically zoned will be appropriately surveyed prior to clearance. If contamination is found in office areas, decontamination, followed by a clearance survey, will also be carried out.

There is no reason to expect particulate contamination to be released from the High Efficiency Particulate in Air (HEPA)-filtered[10] active ventilation system; HEPA filters are routinely changed and disposed of. However, a confirmatory survey of roof surfaces as appropriate will be carried out prior to radiological clearance of the processing building. It is also recommended that a sampling program be implemented to determine the contamination status of the entire ventilation system. As a minimum, it is suggested that a dedicated ventilation system survey be undertaken during the later end of decommissioning, as there is a risk that any particulate material present within the system will be disturbed during decommissioning work. In addition, it may be beneficial to implement a more frequent monitoring program during decommissioning work as the radiological conditions within key areas would then be monitored and remedial action could be undertaken promptly as appropriate.

It is likely that the HEPA filters will be consigned to the LLW decommissioning waste stream as they are difficult to characterize accurately, decontaminate and dispose. They will be sent for disposal at the LLW long-term disposal facility along with other decommissioning waste.

Drain openings will be surveyed and decontaminated if necessary and the drainage system will be removed.

When the DSC processing building structure has been verified to meet clearance levels, it will be released for demolition. The building will then be demolished using conventional demolition techniques. Concrete foundations and exterior walls are assumed to be removed down to the nominal removal depth of 1 m below grade wherever possible. This depth allows for the placement of gravel for drainage, and topsoil so that vegetation can be established for erosion control. It may be necessary to implement a land remediation strategy prior to landscaping activities to manage any residual contamination present in the local soil strata (see Section 4.1.3.4 for potential remediation techniques for contaminated land).

[10] HEPA filters are very high efficiency filters used for removing particulate matter from ventilation systems, typically capable of achieving removal efficiencies of ~99%.

O. Dry Storage Container Storage Buildings

The storage buildings are expected to be free from radiological contamination. However, before the dismantling of structural components, a characterization survey will be carried out to determine if there is any detectable contamination present in each building. This initial characterization survey will be designed to meet the full requirements of a final clearance survey.

Spot decontamination, followed by a final survey of potentially affected areas, will be carried out if necessary. When the structure has been verified to meet clearance levels it will be released for demolition following CNSC approval. Concrete foundations and exterior walls are assumed to be removed down to a nominal depth of 1 m below grade wherever possible. The 1 m depth allows for the placement of gravel for drainage, and topsoil so that vegetation can be established for erosion control.

4.1.3.4 Western Waste Management Facility Site Restoration

Once all of the buildings have been demolished, any remaining protective fences or site structures will be removed. It is unlikely that contamination will be present on outdoor surfaces (i.e., on asphalt or concrete yard surfaces); nevertheless, a survey will be carried out by OPG to confirm that the site is within the clearance limits derived in the DDP before anything is removed. Concrete rubble and clean fill produced by demolition activities will be used on-site to backfill voids. Areas affected by the removal activities will be cleaned and the site will be graded and seeded, consistent with future usage plans to be set out in the DDP.

Any site services such as utilities, drainage, ditches, or sampling and monitoring equipment that have been provided to the used fuel processing and dry storage area by or through the dismantled L&ILW processing and storage facilities area will be disconnected, diverted and restored.

OPG will perform final status surveys to confirm that no radioactive contamination remains.

A. Low- and Intermediate-Level Waste Processing and Storage Facilities Area

Surveys will be conducted to determine if the asphalt surfaces, soil or groundwater around the site has become contaminated. Drainage pipes and ditches, filters, valves and equipment associated with other services will be surveyed for contamination. Drainage pipes found to be above approved levels will be excavated and removed. The removed material will be decontaminated or packaged for disposal. Any soil found to be above the approved clearance level that is discovered in drainage ditches will be removed utilizing standard excavation techniques, other remediation techniques as considered appropriate, or vacuumed and collected for disposal if identified levels of contamination are sufficiently small and localized.

For planning purposes, it has been assumed that a small amount of buried piping on the site is above the approved clearance level. Piping found to be above the approved clearance level will be de-energized and excavated in a controlled manner for disposal, if required. The filter bed will be surveyed; any filter material found to be above the approved clearance level will be removed, and the remaining components will be abandoned in place. Uncontaminated piping and utility lines will be de-energized, capped (if required) and abandoned in place as practical. Electrical manholes, as well as vertical pump structures and sumps, will be backfilled with clean, crushed concrete or another suitable earthen material and abandoned. Culverts, head walls and stone riprap will remain in place to allow natural drainage. Manholes, catch basins, and other voids will be filled with clean debris or fill.

Any voids remaining after the structures have been demolished will be filled with clean, crushed and graded concrete or another suitable earthen material.

For planning purposes, it is also assumed that the site areas will be graded to prevent pooling and to restore natural drainage before being covered with topsoil. The topsoil will be seeded for soil stabilization and erosion control. Actual surface restoration may depend on OPG's plans for subsequent usage, which will be defined in the DDP.

B. Used Fuel Dry Storage Facility Area

Once all of the buildings have been demolished, the protective fences and any remaining site structures will be dismantled. It is unlikely that contamination will be present on outdoor surfaces (i.e., on asphalt or concrete yard surfaces); nevertheless, a final clearance survey will be carried out by OPG to confirm that the site is free of contamination before any dismantling work is performed.

Drainage pipes and ditches, filters, valves and other services will be surveyed for contamination. Uncontaminated piping and utility lines will be de-energized and abandoned in place. Manholes, catch basins and other voids will be filled with clean debris or fill.

Clean concrete rubble and fill produced by demolition activities will be used on-site to backfill voids. Areas affected by the dismantling activities will be cleaned and the site will be graded and seeded consistent with future usage plans to be set out in the DDP.

C. Contaminated Land Management

With regard to the management of land contamination in and around the in-ground facilities, it has been recommended in previous sections of this report that a vacuuming technique be utilized in the event that the identified levels of contamination are sufficiently low and localized. However, it is expected that in some areas, there is the potential for more contamination to be present than it would be practical to treat using such a technique. It is therefore recommended that alternative land remediation options be considered. A report has been compiled[11] reviewing potentially suitable land remediation techniques and technologies (both novel and standard approaches) that may be suitable for use at the WWMF site.

4.1.3.5 Waste Management

Any contaminated materials removed during the dismantling operation will be routed for on-site processing, where they will be characterized and then packaged in B-25 style containers for ultimate disposal at the long-term disposal facility for LLW. The estimated size and weight

[11] Wigginton, I. and Nesbitt, V. (2011) Supporting Information Regarding Land Remediation Techniques and Record Keeping Systems. Ref: 60020/DE/TR/001, Issue 1.

of waste packages will meet the waste acceptance criteria for the long-term disposal facility for LLW.

Material found to be below the established ‘clearance levels’ for radioactive material will be released for recycling or disposal in accordance with the waste management hierarchy (see Figure 4-2). From the very start of the decommissioning process, techniques and technologies that prevent wastes from being produced in the first place will be utilized. Where the production of waste cannot be prevented, management techniques that minimize the quantity, volume or activity of waste requiring disposal will be favoured over options that require its direct disposal. For example, materials will be reused or recycled wherever practicable, potentially following a pre-treatment stage (e.g., decontamination). If materials cannot feasibly be reused or recycled, treatment options that minimize the volume of waste to be disposed of will be employed. Potentially viable options to achieve this include incineration, high force compaction, in-drum compaction and shearing/shredding.

Sorting and segregation of wastes according to their physical, radiological and chemical properties will increase the effectiveness of this approach. Potentially contaminated material, removed during the dismantling operation, will be routed to an on-site processing facility, where they will be characterized, sorted, segregated and packed for disposal or alternative treatment at an appropriately licensed facility.

Where wastes have been characterized as being ‘exempt’ from regulatory control, an alternative route (e.g., to a conventional landfill site) will be defined. These routes will be identified during the development of the DDP.

Any non-radioactive hazardous material will be disposed of at approved disposal facilities. Any hazardous waste that is also radioactive will be disposed of in the long-term disposal facilities.

All processing and packaging of decommissioning waste will be performed on site by the DOC and not by OPG.

During the development of the DDP, a waste management plan will be developed. The plan will provide more detail on the proposed approach to waste management, and will include:

1. Descriptions of procedures, equipment and criteria to be used to characterize, handle and segregate the waste streams;

2. Details of waste volume estimates for each category;

3. Specific plans for waste minimization, including reuse, recycling, or disposal;

4. Options for volume reduction (such as supercompaction, shredding, incineration, etc.);

5. Clearance levels for decontaminated or otherwise clean items;

6. A long-term waste management strategy; and

7. Cost-benefit analyses of the options available.

A. Radioactive Waste Management

All of the L&ILW and used fuel stored at the WWMF will be transferred to the long-term disposal facilities and the APM repository respectively prior to the commencement of decommissioning work. OPG had planned to dispose L&ILW from the WWMF in a DGR at the Bruce Nuclear Site. Early in 2020, the L&ILW DGR Project was cancelled. OPG is exploring options and remains committed to permanent and safe disposal for its operational waste as well as future decommissioning waste. OPG is also participating in Natural Resources Canada's work in public engagement on the existing radioactive waste policy to ensure OPG is meeting international best practices. The NWMO 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. Any progress in regard to the policy and integrated strategy will be taken into consideration in OPG's decommissioning waste disposal strategy. This work is ongoing and is expected to be completed after the 2022 ONFA Reference Plan and associated 2023 CNSC Financial Guarantee update.

Any LLW generated from the decontamination of the L&ILW storage and processing facilities and the DSC processing and storage facilities at the WWMF will be packaged in B-25 style containers and transferred to the long-term disposal facility for LLW. Where practical, the volume of waste will be reduced. It is expected that LLW within the WWMF will be divided into three main categories: incinerable, compactable and non-processible. Volumes of non-processible waste will be kept as low as possible. There is potential for wastes currently labeled as non-processible to be recharacterized and reclassified, optimizing the use of existing waste processing techniques, and potentially opening up new management routes using advanced or more aggressive minimization programs.

Special measures will be taken to handle and package contaminated soil and liquids generated by decontamination processes. It is expected that active liquid wastes will be transferred to an external, off-site processing and/or disposal facility where possible. A potential option for managing suitable factions of this waste stream is incineration. An end point for contaminated soils (if they cannot otherwise be remediated using techniques such as those identified in Section 4.1.3.4) will be identified following the completion of option studies assessing the best available techniques for contaminated land management. A finalized strategy will be incorporated into subsequent revisions of the decommissioning plan.

Estimates of LLW quantities arising from decommissioning of the WWMF are shown in Table 4-2 and Table 4-3 [R-41]. These volumes will be revised as the facilities contributing to waste volumes sent to WWMF develop, and more information about them becomes available. The volume and characteristics of radioactive waste generated from the decommissioning will be estimated more precisely at the detailed decommissioning planning stage, when a more complete history of the facilities' conditions becomes available.

Table 4-2: Low-Level Waste Arising from Decommissioning the Western Low and Intermediate Level Waste Storage Facility

Area	LLW – 2023 to 2027 (m^3)
WVRB	973
Administrative Office	0
LLSBs	103
MPSBs	22
In-Ground Containers	228
In-Ground Heat Exchangers	99
Trenches	498
Tile Holes	777
Quadricells	8
Diversion Manholes, etc.	8
Common Areas	696
TPMB	7
RWSBs	9
Waste Sorting Budling	7
TOTAL	**3,435**

Note: Volumes of waste in this table are taken from the WWMF Decommissioning Cost Estimate [R-41].

Table 4-3: Low-Level Waste Arising from Decommissioning Western Used Fuel Dry Storage Facility

Area/Systems	LLW – 6 DSC Storage Buildings (2023 to 2027) (m^3)
DSC Processing Building	84
DSC Storage Buildings	95
TOTAL	**179**

Note 1: Volumes of waste in this table are taken from the WWMF Decommissioning Cost Estimate [R-41].

B. **Hazardous Waste Management**

As discussed in Section 2.2.10, small quantities of hazardous materials are used in the operation of the WWMF. Hazardous materials will be removed from their respective on-site storage locations at the end of the facility operations, prior to decommissioning.

If required, the following activities will be performed:

- Appropriate approved storage or disposal facilities will be identified prior to the beginning of the decommissioning project;
- Hazardous wastes will be packaged for transport and disposed according to applicable regulations;
- Waste manifests will be prepared and submitted according to applicable regulations; and
- Hazardous wastes will be transferred to appropriate, approved waste management facilities for storage or disposal.

Any hazardous waste that is also radioactive will be disposed of in the LLW long-term disposal facility.

C. **Conventional Waste Management**

Waste that is neither radioactive nor hazardous (such as clean concrete, metals, roofing, cladding, etc.) that has been released as free from contamination will be recycled or disposed of at an approved landfill site. Some clean concrete may be used to fill voids for site restoration.

4.1.3.6 Surveys

A series of surveys for radioactivity and other hazardous materials will be performed throughout the course of the decommissioning work based on available guidelines at the time of decommissioning. In accordance with standard CSA N294:19, surveys will be carried out at the end of each decontamination or demolition work package to ensure that the planned end state has been achieved. Several different types of surveys are likely to be performed at different stages of the decommissioning.

The surveys conducted should be systematic, and statistically robust. The sampling plan will consider the recommendations of CSA N294:19, Annex G regarding the use of the Data Quality Objectives (DQO) approach[12]. The key steps of the DQO process are:

1. Identify the purpose and objectives of the survey;
2. Identify and review available information;
3. Define the boundaries of the survey;

[12] DQO is a systematic approach to problem solving and data capture required in order to develop a robust sampling plan, reflecting the principles of the MARSSIM approach.

4. Identify potential sampling and analytical techniques;

5. Specify the performance and acceptance criteria; and

6. Develop the survey plan.

A post-operational survey will be performed when the facility has ceased operation in preparation for decommissioning. Characterization surveys may be performed to identify the nature and form of the remaining contamination in order to assist in the planning of decontamination work.

Regular contamination control surveying at the site will also help monitor the effectiveness of any mitigation measures implemented in preventing or minimizing potential impacts on receptors throughout the decommissioning process. Review of mitigation strategies may be necessary based on the results of site surveys. If shortfalls are found when comparing monitoring data with predicted environmental conditions, checks will need to be made to ensure that control measures have been correctly implemented or alternative/additional measures will need to be considered. The implementation of a mitigation strategy is considered in more detail in Section 7.3.

Remedial action support surveys will be performed by OPG during dismantling and demolition in order to assess the success of decontamination and excavation activities and guide further efforts. They are used to control the exposure of workers to radiation and hazardous materials. Remediation control surveys are typically based on simple measurements such as contact radiation dose rates or direct contamination checks.

Final surveys will be performed by OPG during site restoration, to confirm that residual activity levels of radioactive and hazardous material in buildings, components and the site itself are below the established clearance levels. This will confirm that the agreed endpoint has been reached. When the results of the final surveys have been accepted by the regulatory agencies the site may be released from further regulatory control. In order to establish the final end state of the site, the results of the final surveys shall be documented in a report that includes (in accordance with the requirements of CSA N294:19):

- The criteria used to define the end state;
- The methods and procedures used to ensure that the criteria were met; and
- The measurement data, including appropriate statistical analysis and systematic approaches.

To ensure that all of the surveys are properly executed, they will be performed when the remaining structures and materials are still accessible. All of these surveys will be performed according to approved procedures that will be based on the recognized standards and guidelines in use at the time. The surveying procedures will describe:

- Sampling strategies and methods that will be employed during the survey.
- Instruments and laboratory methods that will be used.

- Statistical techniques that will be used to analyze and interpret the data.
- Documentation that will be prepared and retained.
- The quality assurance and quality control program that will be in place.
- Performance acceptance criteria.
- Roles and responsibilities.
- The defined boundaries of each survey.

4.1.4 Completion of Decommissioning

Completion of decommissioning involves verifying that all decommissioning activities have been completed satisfactorily, the final end state has been reached, and all documentation has been completed. In some cases, this phase involves verification and acknowledgement by the appropriate regulatory authority that decommissioning is complete and end state objectives have been achieved. Once this is verified the site can be released from regulatory control, in accordance with the NSCA.

Aspects that will be considered as part of this phase include, but are not limited to:

- The final end state of the facility (see Section 4.1.4.1); and
- Release of the licensed facility from regulatory control (see Section 4.1.4.2).

Once the decommissioning is complete, decommissioning records will be retained for at least 10 years, or alternative period as outlined in the relevant licensing requirements in place at the time of decommissioning.

4.1.4.1 End State

By the end of the site restoration phase, the site will meet the release criteria as agreed with the CNSC for release from regulatory control. All radioactive contamination in excess of the established clearance levels and all other hazardous materials will have been removed from the site. All of the facility systems will have been dismantled and all of the buildings demolished. The site will have been restored to a state suitable for other use(s) by OPG. Specific end state criteria will be developed in the future.

In accordance with the requirements of CSA N294:19, final surveys of residual radioactive and hazardous materials shall be performed and documented to demonstrate that the final end state for any remaining equipment, structures and the overall site has been achieved in accordance with the criteria specified in the DDP.

CSA N294:19 Annex F describes the process of defining end state objectives for decommissioning. In summary, the process steps are:

- project definition;

- site assessment;
- establish potential end uses;
- establish end state objectives;
- establish cleanup criteria;
- finalize plan;
- obtain plan approvals; and
- plan implementation.

End state objectives are radiological and non-radiological goals that are considered acceptable for the proposed end use. One end state objective for the decommissioned WWMF site is that a site total effective dose of 0.25 mSv per year to a member of the critical group is assumed (see Section 4.1.4.2).

Once the end state has been reached, a final end-state report will be prepared and retained by the facility.

4.1.4.2 Release from Regulatory Control

A final report of the decommissioning will be prepared describing the decommissioning work that has been performed, the outcome of that work, the results of the final surveys that were performed and the interpretation of those results (i.e., whether remediation activities have achieved the approved levels of residual contamination). Other information required by the applicable regulations will also be included, including those required by the IAEA to confirm that no more safeguards will be required. The final decommissioning report will be submitted to the CNSC in support of application for release of the WWMF site from regulatory control.

In conjunction with the development of the final decommissioning report, OPG will investigate the financial and programmatic implications of meeting the necessary site clean-up requirements. Accepted clearance levels will be met in order for the site to be released from regulatory control.

5.0 DECOMMISSIONING COST ESTIMATE AND FINANCIAL GUARANTEE

This section deals with the costs associated with decommissioning the WWMF and provision of a financial guarantee for the accumulated liability.

5.1 Cost Estimate

A site-specific cost estimate was prepared by TLG in the year 2000 for decommissioning the WWMF based on the unique features and expected condition of the site after removal of all stored radioactive waste. This site-specific estimate was updated in 2007 by OPG and subsequently updated again in 2011, and 2016 by TLG. The 2021 cost estimate provides an update to the previous estimates based on site changes and projected additions during 2023 to 2027 and by the end of life configuration [R-41]. The basis for all estimates, including the source of information, methodology, assumptions and total costs, is described in this section.

The total estimated cost to decommission the WWMF based on the expected site plans for the years 2023 to 2027 is shown in Table 5-1 (below) in year 2022 constant dollars, summarized by decommissioning period [R-41].

Table 5-1: WWMF Cost Estimate Summary by Decommissioning Period for 2023 to 2027 (in Year 2022 k$)

Decommissioning Period	Low and Intermediate Level Waste Storage Facilities and Area[13]	Western Used Fuel Dry Storage Facilities and Area[14]
Period 1 – Planning and Preparation	18,102	5,530
Period 2 – Site Decommissioning	74,479	9,498
Period 3 – Site Restoration	9,190	7,773
OPG Oversight (all periods)	4,856	2,695
Total Estimated Cost	**106,627**	**25,496**

The cost associated with decommissioning the WWMF L&ILW facilities and area during the financial guarantee period from 2023 to 2027 is estimated to be $106.6M in 2022 dollars. The cost associated with decommissioning the WWMF used fuel facilities and areas during financial guarantee years 2023 to 2027 is estimated to be $25.5M in 2022 dollars [R-41]. The decommissioning costs presented in this section are accurate as of the time of PDP approval. As OPG is currently in the process of finalizing its 2022 ONFA Reference Plan, these decommissioning costs may change pending further reviews.

A summary of the cost estimate for decommissioning the WWMF can be found in Appendix E. The cost estimate will be updated when changes to WWMF planning assumptions occur. These changes may include addition of facilities, systems and equipment or other changes to planning assumptions.

The costs associated with the management of used fuel, including interim storage, transportation and disposal, are not included in this estimate. Plans and cost estimates for these activities are described in separate documents.

OPG will continue to provide an annual status report to the CNSC staff detailing amounts accumulated in applicable segregated funds for decommissioning and management of used fuel. The report will also identify any material changes in decommissioning plans or cost estimates, which may impact the financial liability incurred.

[13] L&ILW decommissioning values include 10% risk contingency.
[14] 10% risk contingency is not applicable to WUFDSF decommissioning values.

Only facilities and land within the licensed/protected area are covered by the decommissioning segregated funds.

5.2 Financial Guarantee

For the 2023 to 2027 Financial Guarantee liabilities calculations, the TLG cost estimates will be adjusted to incorporate costs from the Financial Guarantee year onwards. The Financial Guarantee will be submitted to the CNSC for all licensed OPG facilities in 2022.

6.0 HUMAN AND ORGANIZATIONAL FACTORS

OPG will ensure that human and organizational factors issues are considered throughout the planning and execution of the decommissioning project. As development of the decommissioning plan progresses, OPG will liaise with the CNSC to establish a set of human and organizational factors requirements and expectations in accordance with CNSC's regulatory document REGDOC-2.2.1, Human Factors [R-53]. The established human and organizational factors requirements will be incorporated into the DDP. It is expected that special attention will be given to staffing and training in order to minimize potential problems resulting from the loss of experienced personnel over time.

The change of mission from waste processing and storage (L&ILW and DSCs) to decommissioning has the potential to have a significant impact regarding retention and expansion of knowledge management. Operational and facility staff that leave their current positions to take up other duties will take with them extensive and detailed knowledge of the facility at every working level. A relatively high risk is that despite its value in supporting the decommissioning process, such detailed operational information is not always captured in formal reports or other documentation and could therefore be lost as turnover of competent staff continues. It is therefore essential that mechanisms are put in place to capture this information. This can be achieved through staff interviews, questionnaires, and so on.

OPG will retain responsibility for the facility throughout the course of the preparation for decommissioning phase of the project. A DOC will be contracted to perform the dismantling, disposal and site restoration work, but OPG will maintain oversight of its activities.

The staffing numbers for each phase of decommissioning can be found in the WWMF Decommissioning Cost Estimate [R-41], and have been estimated based on the planned activities in each phase, schedule, work difficulty factors, industry experience, etc. The staff numbers should be considered preliminary (i.e., for cost estimating purposes only). Business plan staffing numbers have not yet been established and will be determined at a later date.

7.0 POTENTIAL ENVIRONMENTAL AND SOCIO-ECONOMIC EFFECTS

Over the course of the decommissioning work, there may be impacts on the natural and socio-economic environment. The listing in this section is not intended to be exhaustive since, at this time, the PDP only highlights some of the potential effects.

As the decommissioning plan develops, and the nature and extent of potential impacts are better understood, it is expected that a formal environmental scope will be defined. It is likely that the majority of the impacts identified will have very localized effects restricted to areas within or very close to the site boundary. As a result, it is recommended that a spatial boundary be defined, beyond which environmental impacts are not considered. This is due to the low risk of occurrence and/or low risk of harm being caused as pathways are interrupted and sources dispersed. This would be developed as results from initial survey data are collated.

It is recognized that the baseline conditions for each of these aspects would first need to be defined before decommissioning activities are commenced to allow impacts to be accurately quantified, and appropriate mitigation measures identified. It will also help to establish meaningful remediation targets.

Baseline data will be collated from data produced as a result of historical and continued monitoring programs. At the time of writing, it is recognized that an extensive and comprehensive radiological monitoring program is in place at the Bruce site. It has been designed to measure environmental radioactivity in the vicinity of the BNGS from all sources. To achieve this, the radiation and radioactivity in air, water, soil, groundwater, foodstuffs and fish in the region are monitored. In addition, OPG has and will continue to have monitoring programs in place for non-radiological contaminants, to ensure compliance with applicable federal and provincial regulations.

In addition, the WWMF operates a radiological zoning plan to provide optimal control of radioactive contamination. Each zone area is kept as small as possible, with zone boundaries clearly defined.

Historic and continued monitoring data, combined with the results of historical environmental assessments (e.g., Predictive Effects Assessment for the Western Waste Management Facility Expansion Project [R-54]) will provide a fundamental basis for future environmental assessment work covering decommissioning activities.

The Impact Assessment Act [R-35] came into force in 2019 and is the legal basis for the federal environmental assessment process in Canada, now known as an Impact Assessment (IA). In consultation with the CNSC, OPG will determine the requirements for performing an IA, if required, prior to dismantling and demolition to ensure that adequate provisions for the protection of the environment and the health and safety of persons are made during decommissioning. Some of the effects on the natural and socio-economic environment that might occur over the course of the decommissioning work are described in Section 7.0.

7.1 Natural Environment

The decommissioning activities to be carried out at the WWMF have the potential to exert impacts on staff, local communities and the wider environment. OPG is therefore committed to running its site, from operational through to decommissioning and dismantling activities, in a way that minimizes impacts as much as possible.

Environmental impacts depend on the 'source → pathway → receptor' chain; if any of these links are removed, a potential impact cannot be realized. This is applicable to all the receptors discussed in the following subsections. It is recognized that where the source of an impact cannot be removed, disrupting the pathway to the receptor is often an effective management approach. In response to this, it has been noted in an earlier study[15] that five (5) meter buffer zones are maintained between storage buildings and perimeter fences, and that additional buffer zones (and perimeter fences) should be put in place between the outer perimeter fence and dry fuel store buildings. It is expected that this would reduce the potential for contamination egress off of the WWMF site.

7.1.1 Air Quality

The heavy construction equipment expected to be used during the decommissioning work and the vehicles expected to be used for transport of waste and other materials may release exhaust gases into the atmosphere. These vehicles may also result in traffic and noise pollution. The nature and extent of these releases will depend on the type of equipment in use at the time of the decommissioning. Some localized temporary degradation of air quality may result from the dust released during cutting operations; particularly during dismantling. Dust suppression technology will be employed where possible to reduce the impact of localized dust generation.

7.1.2 Land Use

Since it is expected that the site itself will continue to be used for industrial purposes, the current land use designation will not change. It is not anticipated that the decommissioning work itself will have any impact on the use of the surrounding lands.

7.1.3 Vegetation

The operating area of the WWMF site is highly developed, with most of the non-building area being covered in asphalt. The most heavily vegetated areas surrounding the site are well removed from the facility and not likely to be impacted during the course of the decommissioning work.

7.1.4 Wildlife

Wildlife activity is minimal within the boundary of the WWMF site during operations due to the lack of natural habitat. Many of the birds and the larger mammals anticipated on or near the site are highly mobile and move around the surrounding area in search of food. There will be a short period of time during the planning, mobilization and site preparation activities when there will be little or no human activity on the WWMF site. The level of decommissioning activity will increase during the decontamination, dismantling and site restoration phases and may have the potential to impact wildlife populations. However, the level of work activity is unlikely to be significantly higher than that during normal operations at the WWMF so minimal impact on wildlife is anticipated.

[15] OPG NWMD (2009) Nuclear Waste Management Technical Support Document. New Nuclear – Darlington Environmental Assessment. NK054-REP-07730-00027, Rev 000. OPG Nuclear Waste Management Division, August 2009.

Potential effects may be caused by dust, noise, and sedimentary runoffs as a result of the dismantling work which may have potential to impact some species. Increased vehicular traffic during some phases of the decommissioning may have potential to impact wildlife.

7.1.5 Water Quality and Aquatic Life

The WWMF is well removed from the shore of Lake Huron and decommissioning activities should not have any direct impact on the lake. The WWMF site drains into a wetland area to the east of the site. Water from the railway ditch, originating from the west and central portion of the WWMF site, is treated by oil and grit separators prior to discharge to the wetland. Stormwater from the east portion of the WWMF site is treated by the stormwater management pond prior to discharge to the wetland. Some increase in turbidity of the water along the railway ditch and wetland may result from dismantling and site restoration work. This may have a temporary impact on the fish habitat in the wetland area; all efforts will be taken to physically prevent sedimentary discharges from the decommissioning site.

Since there is no waterway pathway from the WWMF site to the Little Sauble River, the decommissioning of the WWMF is not expected to have any impact on the Little Sauble River.

7.1.6 Noise

Heavy construction equipment may be used during the dismantling work performed towards the end of the decommissioning. This work may produce localized elevated noise levels in the immediate surroundings, but the effect will probably be limited to the nuclear site. Site workers and wildlife may be impacted by the increased noise. The potential impacts of demolition noise will be assessed prior to dismantling and demolition. Appropriate mitigation strategies will be put in place.

7.2 Human and Socio-Economic Environment

7.2.1 Purpose

CNSC regulatory guide G-219 [R-3] and CSA N294:19 [R-4] specify that a PDP should include the “identification of any features of the surrounding social environment that could be significantly affected by the decommissioning process”. The purpose of this section is to identify specific human environmental features that may experience impacts when decommissioning occurs. A range of potential sources of effect is discussed, focusing on the potential for socio-economic impacts, at the local, community, and regional level, associated with the decommissioning of the WWMF.

This section does not attempt to assess or evaluate what impacts may actually result at the time when decommissioning occurs. The determination of impact, or significance of effect, is made by those affected by these changes and, hence, socio-economic impacts are specific to time and place. The impacts resulting from the decommissioning process will be assessed in a future environmental assessment, if required, and their significance determined at that time.

7.2.2 Scope

At a future time, when an environmental assessment is undertaken, if required, the scope of the socio-economic assessment considerations would include the other planned activities occurring in the same time period, such as decommissioning BNGS, which when taken together with the planned decommissioning of the WWMF may have the potential for cumulative impact on the local communities.

Aspects to be considered include:

- Direct economic impacts – employment (local/non-local), skill groups required, labor supply, etc.;
- Indirect economic impacts – employee expenditure, suppliers, labour markets, etc.;
- Demographics – changes in population size and characteristics (long and short term);
- Housing; and
- Other local services – police, health, social, education, and so on.

7.2.3 Definitions

Socio-economic impacts are changes in people's wellbeing and/or changes in significant aspects of their communities as a result of a development or project.

Socio-Economic Impact Assessment (SEIA) is a process designed to identify and evaluate the potential social, cultural, and economic effects of a proposed project, policy, program, or plan on people, organizations, institutions, communities, and social systems. The purpose of the SEIA is to recommend impact management measures that would improve a project by reducing negative community effects and enhancing community benefits.

Impact management involves the coordinated application of measures designed to mitigate, enhance, compensate, plan for contingencies, monitor, and to ensure continuing liaison with the community. Measures could also include formal impact agreements.

SEIA and impact management improve projects by identifying and managing the costs and benefits, and by facilitating decision-making. A SEIA would be undertaken as part of the environmental assessment of decommissioning, if required.

7.2.4 Temporal Considerations

As mentioned in Section 4.1, the four main phases associated with decommissioning of the WWMF are: planning for decommissioning, preparation for decommissioning, execution of decommissioning, and completion of decommissioning.

Each of these phases will involve discrete activities that will result in effects on local communities. Socio-economic effects will begin with the commencement of activities that engage the local communities. For planning purposes, it is assumed that local communities will be impacted by socio-economic effects due to decommissioning during two discrete time frames. The first stage of socio-economic effects on local communities is expected to begin in 2067 with decommissioning of the L&ILW storage and processing facilities and associated area of the site. The second stage of socio-economic effects on local communities is expected to begin in 2092 with decommissioning of the used fuel dry storage facilities and associated area of the site.

Transfer of the stored L&ILW from the WWMF to the long-term disposal facilities will have the potential to affect the local community. Transfer of the stored used fuel to the APM will include planning, licensing activities, and transportation. The removal of the used fuel and the transfer of decommissioning waste from each of the site areas have the potential to affect the local community. The nature and extent of any associated socio-economic effects will be determined at that time in an environmental assessment, if required.

As illustrated in Table 4-1, decommissioning starts in 2067 for the L&ILW processing and storage facilities and continues up to 2094 for the used fuel storage facilities, a period of 27 years. Actual activities associated with these planned phases will be intermittent. However, it is important to understand the overall flow of activities, as they will be the source of potential socio-economic impacts.

7.2.5 Planning and Preparation for Decommissioning: Sources of Effects

Preparation for decommissioning will start in nominally 2064 when the detailed planning activities are scheduled to commence. The preparation of the decommissioning environmental assessment, if required, and the DDP will involve the local community. This involvement and the associated concerns about the impending shutdown and decommissioning of the WWMF may have related socio-economic effects.

In 2043, when the transfer of stored wastes begins, there are expected to be about 100 people working in the L&ILW area of the WWMF. The size of the WWMF workforce is likely to increase slightly in the years during waste transfer to the long-term disposal facilities. When the L&ILW storage and processing facilities are shut down in 2060 the remaining operations workforce for these facilities will no longer be required.

The size of the WWMF workforce is expected to decline in the years before shutdown of the used fuel processing and dry storage facilities as used fuel will be transferred to the APM repository (beginning no earlier than 2043). When the used fuel storage and processing facilities are shut down the remaining operations workforce will no longer be required. OPG staff will be employed in the planning activities to prepare the used fuel facilities and area for decommissioning. See Section 6.0 for further details regarding staffing needs during the different decommissioning phases.

Potential socio-economic effects will be evaluated as required. For planning purposes, it is assumed that the amount of local taxation would not change when the facility is no longer operating up to the end of decommissioning.

7.2.6 Execution of Decommissioning: Sources of Effects

Decommissioning of the L&ILW storage and processing facilities and associated areas will require approximately two years to complete. Decommissioning of the used fuel dry storage facilities and associated site areas will also take approximately two years. This work may represent opportunities for the local labour force (see Section 6.0 for further detail on staffing levels), but it is also possible that, because of the short duration and the nature of the work, workers may commute from outside the region, and seek only temporary accommodation.

Local spending associated with the dismantling activities may benefit local contractors and suppliers. These changes may affect the local and regional communities.

Concrete-based materials free of contamination and clean fill produced by the demolition work will be used on site for fill. The volume of contaminated materials resulting from demolition work requiring transfer to the long-term disposal facility for LLW is not expected to be large (see Table 4-2 and Table 4-3). The impact on the community of dealing with these decommissioning waste materials is therefore expected to be minimal. However, these sources of potential effects will be evaluated in the environmental assessment, if required, at the time.

7.2.7 Site Restoration: Sources of Effects

Following the execution of decommissioning phase, OPG will verify that: all decommissioning activities have been completed satisfactorily; the final end state has been reached; and all documentation has been completed. At the conclusion of the site restoration phase, the associated workforce will no longer be required, and any local spending associated with the decommissioning work will conclude. The site will remain an industrial zone, and its future use may impact the local and regional community.

Under current assessment legislation, OPG will continue to pay the property tax on the same buildings and structures until they are removed. The tax amount paid after the dismantling of all buildings will depend on the future uses of the land.

These issues will be evaluated in the decommissioning environmental assessment, if required, prior to the commencement of decommissioning, and an impact management plan will be developed.

7.3 Mitigation Measures

It is recognized that many of the decommissioning operations to be undertaken on site have the potential to have impacts both on and off site. There is potential for staff, members of the public and the wider environment to be affected. As the decommissioning plan develops, a mitigation strategy will also be developed to address potential impacts.

The purpose of creating and implementing a mitigation strategy is to reduce or remedy significant adverse effects on the environment and human populations. Emphasis is placed on proactive mitigation measures that prevent identified impacts from occurring in favour of reactive measures that manage impacts once they have occurred. A diagram summarizing the hierarchy of mitigation measures is provided in Figure 7-1. This can be applied to both socio-economic as well as environmental effects.

Mitigation measures can be grouped into four main categories: alternative options; physical controls; managerial controls; and deferred mitigation. If a particular operation or technique is identified as being a potential source of harm, it is necessary to consider alternative options that are capable of producing the desired result, but also prevent or minimize the identified impact. Physical control measures are generally engineered solutions aimed at preventing identified impacts from reaching potential receptors. Examples could include: construction of physical barriers such as bunds; enclosed structures for carrying out activities; landscaping to minimize visual or noise impacts; undertaking of regular maintenance work to sustain site conditions; installation of sediment traps; and so on. Managerial measures rely on controlling how activities are carried out on site to reduce impacts. Examples might include: regulating certain activities; limiting the duration of noisy activities; ensuring work is carried out within normal working hours only; limiting the extent of the operation undertaken; ensuring work is carried out in accordance with approved method statements and operational controls; and so on. Deferred mitigation might occur where an impact is unavoidable, and remedial/restorative action is required instead. This might include site decontamination, relocation of local amenities to another area, site landscaping, and so on.

When developing the mitigation strategy, it is essential that the process is carefully managed and reviewed to ensure that the proposed measures are effective, do not conflict with other mitigation measures or site activities, and do not simply shift the problem from one medium to another. It is also valuable when developing the mitigation strategy, to systematically record this process. This facilitates the production of an auditable trail to justify subsequent decisions made. It will be necessary to identify each impact, its source(s), receptors to the impact, and potential significance of the impact – in both a mitigated and unmitigated scenario. This will help determine whether the cost of implementing a mitigation measure is proportionate to the benefits gained.

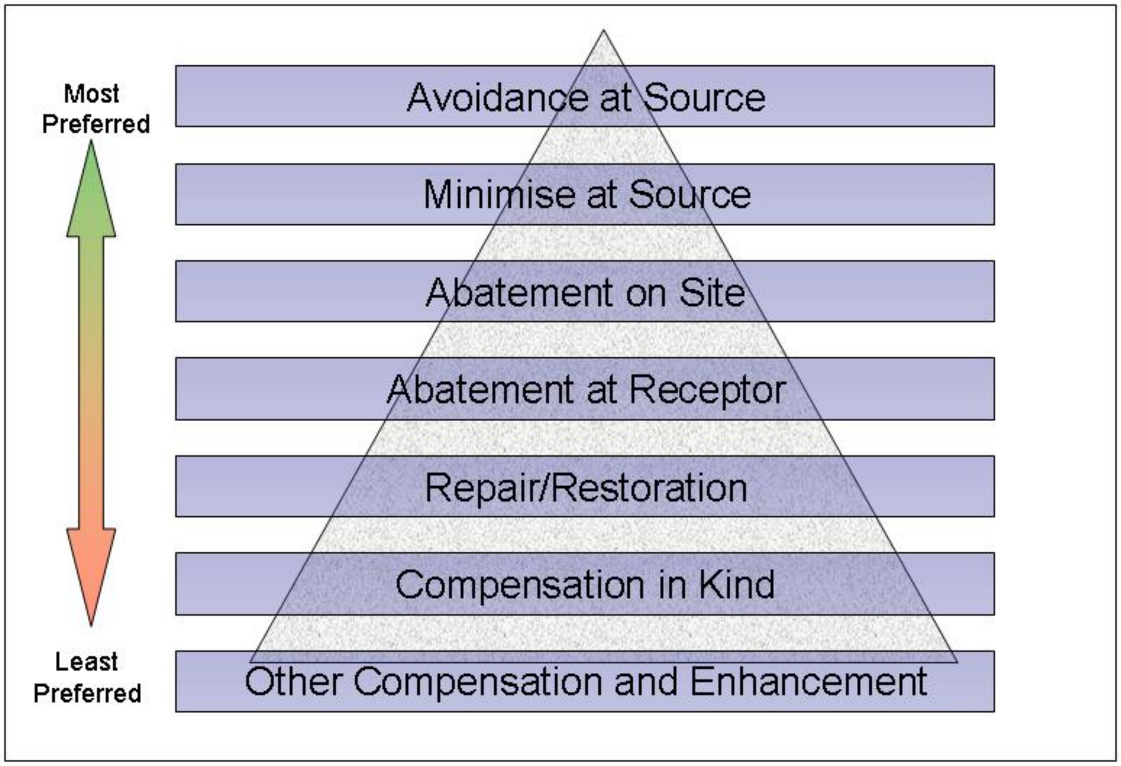

Figure 7-1: Hierarchy of Mitigation Measures

8.0 POTENTIAL HAZARDS AND HEALTH AND SAFETY

8.1 Hazard Assessment

The radiological, chemical and construction hazards that might be encountered during decommissioning work will be similar to those that may arise during some routine operational activities and preparation for decommissioning activities.

A workplace health and safety assessment will be carried out to formally identify and quantify the potential hazards to operators resulting from decommissioning activities. This will help OPG meet their obligations under the OHSA, which stipulates that it is the responsibility of the employer to inform all employees about the potential hazards they may come into contact with as part of their day to day work. Specifically, an employer must: *"acquaint a worker, or a person in authority over a worker, with any hazard in the work and in the handling, storage, use, disposal and transport of any article, device, equipment or a biological, chemical or physical agent"*.

Approaches to hazard assessment, a key tool used in the OHSA, include:

- Carrying out detailed inspections and or testing of the hazard;
- Recording of physical observations made by trained staff;

- Investigations of near misses;
- Conducting operator interviews; and
- Reviewing records such as first aid records and minutes of joint Health and Safety committee meetings.

In addition, under the OHSA, it is also the legal obligation of staff to report unsafe conditions so that they can be addressed promptly.

In order to identify (and subsequently manage) the potential hazards, a workplace health and safety assessment will be carried out, in accordance with the applicable regulations at the time, to formally identify and quantify potential hazards to operators resulting from decommissioning activities. OPG will undertake a hazard assessment that will take into account the following:

1. The nature of the hazard;
2. The potential level of exposure of staff to the hazard;
3. The frequency and duration of exposure of staff to the hazard;
4. The effects on the health and safety of employees;
5. Mitigation measures proposed to address the hazard; and
6. Any other relevant information, including staff reports on (potential) incidents.

To ensure the hazard assessment is comprehensive, the methodology to be used will detail the resources and timeframes required for assessing the hazards, the proposed hazard record keeping system and a timeframe for reviewing and revising the methodology in light of additional information. In addition, the following information should be reviewed and included as appropriate:

- Hazardous occurrence reports;
- Details of existing health and protection programs;
- Employee incident reports;
- First aid/minor injury reports;
- Results of workplace inspections;
- Government or employer reports, studies and tests concerning the health and safety of employees;
- Records of holdings of hazardous substances; and

- Any other relevant information that might help identify and/or quantify potential hazards.

On completion of the hazard review, a hazard prevention program should be developed based on the results of the assessment. In addition to physical (e.g., engineered controls) and managerial (e.g., safe systems of work, operational procedures etc.) preventative measures, the program should include provisions for staff education.

Hazard assessment is a future activity, the results of which will be incorporated into later revisions of the decommissioning plan documentation. Some of the possible hazards are summarized in the following sections.

8.1.1 Radiological Hazards

8.1.1.1 Hazards to Workers

All of the stored L&ILW and used fuel will be removed from the WWMF before decommissioning begins. The only remaining radioactive material on the site will be low levels of contamination on the surfaces of equipment and structures. It is anticipated that radiation fields will be low and the external radiation hazard will be minimal. Contamination control will be the major focus of the radiation protection program.

8.1.1.2 Hazards to the Public

OPG radiation protection procedures will be maintained to prevent the unlikely occurrence of loose contamination being present on persons, packages or containers leaving the site. In addition, an environmental monitoring program looking at emissions and effluents will be maintained through waste removal and decommissioning operations.

The WWMF facility is physically remote from public use areas. The volume of LLW generated during the decommissioning will be small (see Table 4-2 and Table 4-3); hence the frequency of off-site shipments should not cause any additional radiological risk to the public over current levels.

The risk to members of the public will be further reduced through the use of approved packages and containers, deployment of fully Suitably Qualified and Experienced Persons (SQEP) staff, use of approved procedures and adherence to applicable regulatory requirements regarding radioactive waste transport and disposal.

Finally, clearance surveys will be carried out to confirm that clearance objectives have been achieved for areas and materials destined for unrestricted public use.

8.1.1.3 Occupational Dose

Occupational doses are expected to be low, since the only radioactive materials remaining on-site at the beginning of decommissioning is expected to be low-level contamination on equipment and structures.

8.1.2 Chemical Hazards

During decommissioning, potential chemical hazards may arise from the handling of cleaning agents used during decontamination work, and concrete dust generated during the dismantling work.

The risk of harm will be significantly reduced through the use of correct personal protective equipment and staff training. Chemical storage during decommissioning will also 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).

8.1.3 Industrial and Demolition Hazards

Demolition hazards that might be encountered during the decommissioning activities will be similar to those encountered in any other industrial decommissioning project. These may include:

- 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 demolition;
- The use of blasting and other techniques to demolish concrete structures; and
- Falls, lifting of heavy objects, falling objects, use of hand tools and the other hazards routinely encountered during dismantling and demolition work.

8.2 Radiological Safety

All decommissioning activities will be carried out in accordance with the ALARA principle and OPG's approved radiation protection procedures. Where required, the radioactive work planning process will be utilized.

8.3 Chemical and Demolition Safety

OPG will ensure that decommissioning work will be conducted in accordance with the requirements of the applicable federal and provincial occupational health and safety regulations. OPG currently has a comprehensive occupational health and safety program that meets the requirements of the OHSA of Ontario. 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; and
- The right of employees to refuse to perform work that is unsafe.

OPG will ensure that the DOC and any subcontractors maintain occupational health and safety programs that are consistent with OPG's programs and the OHSA.

8.4 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.

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

- The required emergency response plans and procedures will be in place;
- The plans will be reviewed and exercised appropriately;
- An adequate number of personnel will be available to respond to a real or potential emergency situation that may occur; and
- The necessary equipment and supplies will be available for use by emergency response personnel.

9.0 SECURITY AND SAFEGUARDS

9.1 Security

During decommissioning, OPG will continue to comply with the CNSC regulations on the physical security of nuclear facilities.

OPG will be responsible for the security of the site throughout the course of the decommissioning and the DOC and sub-contractors will be required to comply with OPG procedures regarding physical security.

9.2 Safeguards

In accordance with an agreement between the Government of Canada and the IAEA, nuclear safeguards are implemented at the WWMF. These international safeguards will apply to the WWMF until the L&ILW and used fuel are removed from the site. The decommissioning of the WWMF will not be impacted by safeguards requirements since all L&ILW and used fuel will have been removed from the site prior to the commencement of decommissioning. Once all the L&ILW and used fuel has been removed from the WWMF, OPG will provide the required information and access to the IAEA for confirmation that no more safeguards will be required.

10.0 QUALITY ASSURANCE

OPG will incorporate quality programs to assure that all appropriate requirements, including occupational, public, and environmental protection, are met during the decommissioning of the WWMF. The decommissioning quality assurance program will be designed to meet the relevant requirements of CSA N286-12[R-36]. The aspects that will be considered in the quality program may include, but are not limited to:

- Development of a project organization chart, identifying key roles and responsibilities;

- A method for certifying SQEP;
- A system for the production of documents and their control;
- A mechanism for the resolution of comments, or project issues;
- A system for managing staff training requirements;
- A system for the control of procurement; i.e., ensuring that subcontractors, materials suppliers etc. conform to an equally high-quality standard;
- A system for labeling, identifying and tracking waste packages;
- Systems for undertaking and checking calculations, models and analyses;
- Provisions for independent technical reviews;
- An approved document/record keeping system; and
- Provisions for the undertaking of quality assurance audits.

11.0 DOCUMENTATION (RECORDS)

It is recognized that there is a potential for information about the WWMF to be lost as individual facilities within the site shut down, and staff numbers decrease. It is therefore necessary that measures be taken early on to preserve and improve the existing records database, capturing all potentially relevant information. Decommissioning-related documentation will be managed and maintained in accordance with OPG's Record Management requirements, CSA N294 and IAEA guidance related to record keeping (e.g., Technical Reports Series No. 411 [R-55]). These records include:

- Design of facilities and buildings included in the decommissioning plan;
- Details of the initial design and configuration of the facilities and the modifications made over their operating lifetime;
- Descriptions of the nature and location of hazardous materials in the facilities and the disposition of hazardous materials that have been removed;
- Records of worker health and safety, including information required by applicable regulations and doses of ionizing radiation received by workers from the decommissioning work; and
- Details of spills and releases of radioactive materials or environmentally hazardous substances that may have occurred during the operational lifetime of the facility.

Records will meet the following requirements:

- Records will be kept using the storage medium in standard use at the time of decommissioning;
- Duplicate copies will be maintained; and
- Records will be assembled and maintained in secure storage.

12.0 PUBLIC AND STAKEHOLDER ENGAGEMENT PROGRAM

A public and stakeholder engagement program will support the development of the DDP, along with an Indigenous relations program. The program will include both information and consultation opportunities. It 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 program will identify issues and concerns, ensure opportunities for involvement, ensure all input was considered in decommissioning planning and environmental assessment activities, if required, and include the documentation of the process and results. The program will also support the development of an integrated community impact management plan.

Under the current planning assumptions, Radioactive Waste Operations Site 1, the Central Maintenance and Laundry Facility and the Central Storage Facility (other, smaller facilities on the Bruce nuclear site) will be decommissioned together with the WWMF. It is therefore expected that the public and stakeholder engagement program, as well as the Indigenous relations program will include these three facilities as well.

The public and stakeholder engagement program will comply with the applicable requirements of REGDOC-3.2.1, Public Information and Disclosure and REGDOC-3.2.2, Indigenous Engagement.

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Appendix A: Description of the Waste Volume Reduction Building

Table A-1: Descriptions of Functions of Areas and Systems in the Waste Volume Reduction Building

Item	Areas and Systems	Functions
1	Radioactive Waste Incinerator Area	This area contains the radioactive waste incinerator, shredder, associated equipment and an active drainage sump. The incinerator uses a two stage process and is capable of incinerating solid as well as liquid radioactive waste. The incinerator is provided with the following supporting subsystems: air pollution control system; off-gas cooling system; dry scrubber; bag house (the filtration is designed such that stack emissions are within the regulatory limits for radiological particulate and conventional emissions); induced draft fan and main stack (sampling ports are provided on the stack for continuous emission monitoring; opacity metering; and radioactive emissions monitoring); process control and monitoring system; emissions monitoring system; propane supply; emergency vent. The shredder within the facility is not currently operational. Although it is recognized that the operation of this equipment would be beneficial with regard to the incineration of solid wastes (it would facilitate the generation of a homogenous feed), it is also understood that making the shredder operational would require a significant resource input.
2	Compacting Area	This area contains a box compactor and two maintenance shops. These shops are intended for repairs, equipment storage, welding and equipment maintenance activities. The box compactor (Figure 2-6) is designed to compress dry radioactive waste into steel boxes. The box compactor is also used to crush empty drums. The box compactor has an internal ventilation system with filtered exhaust to the WVRB active ventilation system.
3	Control Room	The control room is located in the northeast corner of the building. All L&ILW storage area systems (including the incinerator) and services alarms are monitored from here. The shredder has its own local control panel that is enabled from the control room. The programmable logic controller and the Personal Computers (PCs) used for operator interface are located in the control room. Also located in the control room is a separate PC-based, data acquisition system which will receive all of the data from the emission monitors, prepare required reports and store the required compliance data.
4	Truck Bays	Enclosed truck bays in the southwest corner of the WVRB provide weather protection for transportation vehicles during material receipt and unloading operations. Truck bays are sized to accommodate two semi-trailers and two road tractors with the entrance doors closed. The floor in the area of the truck bays (Zone 2) is lower than the adjacent area of the enclosed loading dock (Zone 3).

Item	Areas and Systems	Functions
5	Material Handling, Storage and Sorting Area	This area allows material movement and sorting, and provides temporary storage of incoming and processed wastes. Access to the incinerator and compactor areas is provided.
6	Electrical and Storage Rooms	Rooms are provided for electrical equipment and non-waste storage.
7	Ventilation System	The ventilation system operates at a constant flow year round. As the building is now largely Zone 3, it operates at a negative pressure relative to outdoors, relative to the Amenities Building, and relative to Zone 2 areas (control room and truck bays) to prevent the spread of contamination. A roof-mounted exhaust fan has been installed in the truck bays to provide local removal of vehicle exhaust fumes. An air-cooled air conditioning unit is provided for the control room.
8	Ventilation Equipment Areas	These areas contain air intake filters, intake fans, heating coils, air exhaust filters and exhaust fans. Radioactive airborne effluent monitors for building ventilation and radioactive incinerator exhaust are also located in this area.
9	Compressed Air System	A small air compressor and receiver unit provides compressed air for the incinerator, other air-actuated equipment and maintenance tools.
10	Breathing Air System	Breathing air headers are installed in the WVRB building.
11	Water Systems	Water is supplied to the WVRB through the Bruce Power site domestic water system and the Bruce Power site fire protection water system. The domestic water and service water system supplies: the washrooms, showers, and drinking fountains in the Amenities Building; and janitor's sinks and hose outlets in the WVRB building. This system also supplies exhaust gas cooling for the incinerator. The fire protection system supplies fire hose cabinets located throughout the WVRB, and the sprinkler systems in the WVRB and the Amenities Building. This system also supplies yard hydrants servicing the WVRB.
12	Drainage Systems	All WVRB drainage and the discharge line from the decontamination sink in the Amenities Building are treated as potentially radioactive and drain into an active drainage holding sump located in the radioactive incinerator room. Depending on the radioactivity concentration in the drainage, the sump is pumped either to the sewage system or into a tanker for transfer to the Bruce A active liquid waste management system. The inactive drainage holdup sump is located in the compactor area, which is in Zone 3. The inactive sump discharges to a lift station and drainage is then discharged to the site sewage processing plant.
13	Fire Detection System	A smoke and heat detection system is provided to give early warning of fires in the building.
14	Electrical System	Power for the incinerator and all auxiliary systems is at the nominal voltage levels of 600/347 and 208/120 volts, 60 hertz.
15	Emergency Lighting	Emergency lighting is available to provide adequate illumination for personnel during loss of normal power.

Appendix B: Description of the Transportation Package Maintenance Building

Table B-1: Description and Functions of Areas and Systems in the Transportation Package Maintenance Building

Item	Areas and Systems	Functions
1	TPMB Maintenance Area	This area consists of two trailer bays with a laydown area for transportation packages, overhead crane and workstations; a bay support area consisting of workbenches, general storage cabinets, hazardous material storage cabinets, and spot decontamination areas.
2	Mechanical Maintenance Support Area	This area contains typical maintenance support equipment such as: non-radioactive grit blasting equipment; welding machines; machine shop with band saw, hydraulic press, belt sander, rod oven; machine shop with engine lathe, milling machine, welding machine, drill press, and pedestal grinder.
3	Control Maintenance Shop	This area contains the radioactive instrument maintenance area, computer workstation area, fume hood area, pneumatic test bench area, and an electrical test bench area.
4	Building Support Services	Separate rooms house services including the electrical room, ventilation exhaust and a small washroom.
5	Ventilation System	There is a potential for both conventional and radiological emissions from the TPMB. The ventilation exhaust from the TPMB passes through a HEPA filter before being released. The ventilation exhaust is monitored for both tritium and particulate releases.
6	Water Systems	Domestic water is provided to the building for drinking water. Two sets of sumps are provided. One is for domestic sewage from the small washroom. The other collects any drainage from potentially contaminated areas. This sump is re-circulated and monitored. If radioactivity is below a certain level, it will be sent to the site sewage system. If activity is above a certain level, it will be sent by tanker to the Bruce Power active liquid waste management system.

Appendix C: Description of the Used Fuel Dry Storage Facilities Area

Table C-1: Descriptions and Functions of Areas, Systems and Components of the Used Fuel Dry Storage Facilities Area

Item	Areas, Systems and Components	Functions
1	Security/Access Control	Provides for a "protected area" designation under the CNSC Class I Nuclear Facilities Regulations and is designated as a Class IB facility.
2	DSC	Provides for safe storage of used fuel from Bruce NGS A and B.
3	Radiation and Contamination Monitoring Equipment	Provides for radiation protection, contamination control and monitoring.
4	Lifting devices and slings for all processing equipment, including Lift Truck/Tow Motor(s)	Provides for lifting/moving and maintenance of processing equipment.
5	Air Systems	Provides for service air and breathing air.
6	Water Systems	Provides domestic water for drinking, washroom and services and for fire protection.
7	Electrical Power, Distribution, and Lighting Systems	Provides for normal operation of electrically operated components and systems, operation of security and safeguards systems under normal and abnormal conditions, which includes an uninterruptible power supply supported by an alternate power source for short term power back-up (stand-by generator) in the event of loss of normal power. Provides lighting for all buildings and yard, and for meeting security and safeguards requirements.
8	Heating, Ventilation, Air Conditioning and Active Ventilation Systems	Provides for control of interior ambient temperatures, prevents ventilation backflow in areas subject to airborne contamination, includes HEPA filters and pre-filters for removal of toxic, volatile and contaminated particles prior to being exhausted into the environment, and for measurement of air flow and collection of ventilation stack air samples.
9	Sanitary Systems	Provides for sewage collection and removal to existing site sewage system.
10	Drainage Systems (Inactive and Provisions for future Active Drainage Systems)	Provides for collection and removal of inactive and active liquid waste to existing site system.
11	Fire Protection	Provides for detection, prevention and impeding the spread of fires.

Item	Areas, Systems and Components	Functions
12	DSC Processing Building overview Office and utility area including rooms for: • Equipment and tools • Active waste • Active ventilation • Operator's modular office • Heating, ventilation and air conditioning equipment • Maintenance area • IAEA staff office • Offices • Stores • Washroom • Lunchroom • Guard station • Radiation monitoring area Receiving Bay: • DSC receipt, inspection and staging space • Overhead crane Workshop: • Seal-welding and welding related systems • Welding inspection systems - Phased Array Ultrasonic Testing facility • Vacuum drying system • Helium backfilling system • Helium leak detection system • Paint bay	The DSC Processing Building provides for safe and efficient receipt, handling and processing of DSCs (see Figure 2-22).
13	Overhead Crane, Rails and Controls	Provides for lifting and transferring the DSC within the DSC Processing Building.
14	Welding Equipment and Controls	Provides for a seal weld between the lid and body of the loaded DSC and drain and vent port plug welds.
15	Phased Array Ultrasonic Testing Inspection Equipment, and Controls	Provides for inspection of the DSC seal weld.
16	DSC Vacuum Drying Equipment and Controls	Provides for vacuum drying the DSC interior to ensure a moisture-free environment for the used fuel.
17	Helium Backfill Equipment and Controls	Provides for helium backfilling of the DSC after evacuation of its interior atmosphere.
18	Helium Leak Test Equipment and Controls, including Bell Jar	Provides for leak testing the final seal weld, drain and port welds and the drain port helium pin weld.

Item	Areas, Systems and Components	Functions
19	DSC Lifting Beam and Storage Stand	Provides for lifting the DSC by the overhead crane.
20	Workstation platforms	Provides for working on the DSC during its various stages of processing.
21	DSC Commissioning Tools/Gauges	Provides for commissioning new (unloaded) DSCs.
22	DSC Transporter	Provides for safe transportation of new or loaded DSCs within the WWMF, and on-site to and from the WWMF and Bruce A and B.
23	DSC Tools, Transfer Clamp(s), and Transfer Clamp stands	Provides for handling and securing the loaded DSC while in transit between Bruce NGS A and B and the WWMF.
24	DSB(s)	Provides for indoor storage of DSCs and allows for access to and retrieval of any DSC at any time (see Figure 2-23).

Appendix D: Type and Location of Hazardous Materials Stored at the Western Waste Management Facility

Table D-1: Type and Location of Hazardous Materials Stored at the WVRB

Material	Type	Estimated Quantities	WVRB Location
Compressed gas	• Sulphur Dioxide/Nitric Oxide (90 ppm SO_2, 180 ppm NO) • Hydrogen Chloride (180 ppm HCL) • Carbon Monoxide/Carbon Dioxide (180 ppm CO, 20% CO_2) • Oxygen (high 20.9% O_2 and low 2.1% O_2) Balance of gas in all bottles is Nitrogen, N_2.	• 1 bottle each in use • 1 bottle each in storage	Hallway outside of Incinerator Control Room and Truck Bay along the North Wall
Flammable chemicals	Paints, solvents, oils	50 Liters	Chemical cabinets in Compactor Room and Storage Room
Corrosive chemicals	Cleaning Agents	100 Liters	Janitors Room

Table D-2: Type and Location of Hazardous Materials Stored at the TPMB

Material	Type	Estimated Quantities	TPMB Location
Compressed gas	Helium, Oxy-acetylene, Argon	• 2 cylinders Helium • 1 cylinder each of Argon and Oxy	Flask Maintenance Area
Flammable chemicals	Paint, solvents, oil	50 Liters	Flammable Liquid Cabinet in Flask Maintenance Area
Corrosive chemicals	Cleaning agents	50 Liters	Corrosive Cabinet in Storage Room

Table D-3: Type and Location of Hazardous Materials Stored at the DSC Processing Building

Material	Type	Estimated Quantities	DSC Processing Building Location
Compressed gas	Helium, Oxy-acetylene[16], Argon, Carbon Dioxide	6300 Liters (actual total bottle volume)	Helium Bottle Store, west side of ground floor
Flammable chemicals	Paint, solvents, oil	250 Liters	Paint enclosure, flammable storage cabinets on west side of ground floor

[16] Acetylene is stored under low pressure.

Material	Type	Estimated Quantities	DSC Processing Building Location
Corrosive chemicals	Cleaning agents	40 Liters	Janitor’s room, west side ground floor

Appendix E: Summary of Decommissioning Cost Estimate for the Western Waste Management Facility

This study [R-41], prepared for OPG by TLG, evaluates the decommissioning of the WWMF following the removal of all stored waste materials. The WWMF consists of the L&ILW storage facility and the WUFDSF. The costs associated with the management of used fuel, including interim storage, transportation and disposal, are not included in this estimate. Plans and cost estimates for these activities are described in separate documents.

This study has been prepared in support of the estimates for the CNSC financial guarantee period from 2023 to 2027 as well as the 2022 ONFA Reference Plan Update. The study consists of two estimates, one for the L&ILW facilities and areas and one for the WUFDSF.

The costs associated with decommissioning the WWMF for the financial guarantee period from 2023 to 2027 are estimated to be: $106.6M for the L&ILW facilities and area and $25.5M for the WUFDSF and area, in 2022 dollars. These costs are based on the facility expansion planning assumptions for the 2023 to 2027 financial guarantee period.

A more detailed breakdown of the cost estimate is shown in Table E-1 below.

Table E-1: WWMF Cost Estimate Summary by Decommissioning Period for 2023 to 2027 (in Year 2022 k$)

Decommissioning Period	Low and Intermediate Level Waste Storage Facilities and Area[17]	Western Used Fuel Dry Storage Facilities and Area[18]
Period 1 – Planning and Preparation	18,102	5,530
Period 2 – Site Decommissioning	74,479	9,498
Period 3 – Site Restoration	9,190	7,773
OPG Oversight (all periods)	4,856	2,695
Total Estimated Cost	**106,627**	**25,496**

Regulations:

The cost estimates for the L&ILW and WUFDSF comply with the guidance on decommissioning planning found in CNSC regulatory guide G-219, “Decommissioning Planning for Licensed Activities” [R-3]. This regulatory guide provides guidance regarding the preparation of decommissioning plans as well as the basis for calculating financial guarantees. It provides recommended CNSC guidance for meeting regulatory requirements associated with decommissioning nuclear facilities. It addresses requirements for choosing a basic strategy for decommissioning, materials and waste managements,

[17] L&ILW decommissioning values include 10% risk contingency.
[18] 10% risk contingency is not applicable to WUFDSF decommissioning values.

radiological surveys, human factors, conventional health and safety, security, environmental assessment, emergency response, quality assurance, and final end state reporting.

This study addresses all activities necessary to comply with the Canadian Environmental Assessment Act[19] [R-33], includes those decommissioning activities and work stages defined by CSA N286-12, "Management System Requirements for Nuclear Facilities" [R-36], and includes necessary activities identified in CSA N294:19, "Decommissioning of Facilities Containing Nuclear Substances" [R-4].

Methodology:

The methodology used to develop this decommissioning cost study follows the basic approach originally presented in the cost estimating guidelines developed by the Atomic Industrial Forum (now Nuclear Energy Institute) [R-56]. This reference describes a unit cost factor method for estimating decommissioning activity costs. The unit cost factors used in this study reflect generic decommissioning activity costs, as well as the latest available information about worker productivity in decommissioning.

The cost study includes direct work, program management, field engineering, equipment rental, quality assurance and security. The systematic approach employed to assemble these decommissioning estimates ensures confidence in the reliability of the resulting costs.

Allowance:

Cost elements in these estimates are based on normal conditions plus difficulty factors; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage allowance applied on a line item basis.

Radioactive Waste Management:

A small volume of LLW will be generated in the decontamination and dismantling of the L&ILW storage structures. LLW will also be generated from the decontamination of the WUFDSF. This study uses unit costs to estimate waste packaging, transportation and costs for long-term management.

Site Restoration:

This study assumes that site structures will be removed to a nominal depth of one meter below the local grade level wherever possible. The site will then be graded and stabilized with a covering of seeded topsoil.

Summary:

This study provides an estimate in, 2022 dollars, of the cost of decommissioning the WWMF under current requirements, and is based on present day costs and available technology.

This cost study is designed to provide sufficient information to assess financial obligations. The estimate was prepared by developing an inventory of installed components and structures, based on

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[19] The Canadian Environmental Assessment Act (CEAA) 2012 [R-33] has been superseded by the Canadian Impact Assessment Act [R-35].

drawing and document reviews. Costs for labour, materials, equipment, long-term radioactive waste management, taxes and program management were estimated using unit cost factors that were prepared by TLG Services, LLC. TLG has prepared all nuclear generating station decommissioning estimates for OPG. They have also prepared the majority of nuclear station decommissioning estimates in the USA.

Appendix F: Compliance with CSA N294:19

Table F-1: Compliance Matrix between 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.	4.1
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. Responsibility for the funding of the decommissioning shall be identified and financial guarantee shall be established to ensure adequate funding for decommissioning	3.1 4.1, 6.0, 11.0 5.0
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	10.0 8.0 7.0 3.1 4.1.3.2, 8.2 4.1.3.5 9.1 9.2
4.4	Programs shall be developed and implemented to support decommissioning.	6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0
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.	5.0
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).	This pertains to the completion of decommissioning and is, as such, not applicable for this PDP.
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.	This is part of DDP preparation, described in 4.1.2.5

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.	This pertains to records following the completion of decommissioning.
5.4.2	The facility shall be characterized. See Annex G for guidance.	4.1.3.1, 4.1.3.6
5.4.3	All radioactive waste generated shall be characterized as per the CSA N292 series of Standards.	4.1.3.5
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.	4.1.3.5
5.6	A hazard assessment commensurate with the tasks to be performed shall be completed prior to decommissioning.	8.1
5.8.1	A quality assurance program shall be implemented.	10.0
6.1.1	The owner shall demonstrate that, under the strategy selected, the facility will be maintained in a safe configuration at all times.	8.0, development of PDPs in itself addresses this requirement.

Section in CSA N294:19	Requirement in CSA N294:19	Section in This PDP
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.	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.	2.2.6, Appendix G
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.	5.1, Appendix E
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.	Section 4.1.2 describes the overall activities involved in preparation for decommissioning. These requirements pertain to the preparation phase and are, as such, not applicable for this PDP.
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.	Section 4.1.2 describes the overall activities for preparation for a safe transition to decommissioning. This pertains to the preparation phase and, as such, is not applicable for this PDP.
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.	This pertains to the preparation phase.

Section in CSA N294:19	Requirement in CSA N294:19	Section in This PDP
7.4.3	During the transition period between shutdown and decommissioning, monitoring and maintenance activities shall be conducted to ensure the health and safety of persons and the protection of the environment.	This pertains to the preparation phase.
7.5.1	An assessment of the state of the facility shall be performed to provide baseline information for condition of the building and SSC, and evaluation of the hazards to be controlled during decommissioning. A thorough survey shall be performed and supplemented by a review of existing records, as applicable.	Section 4.1.2 describes the overall activities for preparation for a safe transition to decommissioning. These requirements pertain to the transition/preparation phase and, as such, are not applicable to 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.	These requirements pertain to the preparation phase.
7.5.2.2	Historical information shall be preserved that is relevant to the eventual decommissioning of the facility.	11.0
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.	Section 4.1.2.5 describes the development of a DDP. This pertains to the actual DDP preparation for the dismantling and demolition phase. This is relevant for the DDP, not this PDP.
7.6.2.1	The DDP shall meet the content provisions of Annex C.	Section 4.1.2.5 describes the development of a DDP. This pertains to the actual DDP preparation for the dismantling and demolition phase. This is relevant for the DDP, not this PDP.
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

Section in CSA N294:19	Requirement in CSA N294:19	Section in This PDP
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.	8.0, however, these requirements pertain to the preparation phase. N/A
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.	Section 4.1.3.5 provides a high-level plan for waste management strategies during decommissioning. This pertains to the preparation phase, during the development of a DDP.
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.	Section 4.1.3.5 provides a high-level plan for waste management strategies during decommissioning. These requirements pertain to the preparation phase, during the development of a DDP.
8.1.2	The work to be performed during the decommissioning shall be described in a DDP.	This pertains to the execution phase and is, as such, not applicable for this PDP.

Section in CSA N294:19	Requirement in CSA N294:19	Section in This PDP
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.	This pertains to the execution phase.
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.	These requirements pertain to the execution phase.
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.	These requirements pertain to the execution phase.
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 pertain to the execution phase.
8.1.9.1	Surveys during decommissioning shall be performed to comply with a) worker occupational safety and radiation protection limits; b) environmental monitoring criteria; and c) processes to release materials and equipment from the site.	Sections 4.1.3 and 4.1.3.1 provide a high-level plan for surveys to be performed during decommissioning. These requirements pertain to the execution phase.

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.	Section 4.1.3.6 provides a high-level plan for surveys to be performed after decontamination and dismantling. These requirements pertain to the execution phase.
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.	This pertains to the execution phase.
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; c) prevent access by unauthorized persons; and d) mitigate infestations of vermin and other organisms.	This pertains to the execution phase.
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.	Section 4.1.3.4 provides a high-level plan for land remediation. This pertains to the completion of decommissioning.
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.	This pertains to the completion of decommissioning.
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.	Section 4.1.4.2 provides a high-level plan for the final end state report. This pertains to the completion of decommissioning.

Table F-2: Compliance Matrix between N294:19 Annex A and this Plan

Section in CSA N294:19 Annex A	Requirement in CSA N294:19	Section in This PDP
A.2	A PDP may include the following, unless they are not applicable to the facility:	As specified below.
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, 2.2, 2.3 Figures: 2-1, 2-2, 2-3, 2-4
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, 3.6 Appendices: A, B, C, D
A.2 (c)	post-operational conditions, including (i) a summary of the shutdown process, including planned removal of stored inventories of hazardous 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;	3.5, 3.6, 4.0, 8.0
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);	3.4, 3.5, 4.1.2.5, 4.1.4.1 3.0 & 4.0 No long-term institutional controls will be established

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;	4.0, 7.0, 8.0 Figure 4-1 Table 4-1
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;	4.0, 8.0, 11.0
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;	Tables: 4-2, 4-3 4.1.3.5 Figure 4-2
A.2 (h)	a commitment to prepare a DDP for regulatory approval prior to dismantling and demolition;	1.0, 4.1.2.5
A.2 (i)	a commitment to periodically review and update the PDP until a DDP is prepared, in accordance with Clause 6.2.2;	1.0, 3.3
A.2 (j)	the physical state of the facility at i) the end of operations; and ii) the start of decommissioning;	3.0
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);	11.0
A.2 (l)	a public engagement plan, including a public information program and avenues for public participation.	12.0
A.2 (m)	an Indigenous engagement plan as per the requirements and guidance of CNSC REGDOC-3.2.2; and	2.3.6, 12.0
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 iii) a description of how the required funds will be provided;	5.0 Appendix E

Appendix G: WWMF to Bruce Power Interface Documents and Services

Table G-1: OPG and Bruce Power Services Interface Documents

Document Number	Document Title	Ownership
BP-PROC-00029	Active Liquid Effluent Waste Acceptance Criteria	Bruce Power
BP-PROC-00095	Site Traffic Management	Bruce Power
BP-PROC-00180	Security Clearances	Bruce Power
B-PROC-RA-00097	Vehicle Monitor Procedure	Bruce Power
BP-RPP-00018	Facility Access and Working Rights	Bruce Power
W-PROC-WM-0027	Landfill Waste Acceptance Criteria	OPG
W-PROC-WM-0048	Tritiated Deuterium Oxide Transportation Package Receiving, Handling, and Shipping	OPG
W-PROC-WM-0065	Lifting ISO-20 & ISO-40 Containers	OPG
W-PROC-WM-0032	Trillium Transportation Package Receiving, Handling and Shipping-Slurrying Resin Through Secondary Lid	OPG
W-PROC-WM-0033	Radioactive Shipments	OPG
W-PROC-WM-0035	Trillium Transportation Package Receipt/Handling, Loading Through the Primary/Secondary Lid	OPG
W-PROC-WM-0041	ISO 20/40 Package Receiving, Handling, and Preparation for Shipping	OPG
W-PROC-WM-0049	Roadrunner Transportation Package Receiving, Handling, and Shipping	OPG
W-PROC-WM-0040	Type A and Less Package Receiving, Handling and Shipping	OPG
W-PROG-WM-0002	Radioactive Material Transportation	OPG
W-PROC-WM-0078	Irradiated Material Transportation (IMT) Package	OPG
W-PROC-WM-0081	Multipurpose Transportation Package (MPTP)	OPG

Table G-2: OPG and Bruce Power Interface Services

Service	Ownership
Scaffolding	Bruce Power
Maintenance Support	Bruce Power
Emergency Response	Bruce Power
Domestic and Fire Water	Bruce Power
Sewage and Storm Sewer	Bruce Power
Active Liquid Waste Disposal	Bruce Power
Electrical Power	Bruce Power

Service	Ownership
Dosimetry	Bruce Power
Effluent Monitoring, between OPG's NWMD and Bruce Power's Health Physics Laboratory	Bruce Power
Security	Bruce Power
Snow Removal	Bruce Power
Bus and Winter Storm Transportation	Bruce Power
Vehicle Radiation Detection	Bruce Power
Site Environmental Monitoring	Bruce Power
Chemical Analysis Laboratory Services for Heavy Water	Bruce Power
Centre of Site Laboratory Support – Certified Heavy Water Standards Preparation	Bruce Power
Centre of Site Laboratory Support – Support Services for NWMD	Bruce Power
Access to Space in the Leased Premises and the Retained Facilities	Bruce Power
Heavy Water Plant Monitoring and Demolition	Bruce Power
Bruce Power General Services	Bruce Power
Maintenance of OPG Transport and Work Equipment	Bruce Power
Landfill Services	OPG
OPG General Services	OPG
Transportation of Non-Waste Radioactive Material	OPG
Southern Ontario Seismic Network Program	OPG
Access to Spare Revenue Meter Instrument Transformers	OPG
Storage of Pressure Tube "Off Cuts"	OPG
Freon Storage	OPG