ONTARIO POWER GENERATION

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February 10, 2017

CD#: W-CORR-00531-01258

MR. MARC LEBLANC
Commission Secretary

Canadian Nuclear Safety Commission
280 Slater Street
Ottawa, Ontario
K1P 5S9

Dear Mr. Leblanc:

Notice of Participation for the CNSC Public Hearing – Western Waste Management Facility Licence Renewal Application – April 2017

References: 1. OPG Letter, L. Swami to M. Leblanc, "Application for Renewal of Western Waste Management Facility Operating Licence," May 16, 2016, CD# W-CORR-00531-01118.

The purpose of this letter is to notify the CNSC of OPGs intent to participate at the April 2017 Public Hearing for renewal of the WWMF operating licence, pursuant to Rule 18 of the Canadian Nuclear Safety Commission Rules of Procedure.

OPG has requested a renewed term to May 31, 2027 for the Western Waste Management Facility operating licence that includes the construction and operation of additional Used Fuel Dry Storage Buildings and various buildings/structures to store low and intermediate level radioactive waste (Reference 1). In support of the Hearing, OPG has attached a written submission regarding the Licence Renewal of the Western Waste Management Facility.

If you have any questions or concerns, please contact Ms. Leslie Mitchell, Manager, Regulatory Affairs, at (905) 839-6746 extension 5198.

Sincerely,

Lise Morton

Lise Morton
Vice President
Nuclear Waste Management
Ontario Power Generation Inc.

Attach.

cc: K. Glenn - CNSC (Ottawa)
S. Thompson - CNSC (Ottawa)
S. Oue - CNSC (Ottawa)

Attachment to OPG Letter, L. Morton to M. Leblanc, “Notice of Participation for the CNSC Public Hearing – Western Waste Management Facility Licence Renewal Application – April 2017,” CD # W-CORR-00531-01258.

ATTACHMENT 1

Written Submission from Ontario Power Generation on the Licence Renewal Application for the Western Waste Management Facility

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Original

CNSC Commission Member Document (CMD)

CMD: 17-H3.1

Date Submitted: 10 February 2017

Reference CMDs: N/A

Ontario Power Generation

One-Day Public Hearing

Scheduled for:
April 12, 2017

Request for a Licensing Decision:

Regarding:

The application for Western Waste Management Facility Waste Facility Operating Licence Renewal

Submitted by:
Ontario Power Generation

Table of Contents

Executive Summary

The purpose of this submission is to request approval from the Canadian Nuclear Safety Commission (CNSC) to renew the Western Waste Management Facility (WWMF) Waste Facility Operating Licence for another ten year term from June 1, 2017 to May 31, 2027. The current ten year WFOL W4-314.03/2017 for the WWMF expires on May 31, 2017.

Upon renewal, Ontario Power Generation Inc. (OPG) requests authorization for the site preparation, construction or construction modification for the following facilities:

- 4 storage buildings for used fuel dry storage;
- 11 storage buildings for low and/or intermediate level radioactive waste;
- 270 in-ground storage containers (IC-18s) for intermediate level waste;
- 30 in-ground containers for heat exchangers (IC-HXs);
- Large Object Processing Building; and
- Waste Sorting Facility.

WWMF has been operating safety since it was established in 1974. The additional buildings and structures would not alter the basic purpose and activities associated with the WWMF. The ongoing operation of WWMF will enable the nuclear generating stations in Ontario to continue operating as planned under their current respective operating licences.

OPG is requesting that the licensed area be expanded to include areas identified as the woodlot and construction laydown area. A Predictive Effects Assessment was conducted to determine the impact on human health and on non-human biota from the activities to be located in these areas, and it concluded that with mitigation measures, no adverse effects are expected.

OPG has been safely transporting radioactive materials for over 42 years, and has never had an accident resulting in a radioactive release or serious personal injury. OPG drivers transporting radioactive materials have an excellent safety record on the roads and have travelled over 3 million kilometers during the last 9 years (current licensing period between 2007 and 2016) without any at fault incidents.

OPG is committed to innovative and responsible solutions for managing radioactive materials safety, efficiently and cost effectively, and making investments for the continued safe operation of WWMF.

OPG has built a healthy safety culture that permeates the organization, and maintains a focus to improve organizational effectiveness through the use of industry best practices, human performance tools and continuous learning.

This submission presents information on the performance of WWMF in the CNSC's 14 Safety and Control Areas to meet the requirements for renewal of the WWMF operating licence under section 24(4) of the *Nuclear Safety and Control Act*. The information presented demonstrates OPG is qualified to continue operation of the WWMF, and will continue to make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

During the current licensing period, WWMF has operated safely and reliably to protect the public, the workers and the environment. This submission lays out the planned improvements and upgrades currently envisaged for the next licence period. OPG is proud of its excellent record in conventional and radiological worker safety, and is well positioned for the continued operation of WWMF.

1.0 Introduction

1.1 Background

Ontario Power Generation (OPG) is an Ontario-based company whose principal business is the generation and sale of electricity in Ontario. More than half of the electricity comes from nuclear power, a low-cost and low-carbon source of energy; these benefits of nuclear energy go hand-in-hand with good stewardship of the nuclear waste. OPG is committed to the safe, responsible and comprehensive management of all its radioactive waste, which it stores at waste facilities at the Bruce, Pickering and Darlington nuclear sites.

OPG is appearing before the Commission Tribunal during the April 2017 public hearing on the matter of the renewal of the Western Waste Management Facility (WWMF) operating licence. The current operating licence for the WWMF expires on May 31, 2017. OPG is requesting a renewal of the operating licence for another ten (10) years, from June 1, 2017 to May 31, 2027. The renewal would allow OPG to continue with the safe interim processing and storage of used fuel and low- and intermediate-level waste (L&ILW).

This submission is in support of the licence renewal application for the WWMF, located on the Bruce nuclear site within the Municipality of Kincardine, Ontario, and demonstrates that:

(1) OPG is qualified to operate the WWMF; and,

(2) OPG has and will continue to make adequate provision for the protection of the environment, the health and safety of persons, and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

The WWMF is licensed by the Canadian Nuclear Safety Commission (CNSC) under section 24(2) of the *Nuclear Safety and Control Act*. It is a Class IB nuclear facility as defined in the *Class 1 Nuclear Facilities Regulations* to provide for the safe handling, management, and the interim storage of radioactive wastes, including L&ILW from all 20 reactors located at Bruce, Darlington and Pickering, and used fuel produced by Bruce Power Nuclear Generating Stations (NGS). The WWMF site has been developed in stages since 1974 to accommodate waste produced during reactor operation, maintenance and refurbishment.

During the next 10 year licence period, several activities will affect the operations at the WWMF. OPG will be pursuing the refurbishment of the Darlington NGS, and the extended operation of the Pickering NGS. These will result in ongoing shipments of L&ILW to the WWMF in similar or potentially greater quantities than occur today. Similarly, Bruce Power will commence the major component replacement program, which will result in sustained levels of L&ILW including additional steam generators and retube wastes. This will increase the number of used fuel bundles that require interim storage in dry storage containers at WWMF.

To provide for safe interim waste storage until long term or permanent facilities are in service, OPG requests authorization for the site preparation, construction or construction modification for the following structures:

- 4 storage buildings for used fuel dry storage;
- 11 storage buildings for low and/or intermediate level radioactive waste;
- 270 in-ground storage containers (IC-18s) for intermediate level waste;
- 30 in-ground containers for heat exchangers (IC-HXs);
- Large Object Processing Building; and,
- Waste Sorting Building.

These buildings and structures are described in more detail in the following sections of this submission. Except for the Large Object Processing Building and Waste Sorting Building, no significant changes are anticipated in the designs that have been previously approved for similar buildings and structures on-site. Project specific design requirements will be submitted to the CNSC in accordance with the WWMF operating licence prior to the start of construction. Consistent with OPG's practice, OPG will construct any new facilities on an as needed basis. In addition, the operation of any building or structures would only begin following OPG's submission of a commissioning report and its acceptance as required by the licence.

The licensed area needs to be expanded outside the existing licensed area to accommodate some of the new buildings because of land constraints in the existing WWMF licensed area. The expanded area will include the appropriate security measures required for each additional building. A predictive effects assessment was conducted to identify the effects to human and non-human biota.

This document is presented in support of the public hearing scheduled in April 2017 for the renewal of the WWMF Operating Licence (WFOL-W4-314.03/2017). It provides the CNSC members, and members of the public with a summary of information on the performance of WWMF in areas related to the 14 Safety and Control Areas as defined in the CNSC "*Guide for Applicants and Intervenors Writing CNSC Commission Member Documents (GD-379)*".

1.1.1 Classification of Radioactive Waste

During the operation of a nuclear facility, waste is produced much like any other industry. Some of this waste becomes radioactive and must be handled using special procedures. OPG categorizes the radioactive waste into low, intermediate and high level waste, consistent with international standards.

- **Low-Level Radioactive Waste** is radioactive waste having a dose rate less than 10 mSv/h (1 rem/h) at 30 cm (unshielded). Low level waste consists of minimally radioactive material that has become contaminated during routine cleanup and maintenance, and includes (but is not limited to) lightly contaminated metal objects and parts, incinerator ash, insulation, drummed wastes, solidified liquids and desiccant. Low level wastes from the Bruce, Darlington and Pickering NGSs are received at the Waste Volume Reduction Building at the WWMF where it is processed through either incineration or compaction to reduce its volume, or stored as is. Low Level waste comprises about 95% of the total non-fuel waste volume produced by the NGSs.

- **Intermediate-Level Radioactive Waste** is radioactive waste having a dose rate greater than or equal to 10 mSv/h (1 rem/h) at 30 cm (unshielded). Intermediate level waste consists primarily of used reactor core components, ion exchange columns, resins, and filters used to keep the reactor water systems clean. Intermediate level waste is more radioactive than low level waste, and requires shielding to protect workers during handling. This waste is not processed for volume reduction, and makes up about 5% of the total volume of non-fuel waste produced by the NGSs.
- **High Level Radioactive Waste (also referred to as irradiated fuel or used fuel)** is defined as a CANDU (CANada Deuterium Uranium) fuel bundle that was irradiated in a reactor core. It is stored at the nuclear station in irradiated fuel bays for a period of typically ten years or more, and then transferred into dry storage containers (DSCs).

1.1.2 Existing Western Waste Management Facility

The WWMF site was established in 1974 in an area on the Bruce Nuclear site (Figures 1 and 2). The WWMF is dedicated to the processing, and the interim storage of L&ILW received from the OPG owned Nuclear Power Generating Stations (Darlington, Pickering) and Bruce Power NGS and the interim storage of used fuel from Bruce Power NGS. OPG's approach to the interim management of used fuel is to store all the used fuel generated at a nuclear generating station on the site where it is produced until a long term solution is available.

WWMF is approximately 19 hectares in size. It has undergone an orderly development in stages since 1974. Additional storage buildings and structures have been constructed when required, as shown in Table 1 and Table 2.

Figure 3 shows the current layout of WWMF. Approximately 75% of the 19 hectares of the WWMF is dedicated to the management and storage of L&ILW. This area now includes 16 above-ground storage buildings for low and intermediate level wastes. Fourteen of these buildings (Low Level Storage Building 1 to 14) are used to accommodate low level waste, and one for steam generators, and one for retube components. In addition, WWMF also has an Amenities Building, a Waste Volume Reduction Building, a Transportation Package Maintenance Building and waste storage structures called quadricells, in-ground containers, trenches and tile holes. These buildings and structures are used for the processing and storage of L&ILW received from OPG's Pickering, Darlington and Bruce Power NGSs.

Approximately 4 hectares of the WWMF site are dedicated to the management and storage of used fuel received from the Bruce Power NGS. The used fuel dry storage area is a security-protected area located northeast of the L&ILW storage area, and consists of a DSC processing building and four DSC storage buildings.

The WWMF is fenced to limit access. Normal personnel access to and from the WWMF site is via the Amenities Building. Vehicular traffic enters the WWMF site through gates located in the access control fence. Vehicular traffic entering the used fuel dry storage area is minimal and controlled. Access control to this area is provided by a security system.

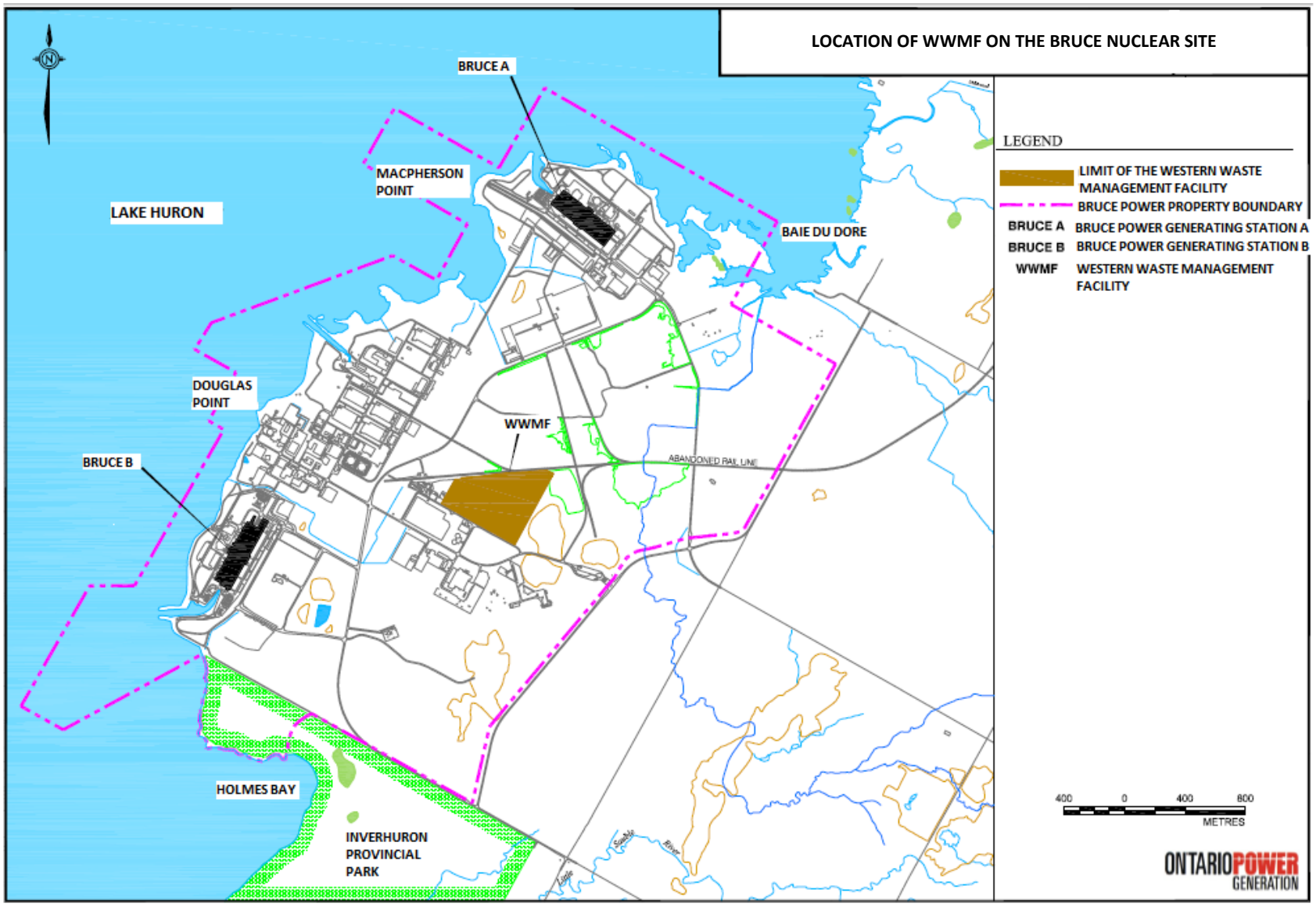


Figure 1: Bruce Nuclear Site

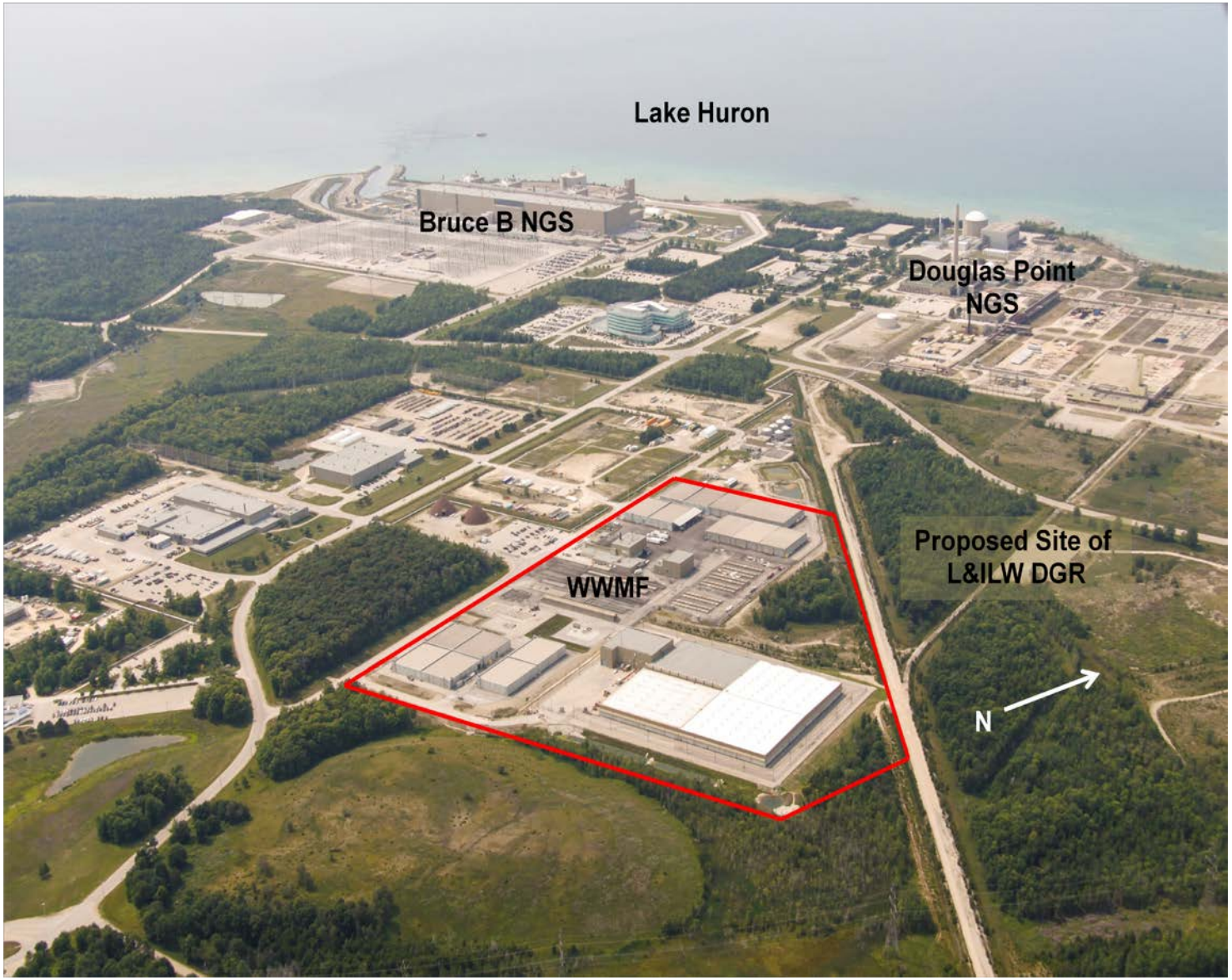


Figure 2: WWMF on the Bruce Nuclear Site

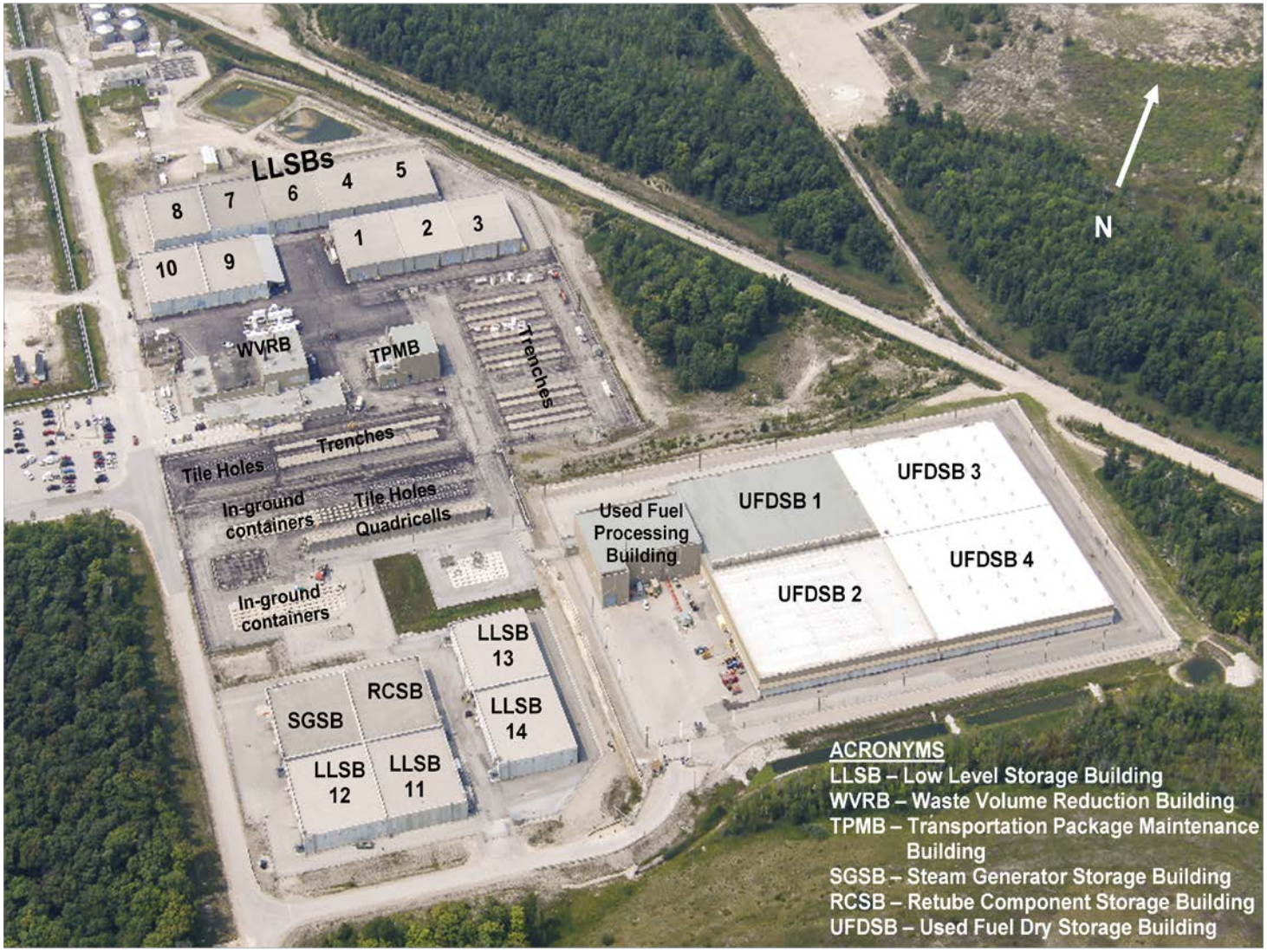


Figure 3: Layout of WWMF in 2017

Table 1: Chronology of Development for L&ILW at WWMF

Structure/Building	Units	Number/ Capacity	In-Service Dates
Above-Ground Structure or Building			
Low-Level Storage Buildings	1	7,050 m^3	Oct 1982
	2	7,050 m^3	Dec 1985
	3	7,050 m^3	Mar 1988
	4	7,050 m^3	Jun 1989
	5	7,050 m^3	Jun 1989
	6	7,050 m^3	Nov 1992
	7	7,050 m^3	Dec 1999
	8	7,050 m^3	May 2002
	9	7,050 m^3	Dec 2004
	10	7,050 m^3	Jan 2007
	11	7,000 m^3	May 2009
	12	7,000 m^3	Sep 2011
	13	7,000 m^3	Jul 2013
	14	7,000 m^3	Jul 2013
Steam Generator Storage Building	1	24 units	Jan 2007
Retube Component Storage Building	1	192 containers	Jan 2007
Quadricells		360 m^3	Oct 1978
Contaminated Tool Storage Area		4,700 m^2	Sep 1990
In-Ground Structures			
Trenches	Stage 1	2,080 m^3	Dec 1974
	Stage 3	1,440 m^3	Mar 1976
	Stage 3E	2,350 m^3	May 1979
Tile Holes	Stage 1	80 m^3	Mar 1974
	Stage 3	144 m^3	Jun 1977
In-Ground Containers	Type (#)		
	IC-2 (20)	40 m^3	Dec 1985
	IC-12 (20)	240 m^3	Mar 1987
	IC-18 (8)	144 m^3	Jun 1989
	IC-18 (32)	576 m^3	Dec 1990
	IC-18 (54)	972 m^3	Oct 1993
	IC-18 (50)	900 m^3	May 1997
	IC-18 (54)	972 m^3	Feb 2002
	IC-18 (54)	972 m^3	Jul 2013
In-Ground Heat Exchanger Containers (IC-HXs)	Area 1, Phase 1	23	1991
	Area 1, Phase 2	4	1993
	Area1, Phase 3	10	1997
	Area 2, Phase 4	4	2002
Processing			
Waste Volume Reduction Building	n/a	n/a	1977
• Renovations & Upgrades			2002
Radioactive Incinerator	n/a	n/a	1977 - 2001
• Replacement			Dec 2002
Box Compactor	n/a	n/a	
• B-400 Box Compactor			1993 – 2010
• B-1000 Box Compactor			2011
Amenities Building			Dec 2001
Transportation Package Maintenance Building			Dec 2004

Table 2: Chronology of Development for Used Fuel at WWMF

Building	Number	Capacity	In-Service Dates
Processing Building			Oct 2002
Storage Building	#1	500 DSCs (nominal)	Oct 2002
	#2	500 DSCs (nominal)	Dec 2007
	#3	500 DSCs (nominal)	Dec 2012
	#4	500 DSCs (nominal)	Dec 2012

1.1.3 Management of Low and Intermediate Level Radioactive Waste

Figure 4 shows the flow of radioactive waste starting from generation at a nuclear facility through to packaging and transportation, processing and interim storage at WWMF, to ultimate disposal. The WWMF licence encompasses only processing and interim storage. The three areas shaded in gray: Generation, Packaging and Transportation, and Proposed Permanent Disposal are briefly described here for context, but are outside the scope of this licence.

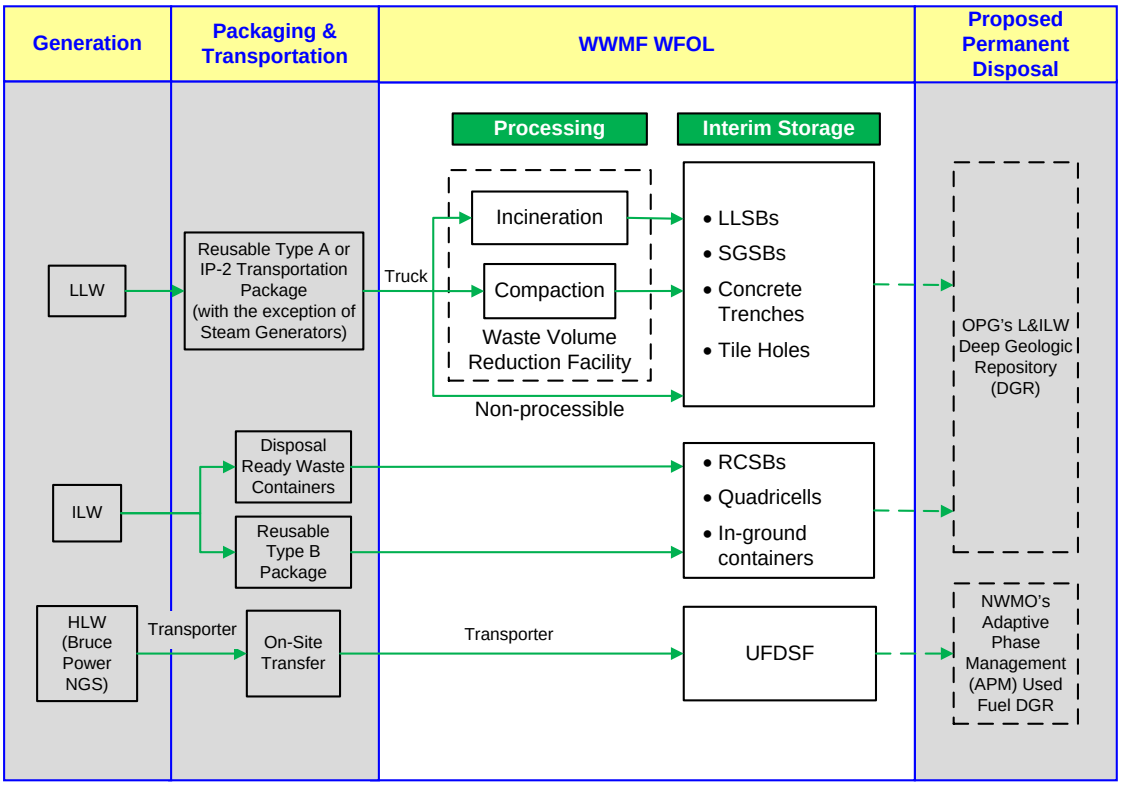


Figure 4: Waste Management of L&ILW and Used Fuel

Generation of L&ILW

During normal operations involving radioactive work at the NGSs, solid waste (e.g. protective clothing, cleaning material, bags, containers, etc.) is generated which becomes contaminated with radionuclides. L&ILW is collected from waste receptacles throughout the stations. OPG's Active Waste Program provides three receptacles for this waste: Active, Active Metal and Likely Clean. Bags of waste are taken from these receptacles.

Active waste is checked for tritium and gamma; that information is then transferred onto a Radioactive Material Tag, which is attached to the radioactive waste bag. The radioactive waste bag is then segregated into containers to transport incinerable, compactable or non-processible waste, and then shipped to WWMF for processing.

Active metal bags are checked for tritium and gamma; that information is then transferred onto a Radioactive Material Tag, which is attached to the bag or item. The bag or item is then placed into a non-processible radioactive shipping container, and then shipped to WWMF for storage.

The Likely Clean waste is monitored for tritium, alpha, beta, and gamma emitters. If it is determined that the waste is radioactive, it is monitored and transported off-site as active waste for processing at the WWMF. Non-radioactive or radioactive material below the acceptance waste criteria and in accordance with the *Nuclear Substance and Radiation Devices Regulations* is sent for disposal at licensed landfills.

Packaging and Transportation of L&ILW

In a typical year OPG completes approximately 700 truck shipments of radioactive materials. Most of these shipments are from Pickering and Darlington NGSs to the WWMF. All shipments are carried out in accordance with federal and provincial regulations for the transportation of radioactive materials.

The type of packaging used for transportation of radioactive material is dictated by the CNSC's *Packaging and Transport of Nuclear Substance Regulations* and Transport Canada's *Transportation of Dangerous Goods Regulations*. Package types can range from industrial packaging such as metal boxes to much more rugged Type B packages, depending on the radiological hazard.

All low level waste is currently transported from Pickering and Darlington NGSs to the WWMF inside containers that comply with CNSC Type A or Type Industrial Package (IP)-2 transportation package requirements. Intermediate level waste is transported in Type B packages, which are designed to withstand severe accident conditions and have received a package design approval certificate from the CNSC.

A range of safety measures are used to ensure prevention of a release of radioactivity from a transportation accident involving a shipment of low and intermediate level waste:

- Robust transportation package design which meets all regulatory requirements
- Strong and comprehensive management system which provides oversight to OPG's transportation program;
- Operating experience from more than 43 years of transporting radioactive materials;

- Extensive Training of personnel (drivers and Transportation Officers) involved with transportation; and,
- A Transportation Emergency Response Plan.

OPG has been safely transporting radioactive materials for over 43 years, and has never had an accident resulting in a radioactive release or serious personal injury. OPG drivers transporting radioactive materials have an excellent safety record on the roads and have travelled over 3 million kilometers during the last 9 years without any at fault incidents.

Processing of L&ILW at WWMF

As shown in Figure 4, processing of radioactive waste is a licensed activity under the WWMF licence. Low level waste that is generated at the nuclear facilities is segregated at the source into processible (for incineration or compaction) or non-processible wastes prior to being transported to the WWMF (Figure 5). All incoming L&ILW received at the WWMF must meet the waste acceptance criteria.

For processible wastes, volume reduction involves processing waste into a smaller volume, either through incineration or compaction, to reduce the handling and storage requirements, and to minimize future disposal needs. About 60% of all low level waste sent to the WWMF is either incinerated or compacted at the Waste Volume Reduction Building. Currently, non-processible low level waste received at the WWMF is further sorted prior to it being sent to a Low Level Storage Building for interim storage.

Intermediate level waste is packaged in Type B transportation packages or disposal ready waste containers, transported to WWMF and sent directly to an in-ground structure for interim storage. Retube Waste Containers from Bruce Power NGS which are transported to WWMF and sent directly to an above ground storage building for interim storage.

Incinerable wastes are volume-reduced in a batch controlled- air incinerator. The incinerator is designed to accept bagged and boxed solid wastes with a maximum dose rate of 0.60 mSv/h on contact and 100 MPCa (maximum permissible concentration in air) tritium, and it can burn up to 2,270 kg of waste per day. It provides a high volume reduction factor, currently 37:1, and produces a stable waste material in the form of ash. The ash is discharged into 2.5 m^3 rectangular metal containers, and the ash-filled containers are then sent to a Low Level Storage Building and stored on site.

The high temperature exhaust gas stream from the incinerator is cooled using a water-injected spray cooler. Powdered hydrated lime is injected into the cooled exhaust gas stream to neutralize acid gases such as hydrogen chloride and sulphur dioxide. Activated carbon injected into the gas stream adsorbs heavy metals and the unburned organic compounds to transfer them from gas phase to solid phase. The baghouse particulate filtration system then removes all solid phase materials from the gas stream. A small amount of ash is collected in the incinerator's baghouse filter which is placed in a separate ash bin, and sent to storage on site.

Radioactive waste oil is also accepted for incineration. The waste oils must meet the following waste acceptance criteria:

- Total PCB < 50 ppm;
- Total chlorine < 20,000 ppm;

- Total lead < 300 ppm;
- Total cadmium < 2 ppm;
- Flash point > 61°C;
- Tritium < 9.59 x 10-2 Ci/L (3.55 x 109 Bq/L), and,
- Gross beta/gamma < 3.14 x 10-4 Ci/L (1.16 x 107 Bq/L).

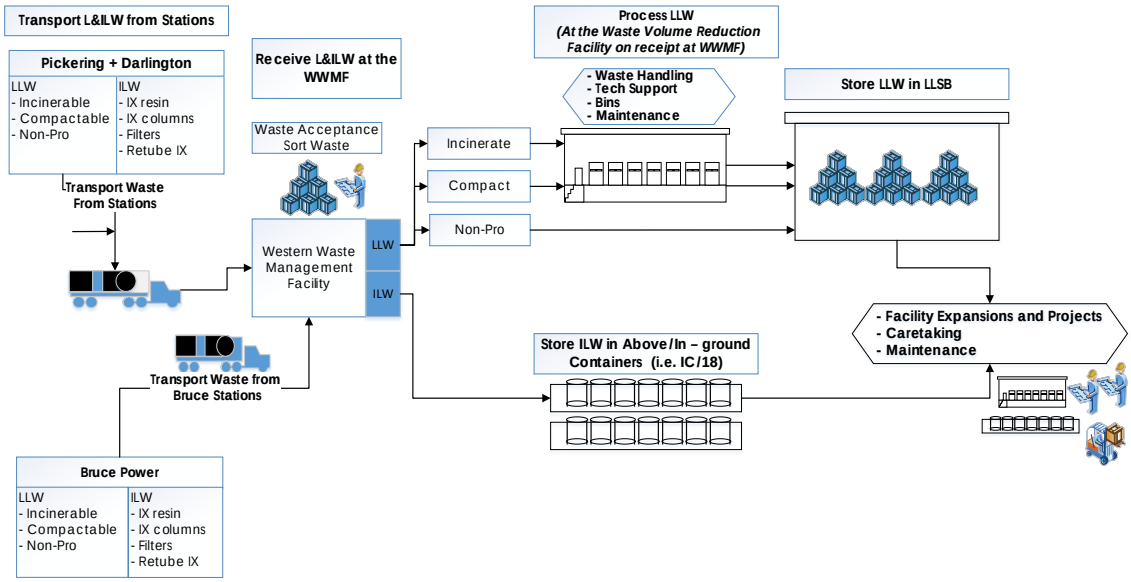


Figure 5: L&ILW Operations Process

Air emissions from the incinerator are continuously monitored and have always been within regulatory limits. The incinerator currently operates under an Ontario Ministry of Environment and Climate Change amended Environmental Compliance Approval (ECA #8047-8GLPAM, dated May 10, 2011) with concurrence by the CNSC.

The box compactor is designed to compress dry radioactive waste, up to a maximum 2 mSv/h on contact, into stackable steel boxes, that are approximately 2.5 m^3 in volume. The compressed waste is retained in the steel box by integral anti-spring back devices and a steel lid. These stackable boxes are removed from the box compactor by forklift truck and transferred to a storage building. This compaction process produces a net volume reduction factor of approximately 5:1.

Non-processible waste received in containers suitable for direct storage are transferred by forklift truck from the Waste Volume Reduction Building to an above-ground storage building or an in-ground structure. All storage containers for L&ILW are monitored and assigned unique bar-codes for waste tracking purposes.

The floor drainage within the incinerator room is treated as potentially radioactive, and is drained to an active drainage holding sump located in the radioactive incinerator room (Figure 6). The sump is sampled and analyzed for radioactivity and chemical characterization, and then it is pumped into a tanker for transfer to the Bruce NGS active liquid waste management system.

An inactive drainage holdup sump is located in the compactor area. Access to the sump is sealed to minimize possible contamination. The inactive sump discharges to a lift station and is then discharged to the site sewage processing plant.

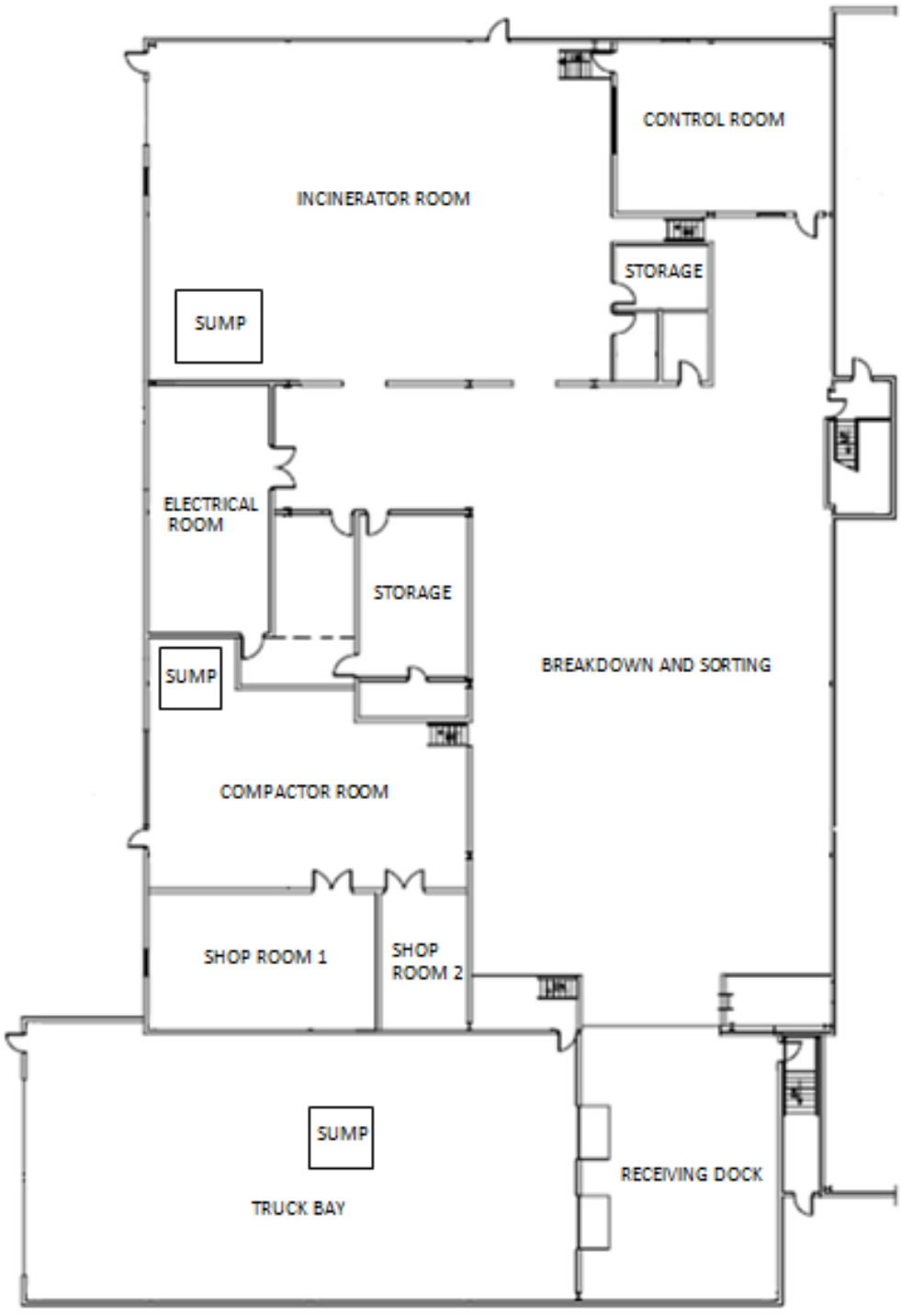


Figure 6: Layout of Waste Volume Reduction Building

Storage Facilities for L&ILW at WWMF

Since storage operations began at the site in 1974, there has been an evolution in storage structure designs to incorporate a smaller footprint, better efficiency and more robust designs. Initially all wastes were placed in small capacity in-ground structures. The modular nature of the storage structures incorporated improvements in the design and construction techniques to be included in each evolution. All storage structures are designed to match the physical and radiological characteristics of the waste being stored.

Table 1 lists the principal storage structures being used and the volumes of waste that are stored in each type of structure. The following sections describe the structures that are used for interim storage.

Above-ground Storage Buildings

There are currently sixteen above-ground storage buildings for L&ILW located at WWMF. Fourteen of these storage buildings are used to accommodate low level waste, one storage building is for steam generators, and another storage building is for retube components from Bruce Power NGS.

Existing Low Level Storage Buildings

An above-ground Low Level Storage Building is a warehouse-like building (Figures 7, 8 and 9) used to store low level waste with contact radiation fields less than 10 mSv/h at 30 cm (unshielded). The approximate building dimensions are 50 m long by 30 m wide by 8 m high, and each building can store about 7,000 m^3 of waste.

Figure 7: Low Level Storage Building

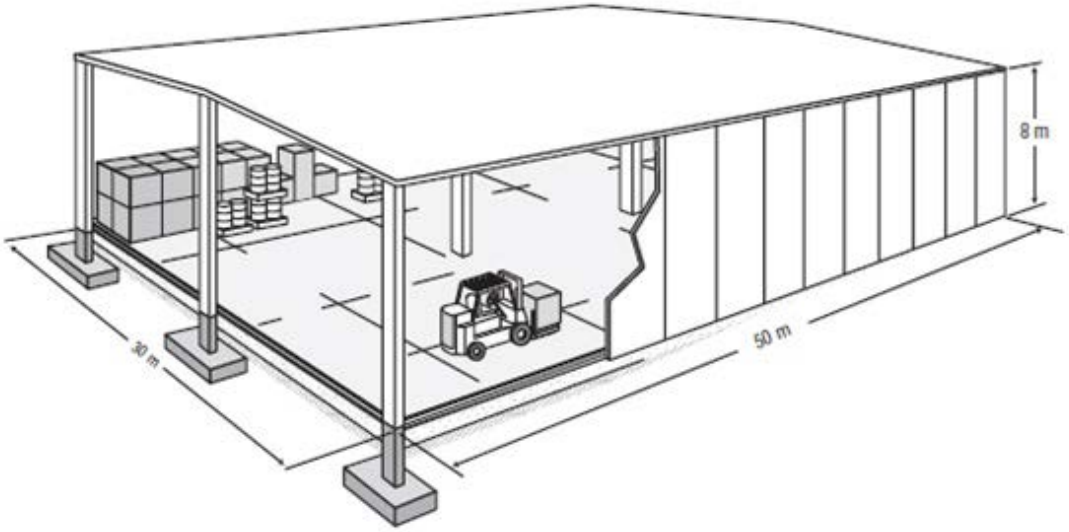


Figure 8: Cutaway of a Low Level Storage Building

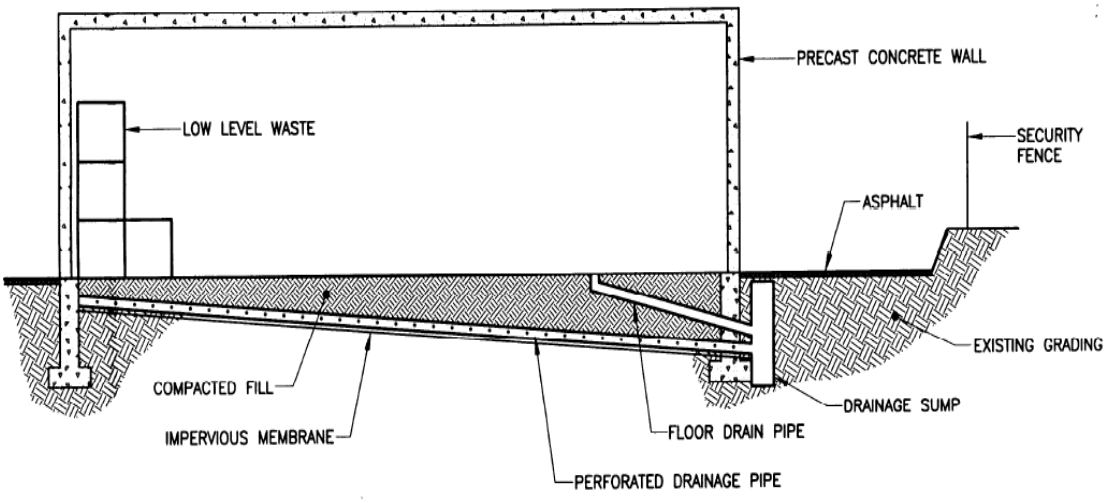


Figure 9: Typical Low Level Storage Building Layout

Low Level Storage Buildings are constructed in accordance to the *National Building Code of Canada*, and the *National Fire Code of Canada* in compliance with the licence requirements in place at the time. They are constructed using prefabricated, pre-stressed concrete panels, which are joined with an overlap to prevent any radiation streaming between the panels. The panels are 38 cm thick and can be removed from the structure to allow for waste retrieval and dismantling of the storage structure. The concrete roofs of the Low Level Storage Buildings vary in thickness from 10 cm to 16 cm to meet radiation shielding requirements. A Low Level Storage Building floor is constructed of poured concrete.

The buildings are unheated and are provided with a gaseous carbon dioxide fire extinguishing or suppression system, fire detection system and internal fixed lighting. A geomembrane liner and water collection system is also provided directly below the Low Level Storage Buildings for floor and sub-floor drainage. The drainage lines are directed to a sump where water can be collected, sampled and, if necessary, treated prior to discharge.

The freestanding stackable steel containers for low level waste are stacked to heights of 6 m (4 to 6 containers high) inside the Low Level Storage Buildings. Either a conventional forklift for the lower tier packages or a special boom-based heavy forklift for the upper tiers is used to stack waste packages in the Low Level Storage Buildings.

With CNSC approval, a Liquid Waste Area can be constructed within a Low Level Storage Building to facilitate the storage of liquid waste. The Liquid Waste Area is isolated by way of a curbed dyke, and the dimensions can be altered to suit the volume of liquid waste that is stored. The curbed area is sealed with a plastic liner to contain any liquid that may leak or spill. Liquid waste is stored in suitable containers. It is solidified before storage, or incinerated in the case of waste oils.

Steam Generator and Retube Waste Storage Buildings

WWMF currently has one storage building to store steam generators and another storage building to store retube waste in retube waste containers from the refurbishment of Bruce Power Units 1 and 2 (Figures 10 and 11). The design requirements of the steam generator and retube waste storage buildings are generally the same as the low level storage buildings described above. The Fire Hazard Assessment considered the storage of metal components within metal containers, and determined that a carbon dioxide fire suppression (or extinguishing) system was not required for these buildings.

The available space within these structures will continue to be used to satisfy the waste arising from the Bruce Power Major Component Replacement program. As that effort progresses, OPG expects to need to construct additional buildings for retube waste containers and for steam generators. Where practical, OPG will use any available space in these buildings to store other non-combustible low and intermediate level waste.

Figure 10: Retube Waste Container Storage at WWMF

Figure 11: Storage of Steam Generators

Quadricells

There are currently fifteen reinforced concrete quadricells at WWMF (Figure 12). Quadricells are designed to store operational intermediate level waste e.g. spent resin liners. Each quadricell has a 24 m^3 storage capacity which provides a total storage of 360 m^3 of waste.

Thirteen quadricells are filled, and there have been no additions to the quadricells since 1989. Two quadricells remain empty as reserve. There are no plans to construct additional quadricells.

Figure 12: In-ground Containers (foreground) and Quadricells (background)

In-Ground Storage

In-Ground Containers

The design of in-ground containers has evolved from small capacity 1 m^3 precast concrete tile holes to large capacity 18 m^3 prefabricated in-ground steel liners. The early tile holes were constructed by digging a trench to the required depth, pouring a concrete slab, setting the sampling pipes, and then backfilling the area around the sampling pipes. Most of the tile holes are fitted with a retrievable steel liner into which the waste was placed. A subsurface drainage system is located at the base of the tile holes to prevent water from accumulating around the tile hole and to provide a means of detecting leakage. There are 224 tile holes in service and OPG has no plans to construct additional tile holes.

In more recent years, the “IC” series of in-ground containers have been used to store both low and intermediate level waste. The containers have storage capacities of 2 m^3 (IC-2), 12 m^3 (IC-12) and 18 m^3 (IC-18) with the majority of the containers being IC-18s

(Figure 13). There are currently 20 IC-2s, 20 IC-12s and 252 IC-18s on site. The IC-12s and IC-18s are designed to accept intermediate level waste, e.g. ion exchange (IX) resin containers. OPG is requesting 270 additional IC-18s in order to store intermediate level waste produced from Darlington NGS Refurbishment and Bruce Power Major Component Replacement as well as continued operation of all OPG owned NGSs in Ontario.

Except for size, the main design features of the IC series of structures are similar (Figure 13). Each structure has an outer carbon steel liner that is leak-tested before installation. The IC-18s can be fitted with different types of inserts to allow other wastes, such as reactor core components, to be stored. Figure 14 shows the loading of an in-ground container.

There is an interspace between the waste package and the outer fixed liner. This interspace is sampled to detect possible water ingress by using a sampling pipe attached to the exterior of the IC-18 liners. This pipe permits access to the space between the waste-packaging container and the IC-18 liner for periodic sampling and monitoring without removing the shielding cover. A pump can be lowered to the bottom of the IC-18 sampling pipe for water removal, if water is detected. Waste can be retrieved by directly lifting the waste packages out of the in-ground containers.

OPG stores waste heat exchanger tube bundles from moderator, primary heat transport and auxiliary systems in in-ground containers, known as IC-HXs. There are currently 41 in-ground containers for heat exchangers (IC-HXs) at WWMF, with the last one constructed in 2002. The diameter and depth of the augured holes can be altered to suit the various sized containers.

Concrete Trenches

Concrete trenches are in-ground structures that have been designed to accept operational L&ILW such as drummed waste and waste of irregular shapes with radiation fields up to 150 mSv/hr. Most of the trenches are approximately 40 m long by 4 m wide and 3 m deep, and are divided into 3 compartments. The trench walls are 38 cm thick and the in-ground portions of the exterior walls are waterproofed with emulsified asphalt. The bottom of each trench compartment slopes to a sump and standpipe to permit water detection and removal (Figure 15). Some design details vary between the original trenches and those constructed later (see Figure 15 a, b). After the waste is placed into the trench, 30 cm precast concrete lid caps with neoprene gaskets are placed on the trenches. The total capacity of the 15 in-ground trenches is approximately 5,800 m^3. There are no plans to build additional trenches.

The surrounding ground surface is graded to direct surface water away from the structures. There is a drainage system adjacent to and underlying each trench. The drainage systems prevent the accumulation of water between the concrete storage structures and the surrounding low-permeability silt till deposit. The drainage systems also provide a convenient means of detecting and controlling any potential leakage of contaminated water from the storage structures.

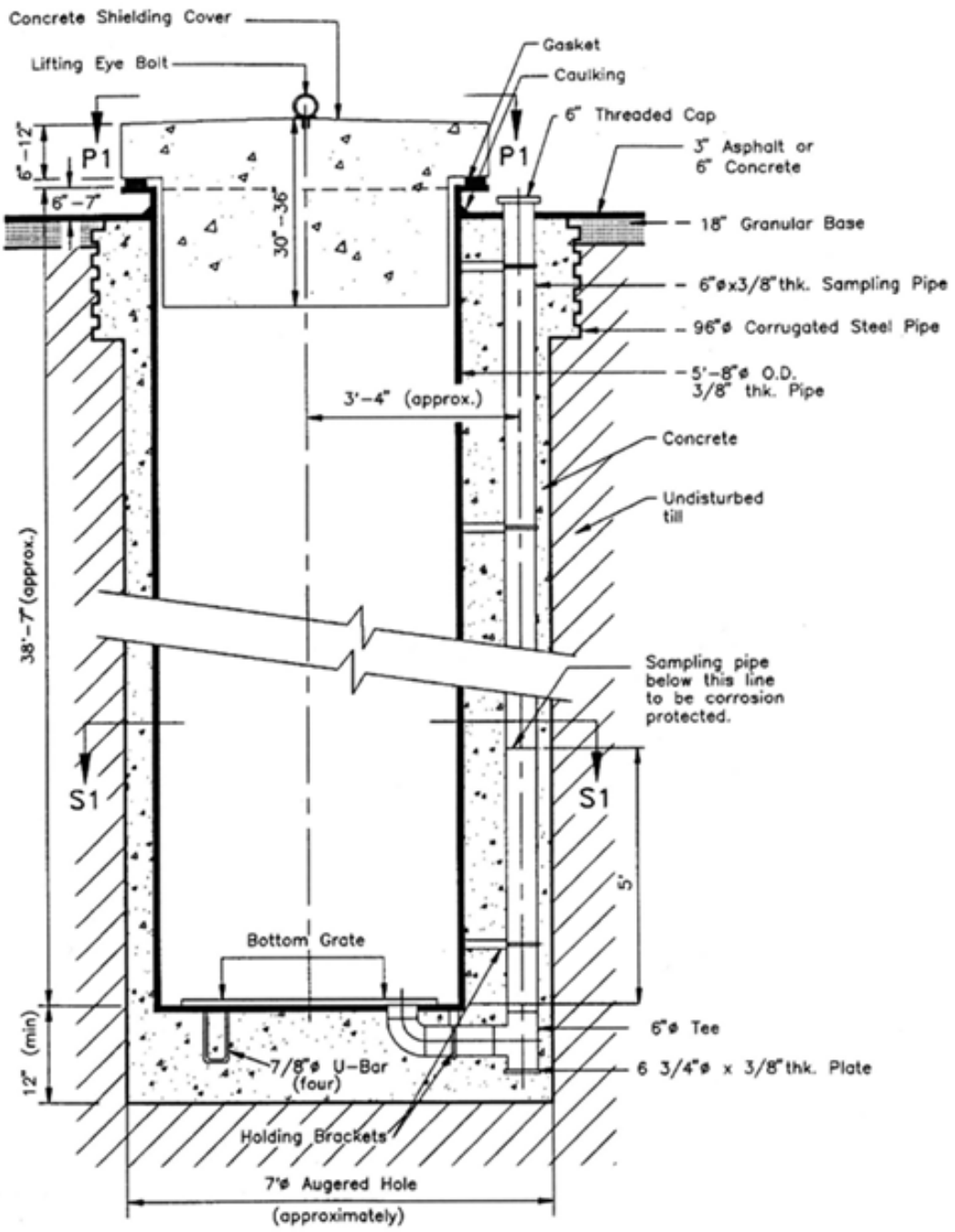


Figure 13: Cross-Section of IC-18

Figure 14: Loading an IC-18

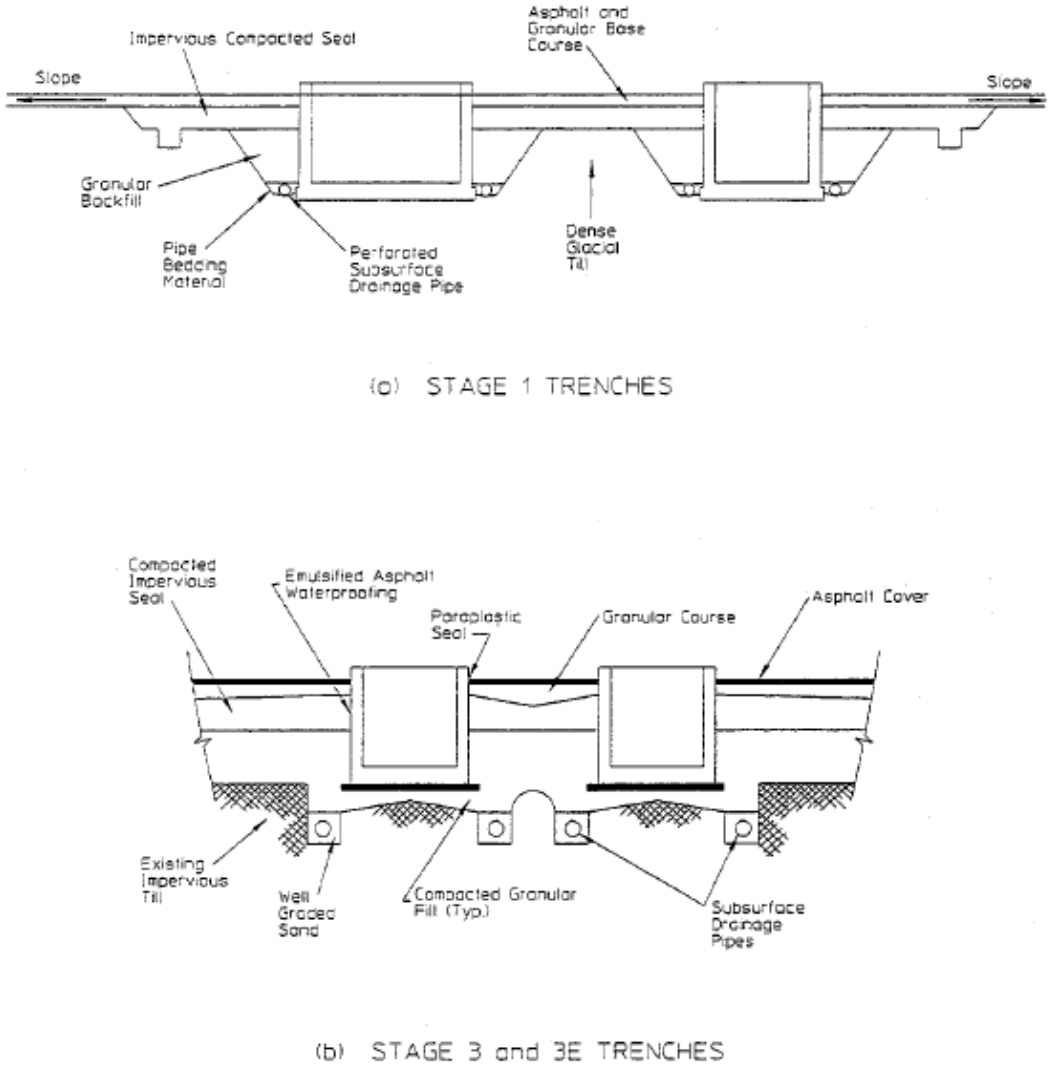


Figure 15: Sectional View of Subsurface Drainage and Backfill Material around Trenches

1.1.4 Management of High Level (Used Fuel) Waste

The Used Fuel Dry Storage Facility is a security-protected area located northeast of the L&ILW storage facility area, and consists of a DSC processing building and four (4) storage buildings designed to provide interim storage space for up to 2,000 DSCs (about 768,000 bundles) for used fuel generated by Bruce Power NGS. The Used Fuel Dry Storage Facility was placed in service in October 2002 and received the first DSC from Bruce Power NGS in February 2003 (Table 2). A second DSC Storage Building was placed into service in 2007, and two additional storage buildings were constructed and placed into service in 2012. As of the end of Q2 2016, 1,211 DSCs have been safely stored in the DSC storage building at the WWMF. Based on contractual agreements with Bruce Power to process up to 130 DSCs per year, OPG expects that the next storage building will be needed by 2019.

Dry Storage Containers

A DSC is a free standing reinforced concrete container with an inner steel liner and an outer steel shell, for the storage and on-site transfer of used CANDU fuel. It is made of two sub-assemblies, a lid and a base. The base provides the storage space for the used fuel.

The DSC MKII model constitutes the reference container design for the WWMF. The DSC is a double-shell rectangular container, with exterior dimensions of 2.121 m x 2.419 m by 3.557 m in height (including the lid), and an inside cavity of 1.046 m x 1.322 m by 2.520 m. The nominal thickness of each carbon-steel shell is 13 mm. The DSC walls consist of 520 mm (nominal thickness) concrete placed between the inner liner and the outer shell. The reinforced high-density concrete provides radiation shielding and structural strength while maintaining adequate used fuel decay heat dissipation. The concrete has a density in the range of 3.5 to 3.7 Mg/m^3 and a compressive strength of at least 40 MPa. The maximum total mass (including the lid of 11 Mg) is approximately 60 Mg when empty and approximately 70 Mg when loaded with four modules (384 used fuel bundles).

All welds that form this containment system and all welds attaching items to the containment system are classified as “Nuclear Welds”. Helium is used as the inert cover gas in the DSC cavity to protect the fuel bundles from potential oxidation reactions and to facilitate leak testing of the containment boundary.

The DSC is designed with the provision for installing safeguards seals. Two separate U-shaped 25.4 mm outer diameter stainless steel tubes are embedded in the DSC walls and floor in the plane of the outer reinforcing grid. These tubes are placed so that each tube runs across the centre of opposite container walls. Two similar tubes are embedded in the DSC lid and run diagonally across the lid. The configuration of the safeguards tubes is shown in Figure 16. These tubes are used for attaching two different types of International Atomic Energy Agency (IAEA) seals.

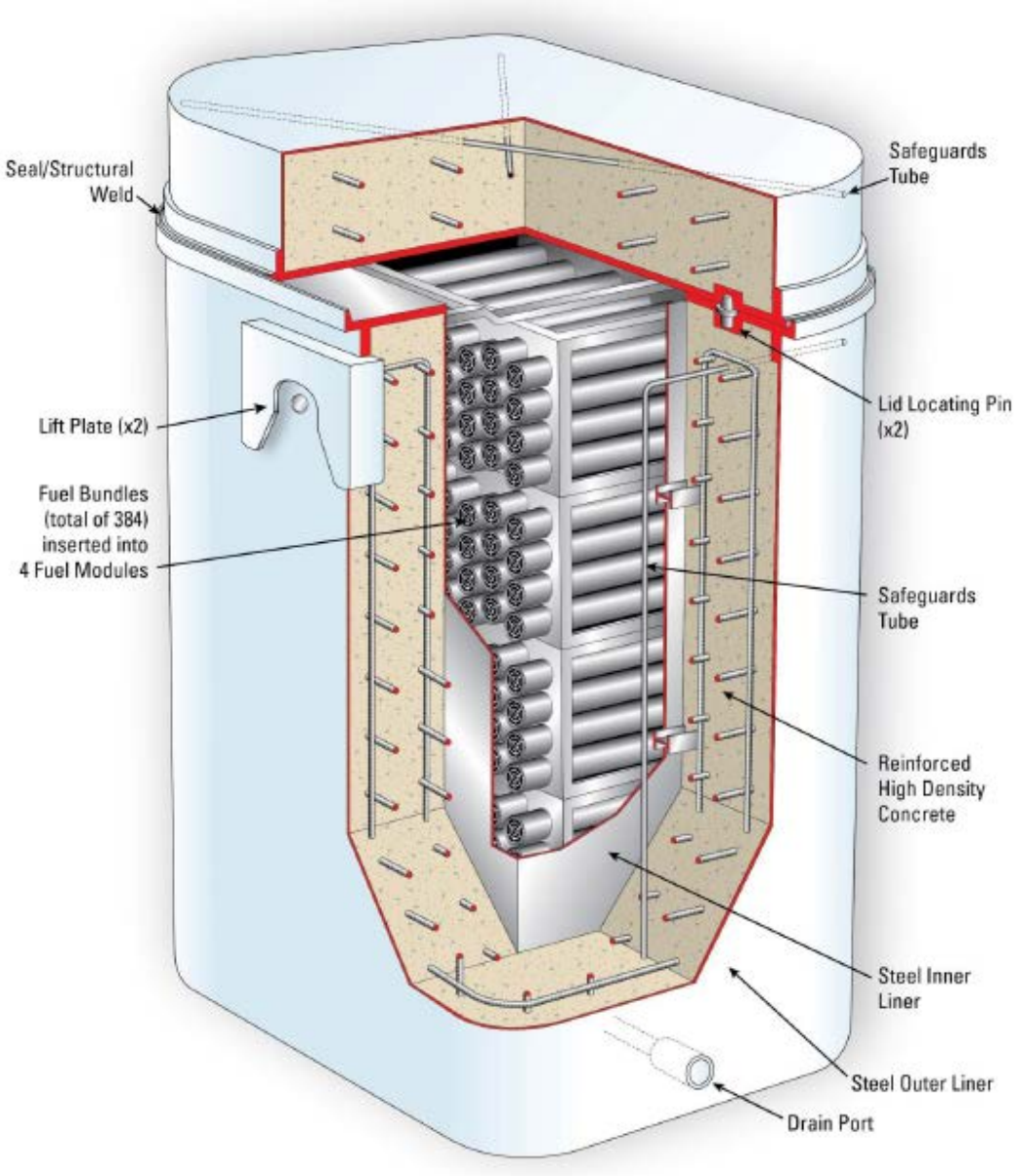


Figure 16: Dry Storage Container

Used Fuel Dry Storage Processing

The processing of a DSC begins with the preparation of new DSCs at the DSC processing building and ends with the storage of loaded, hermetically sealed DSCs in storage buildings for used fuel. The steps are summarized in Figure 17 and discussed below.

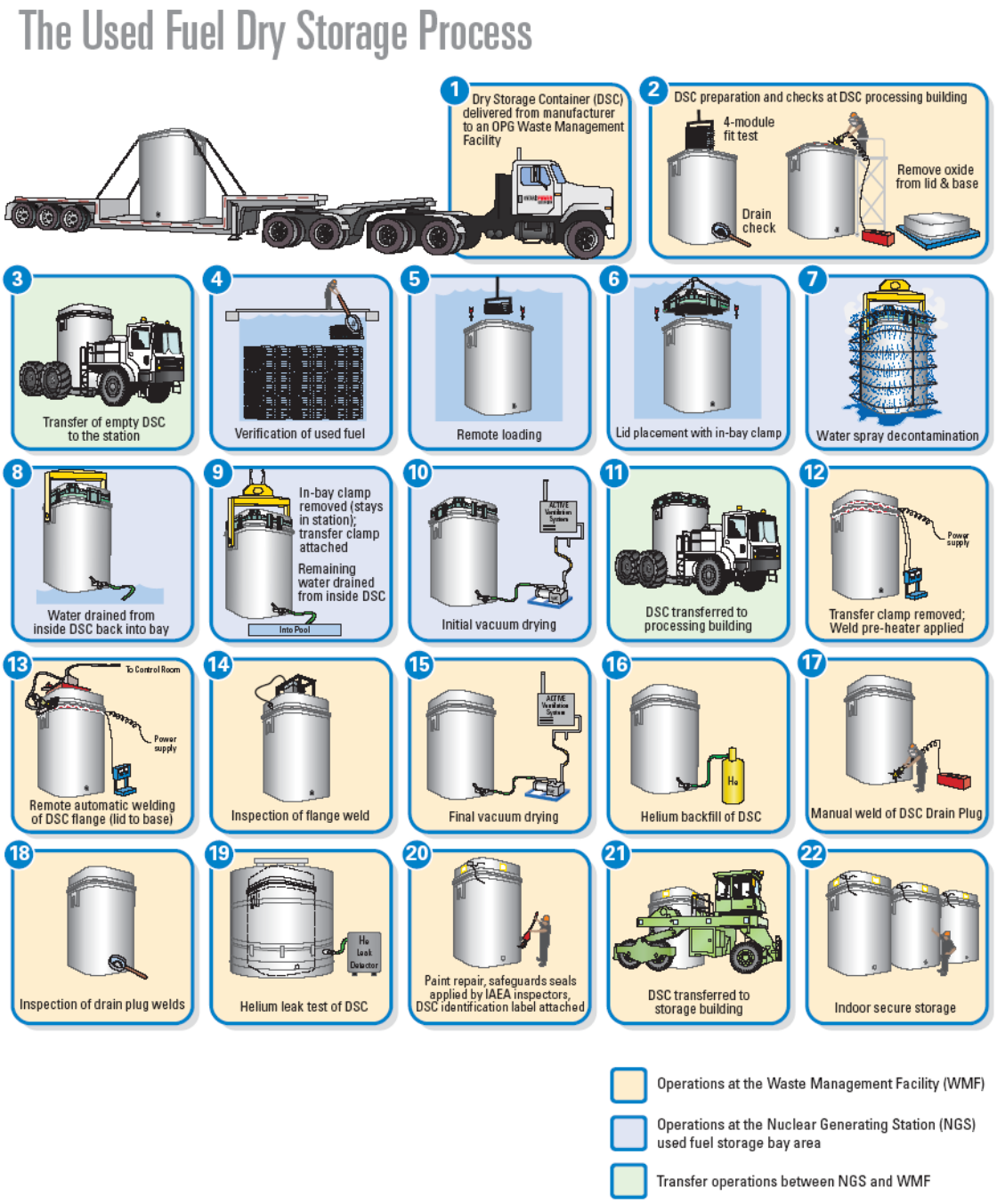


Figure 17: Used Fuel Dry Storage Process

Steps 1-3: Preparing and Transferring Empty DSCs

New, empty DSCs are received from the manufacturers at the DSC processing building, where they are prepared and then transported to the Bruce Power NGS for subsequent loading of used fuel.

One of two vehicles (either the DSC Transfer Vehicle or the DSC Transporter) is used to transfer both new (empty) and loaded DSCs between WWMF and Bruce Power NGS.

Steps 4 – 10: Loading a DSC at Bruce Power NGS

The process of loading, decontamination, draining and initial drying are completed at Bruce Power under their operating licence. At the Bruce Power NGS, after a 96 bundle module has been loaded, it is transferred under water to a DSC. Each DSC is designed to hold four storage modules, each with a capacity to hold 96 bundles, for a total capacity of 384 bundles per loaded DSC.

While the loaded DSC is still submerged in water in the loading bay, the in-bay clamp is used to secure the DSC lid to the container. The DSC is lifted out of the water, and then drained and the DSC exterior is decontaminated. The in-bay clamp is replaced with the transfer clamp, and the DSC interior cavity is vacuum-dried in preparation for on-site transfer to the WWMF.

Prior to leaving the station, Bruce Power surveys and decontaminates the entire exterior surface of the loaded DSC and its components including lid flange, drain housings, and the transfer clamp to ensure there is no detectable loose contamination as per OPG's Waste Acceptance Criteria for WWMF.

Step 11: DSC transfer between Bruce Power NGS and the DSC processing building at the WWMF

The Transfer Vehicle or Transporter picks up a loaded DSC from the Bruce Power NGS after confirmation that it meets OPG's waste acceptance criteria. Both the vehicle and the DSC are monitored for contamination and decontaminated, as required, before leaving the station.

The vehicle with a loaded DSC then leaves the station and travels along the Bruce site roads to the WWMF in accordance with security and safeguards requirements for on-site transfer. The maximum lift height required for loading/unloading a DSC is about 0.60 m, which is well within the safety envelope of 2.4 m. When traveling with a DSC, the DSC Transfer Vehicle operates at low speed and has a short stopping distance where stopping is essentially instantaneous. The vehicle is always operated from the cab by a trained vehicle operator. Upon arrival at the WWMF site, the DSC is surveyed to ensure it is clean prior to the DSC being processed.

Steps 12 - 20: Processing a DSC at WWMF

The loaded DSC is transported on Bruce site roads to the WWMF Used Fuel Dry Storage area, where it is off-loaded at the DSC processing building for further processing, as follows:

- **Receiving a Loaded Dry Storage Container (Step 12) -** Upon arrival at the DSC processing building, both the vehicle and the DSC are re-monitored for contamination. After the loaded DSC is received at the DSC processing

building, the DSC is lifted from the receiving bay floor using the overhead crane and lifting beam and moved into the workshop.

- **Dry Storage Container Lid Seal Welding (Step 13) -** The DSC is moved to a welding station where the DSC drain port transfer plug, transfer clamp and seal are removed and the weld pre-heater is installed. The pre-heater is used to heat the DSC weld flange to a prescribed temperature. At the conclusion of lid welding, the weld machine is removed and the DSC is allowed to cool.
- **Welding Inspections (Step 14) -** The Phased Array Ultrasonic Testing system is used for the inspection of the DSC lid-to-base seal weld. The scanner is mounted on the DSC base's top flange and is held in place by three magnetic wheels. A loading ramp is used to minimize the force required by the operator when engaging and disengaging the scanner. The inspection covers 100% of the weld as well as the Heat Affected Zone. After completion of the lid weld inspection, partially processed DSCs may be transferred to the surveillance area and temporarily stored for up to one year from time of loading.
- **Final Vacuum Drying, Helium Backfill, and Drain Port Seal Welding (Steps 15 – 18) -** After successful completion of the weld inspection, the DSC is lifted into another work station for final vacuum drying and helium backfilling. The lifting beam is removed and the vacuum drying/helium backfilling system connected.
- **Helium Leak Testing (Step 19) -** Helium leak testing is carried out using a vacuum chamber (bell jar). The lid of the bell jar is removed and the seal-welded DSC is lifted into the lower half of the bell jar. The bell jar lid is craned over the DSC and sealed onto the base of the bell jar. Using the vacuum skid, air is first removed from the bell jar and then the helium leak detector is activated. If a leak is detected, the vacuum equipment is removed and remedial work is carried out. This work may involve finding the leak and repairing the weld. A follow-up leak test is then performed.
- **Paint Touch Up and Safeguards Seals (Step 20) -** Areas affected by the welding are cleaned and painted. Touch-up paint is also applied to scrapes or scuffs on the DSC that may have resulted from handling. Painting is carried out in the paint bays. Documentation and identification labelling are completed and permanent safeguards seals are installed in a designated IAEA surveillance area.
- **Dry Storage Container Placement and Storage (Steps 21 and 22) -** The DSC is moved, using the Transporter, to a designated location in a Used Fuel Dry Storage Building for storage (Figure 18). In the Used Fuel Dry Storage Building, the Transporter unloads the DSC in a designated storage location.

Figure 18: Storage of DSCs

On-Site Transfer of DSCs

Dry Storage Container On-Site Transporters / Transfer Vehicles

The OPG DSC Transporters / Transfer Vehicles are specially designed multi-wheeled vehicles for the transfer of loaded DSCs from the station's irradiated fuel bays to the DSC Processing Building, and for transporting processed DSCs from the DSC Processing Building to storage (Figure 19). The DSC Transporters / Transfer Vehicles are self-powered by a diesel engine. The DSC is carried at a low lift height (about 20 cm) during transfer. The tires on the Transporters / Transfer Vehicles will not deflate if punctured.

When travelling with a DSC, the Transporters / Transfer Vehicles operate at low speed and have a short stopping distance. When travelling at minimal speeds (e.g. when moving DSCs within the DSC Processing and Storage Buildings), stopping is essentially instantaneous. The Transporters / Transfer Vehicles are capable of forward and reverse motion and have a tight turning radius. Vehicle lighting is provided for night-time operation, if necessary, although this is rarely employed.

WWMF may use any of three types of Transporter / Transfer vehicles. Each type has a different manufacturer – Liftking, MacLeans or TOR.

The Liftking and MacLeans models do not require the assistance of a crane when picking up or positioning a DSC. The DSC is lifted and transferred via lifting trunnions mounted on the upper frame of these two machines. Locking arrangements prevent the DSC from being inadvertently lowered to the ground upon hydraulic failure. A crane loads the DSC onto the TOR model's flat bed which prevents the DSC from contacting the ground.

The vehicle control systems limit the maximum speed of each type of vehicle (4 km/h for the Liftking model, 12 km/h for the MacLeans model and 20 km/h for the TOR model).

Figure 19: Liftking (top) and MacLeans (bottom) DSC Transporters

Transfer Clamp

A transfer clamp is used to securely attach the lid to the DSC base during on-site transfer of a loaded DSC between Bruce NGS irradiated fuel bays and the WWMF. The transfer clamp prevents the lid and base from separating under credible accident scenarios during the transfer of loaded DSCs between the station and the DSC Processing Building, and during DSC handling and storage inside the Processing Building prior to seal-welding the DSC lid to the DSC base.

Storage Building for Used Fuel

Each Used Fuel Dry Storage Building is designed to have an approximate area of 5,300 m^2, with a nominal storage capacity of approximately 500 DSCs. The walls consist of 0.20 m thick precast concrete panels from ground level to a 4.2 m height. Vertical louvres, providing passive ventilation, and metal cladding are installed at upper wall elevations. 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 with minimal maintenance, to retain surface alignment and provide a hard, smooth and durable surface. Floors are sloped to provide drainage to floor drains. The DSC processing building and storage buildings are designed to the *National Building Code of Canada* and the *National Fire Code of Canada.*

The building roof has provisions for drainage of rainwater and melted snow. Access to the roof is by the use of an outside, all weather, and permanent stairway. The building is grounded to protect against lightning.

1.1.5 Description of Other Supporting Facilities at WWMF

Transportation Package Maintenance Building

The Transportation Package Maintenance Building consolidates many of the maintenance activities at WWMF into one location. The building houses two bays for maintenance work on transportation packages plus control maintenance and mechanical maintenance workshops.

The Transportation Package Maintenance Building includes an area for two trailer bays with a laydown area for the transportation packages, overhead crane and work stations. There is also a bay support area consisting of workbenches, general storage cabinets, hazardous material storage cabinets, and spot decontamination areas.

Amenities Building

The Amenities Building is approximately 1,200 m^2 and provides entry space, office space, locker and shower facilities, and lunchroom facilities for the WWMF staff.

Office, cafeteria, and associated areas are designated as Zone 1. Zone 1 is a clean area inside the *zoned area* that is considered equivalent to public domain. Locker rooms and associated areas are designated as Zone 2, an area inside the *zoned area* that is normally free of contamination but is subject to infrequent cross-contamination due to the movement of personnel and equipment from contaminated areas. This zone may also contain enclosed, sealed radioactive systems and sources (i.e., active ventilation ducts, radioactive monitoring pipelines, and constancy check sources).

1.2 Highlights

Upon renewal, OPG requests authorization for the site preparation, construction or construction modification of the following structures:

- 4 storage buildings for used fuel dry storage;
- 11 storage buildings for low and/or intermediate level radioactive waste;
- 270 in-ground storage containers (IC-18s) for intermediate level waste;
- 30 in-ground containers for heat exchangers (IC-HXs);

- Large Object Processing Building; and,
- Waste Sorting Facility.

To provide for safe interim waste storage until long term or permanent facilities are in service, the licensed area will be expanded outside the existing licensed area to accommodate some of the new buildings. The expanded area will include the appropriate security measures required for each additional building. Environmental Assessments confirmed there would be no significant adverse effects from the construction and operation of the DSC Storage Buildings on human and non-human biota.

1.2.1 Ten-Year Operating Licence Renewal Request

OPG is requesting a decision from the CNSC Commission for a licence renewal of the WWMF Operating Licence for another 10 year term to May 31, 2027. OPG is requesting authorization for the site preparation, construction or construction modification of the following structures:

- 4 storage buildings for used fuel dry storage;
- 11 storage buildings for low and/or intermediate level radioactive waste;
- 270 in-ground storage containers (IC-18s) for intermediate level waste;
- 30 in-ground containers for heat exchangers (IC-HXs);
- Large Object Processing Building; and,
- Waste Sorting Facility.

These facilities would not alter the basic purpose and activities associated with the WWMF. The additional DSC Storage Buildings will allow OPG to store all of the used fuel generated by Bruce Power Nuclear Generating Station (NGS). WWMF will continue to provide safe, interim dry storage of used fuel generated by Bruce Power NGS under the current Power Reactor Operating Licence.

No significant changes are anticipated in the designs that have previously been accepted by the CNSC for the DSC Storage Buildings.

OPG is requesting a renewal of the operating licence for WWMF until May 31, 2017 on the basis that it has been safely managing low and intermediate level waste at this facility for over 40 years. OPG also has considerable experience managing used fuel in DSCs at its three waste management facilities, beginning with Pickering in 1996, and has gained 20 years of experience processing and storing DSCs. The three OPG-owned waste management facilities for used fuel are similar, and operate under existing programs and controls.

Nuclear Waste Management has consistently demonstrated that it can operate in a manner that protects the environment, and the health and safety of its workers. Currently, OPG's Darlington Waste Management Facility, Pickering Waste Management Facility and the Western Waste Management Facility have each operated under 10 year operating licences. Expansion of the WWMF is described below.

1.2.2 Expansion of Western Waste Management Facility

Figure 20 shows the existing licensed area in red. The woodlot and construction laydown areas are two locations currently being considered for the expansion. This expansion would not alter the basic purpose and activities associated with the WWMF. The additional storage capacity at the WWMF will enable the generating stations to continue operating as planned under their operating licences.

Additional Storage Buildings and Structures for L&ILW

Additional above-ground Storage Buildings

Over the next licensing period, OPG plans to construct up to 11 above-ground storage buildings, as required, to accommodate L&ILW.

- Five of the eleven storage buildings are approved in the current licence, and OPG is requesting that they be carried over into the next licensing period. The planned location for these L&ILW storage buildings is the north area as shown in Figure 20.
- Two other storage buildings were assessed in previous environmental assessments, but not included in the current licence. These buildings were assessed in previously approved EAs [R1; R2]. OPG is requesting that these two buildings be included in the licence.
- Because of land constraints on the WWMF, OPG will need to construct four additional storage buildings outside the current licensed area - either in the construction laydown area or woodlot (Figure 20). A predictive effects assessment has been conducted to identify the impacts to human and non-human biota.

OPG's strategy of constructing buildings as needed means the specific siting of some of these buildings will be determined at a later date. The timing and location of the buildings is also dependent on whether OPG's L&ILW Deep Geologic Repository is approved for construction at the site. Currently, four areas are being considered - two areas are within the current WWMF (north area, and the northeast area as shown in Figure 20) and two areas are outside the WWMF (construction laydown area, and the woodlot area as shown in Figure 20). The north area within WWMF will be developed first for the construction of two Low Level Storage Buildings and three storage buildings for low and/or intermediate level waste, called Multipurpose Storage Buildings. Once the land space within WWMF is filled, OPG plans to construct the additional storage buildings for L&ILW in either one of the two locations (construction laydown area and/or woodlot shown in Figure 20) outside the WWMF licensed area.

The same activities will occur in these buildings as are allowed under the current licence. No significant changes are anticipated in the designs that have been previously approved for similar structures on site. The storage buildings for L&ILW will utilize existing design requirements for Low Level Storage Building, Retube Component Storage Building or the Steam Generator Storage Building. However, the design requirements will be updated to meet current codes and standards, incorporate any lessons learned from the previous design, meet site specific constraints and incorporate any operational improvement requirements. They will also meet regulatory dose requirements at the facility fence, and at the Bruce site boundary fence.

In order to allow operational flexibility, and to utilize existing space within all the above-

ground storage buildings for both low and intermediate level waste, OPG may store compatible waste types in these buildings. These buildings will be referred to as Multi-Purpose Storage Buildings. In addition, one of the existing Low Level Storage Buildings or one of the new Low Level Storage Buildings may be repurposed and used as a staging and overpacking area for low level waste before it is transferred to the L&ILW Deep Geologic Repository if the repository is approved.

Based on projected L&ILW forecasts, the 11 new storage buildings will be used to accommodate low level waste, steam generators (and potentially pre-heaters and heat exchangers), retube component wastes (including pressure tubes, calandria tubes, end fittings and shield plugs, spacers), and other compatible wastes. The timing of the construction of the buildings is dependent on the timing and volume of waste expected to be received from the stations. OPG makes decisions on when to construct new buildings approximately 5 years before they are required to ensure sufficient time in advance of the use of the existing available storage space, to allow for the design, site preparation and construction activities.

Additional In-Ground Containers

IC-18s

The scope of the project for the Radioactive Waste Operations 2 Environmental Assessment conducted in 2001 included the construction of 108 IC-18s [R3], which are included in the current licence and have been built.

In 2006, OPG conducted the Refurbishment Waste Storage Environmental Assessment. The scope of the project included 270 IC-18s (5 batches of 54 IC-18s). To align with this Refurbishment Waste Storage environmental assessment which was accepted by the CNSC, OPG is requesting that the 270 IC-18s be included in the next licence.

In-Ground Container – Heat Exchangers (IC-HX)

In 2006, OPG conducted the Refurbishment Waste Storage Environmental Assessment. The scope of the project included 30 IC-HXs. To align with this Refurbishment Waste Storage Environmental Assessment, which was accepted by the CNSC, OPG is requesting that the construction of 30 IC-HXs be included in the next licence.

Additional Storage Buildings for Used Fuel during the Next Licensing Period

For planning purposes, a 12-month in-bay buffer space and a minimum of one core dump emergency reserve space in the station's irradiated fuel bays are assumed. OPG intends to construct four additional storage buildings to accommodate DSCs from Bruce Power NGS, to be located outside of the current WWMF licensed area.

The design of the proposed Used Fuel Dry Storage Buildings will be similar to the design of the existing Used Fuel Dry Storage Buildings, approved and in use at all three of OPG's waste management facilities for the storage of DSCs. The Used Fuel Dry Storage Buildings will be designed to have an approximate area of 5,300 m^2, and a nominal storage capacity of approximately 500 DSCs.

A conceptual design study has been completed and a decision has been made to locate the new Used Fuel Dry Storage Buildings in the construction laydown area south of the WWMF (shown in Figure 20). These buildings will be within a designated

secured area as required by the *Nuclear Security Regulations* under the *Nuclear Safety and Control Act*.

The buildings will be designed to ensure that when filled, the dose rate at the facility fence will be less than 0.5 µSv/h (0.05 mrem/hr) on a quarterly averaged basis, and the dose rate at the Bruce site boundary shall be less than 0.010 mSv/year (1.0 mrem/year). Processing activities will continue in the existing processing building located within the existing WWMF. Similar to the Pickering Waste Management Facility, OPG may conduct a campaign to transfer DSCs already processed and stored, from the existing storage buildings (1 to 4), into buildings 5, 6, 7 or 8 as they are constructed.

Additional Processing Capability during the Next Licensing Period

Large Object Processing Building

OPG is considering the construction and operation of a Large Object Processing Building for the processing of large metallic components such as steam generators or large heat exchangers. The Large Object Processing Building would be a single-story structure with a robust floor capable of supporting a rail-mounted gantry crane. Conceptually the processing facility would utilize prefabricated pre-stressed concrete, similar to the existing storage buildings for L&ILW. Operations within the building would include segmenting activities such as cutting and grinding as well as packaging activities.

The primary function of the large object processing building would be to safely process the steam generators and other large components into segments, in order to reduce the volume required to be stored, whereby improving the storage efficiency on the current site.

The processing of the large components would also enable OPG to remove and recycle elements of these components that are not radiologically contaminated. The potential location for the new Large Object Processing Building is inside the current licensed area of WWMF, and the planned construction date is about 2024.

Waste Sorting Building

The existing WWMF licence allows for the retrieval and reprocessing of L&ILW, including sorting, processing and/or diversion to conventional disposal or free release, subject to meeting the established clearance level. OPG is planning on constructing and operating a building specifically for this purpose in order to further reduce the volume of L&ILW stored on site. The building will be approximately 2,500 m^2. The potential location of the new Waste Sorting Building is inside of the current licensed area, near the Waste Volume Reduction Building.

1.2.3 Move to New Licence and Licence Condition Handbook

Although there are no changes being requested to the current licence conditions, OPG agrees with the move to a new Operating Licence format, supported by the Licence Condition Handbook, which retain current licensing requirements for the most part, but also allows for their evolution (for example, updated standards with documented transition plans).

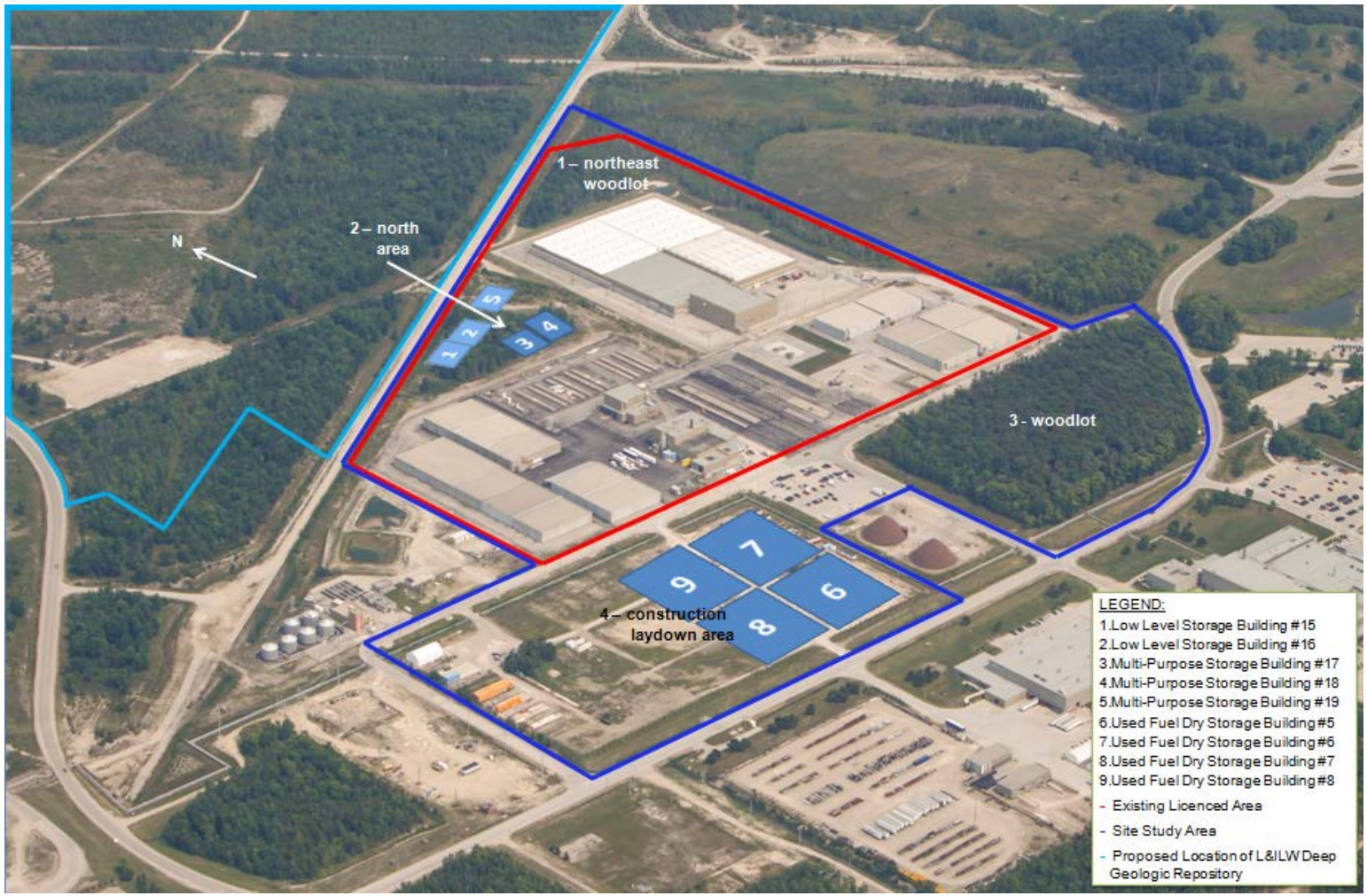


Figure 20: Location of Storage Buildings for L&ILW

2.0 Business Plan

2.1 Nuclear Waste Management

WWMF accepts low and intermediate level waste from the Pickering, Darlington and Bruce Power NGSs and is so doing, ensures ongoing support for the operation of these generating stations. WWMF is also integral to the ongoing operations of the Bruce Power NGS to ensure sufficient space is available in the wet bays to accept new used fuel arising from the operation of the station.

The Vice-President, Nuclear Waste Management has the overall responsibility for the safe and reliable operation of OPG's three waste management facilities, including the WWMF. The Director, Western Waste Operations leads all operations at the WWMF. The day-to-day operations and management of WWMF is the responsibility of the Operations Managers for Low & Intermediate Level Waste and Used Fuel. Only those persons who are authorized by the facility operations managers can supervise the operations at WWMF. There are approximately 160 qualified personnel in attendance at WWMF to ensure safe operation within the requirements of the CNSC operating licences, and all applicable federal and provincial Acts and Regulations.

The Nuclear Waste Management program at WWMF will continue to meet OPG's needs to manage waste arising from electricity generation and plant refurbishment. Its top priority will continue to be the safe and environmentally conscious management of low and intermediate level radioactive waste from Pickering NGS and Darlington NGS as well as used fuel from Bruce Power NGS.

2.2 Planning for the Future at WWMF

Nuclear Waste Management maintains a system plan document which is based on a set of planning reference assumptions (such as reactor end of life), then projects future waste volumes. This system plan document enables Nuclear Waste Management to forecast future needs for storage structures, transportation packages and campus planning. The system plan document is reviewed and updated annually.

WWMF maintains a managed process to determine and plan when storage buildings are required for used fuel. Used fuel inventory forecasts are based on the fuel loading of power reactors, reactor performance, storage space in the irradiated fuel bays and the projected amount of used fuel that would be transferred to dry storage. The planning assumption is that a long term storage solution for used fuel will be available in 2043. Each of these variables is reviewed and validated annually and then Nuclear Waste Management determines the fill date of existing waste management storage structures.

WWMF maintains a similar managed process to determine and plan when storage buildings are required for L&ILW. L&ILW inventory forecasts are projected based on the number and duration of reactor outages, including refurbishment and major component replacements. The volume reduction capability of processing equipment such as the incinerator and compactor is also incorporated. For planning purposes, it is assumed that a long term storage solution for L&ILW would be available in 2026. Each of these variables is reviewed and validated annually and then Nuclear Waste Management determines the fill date of existing waste management storage

structures, examines alternative waste processing and storage technologies to determine the planned in-service dates for new storage structures.

The information is used to:

1) map the forecast requirements of the System Plan to WWMF site specific expansion needs; and,
2) provide a means to control the allocation of space on the WWMF site.

WWMF is based on a staged construction approach, with new buildings being built as required to meet storage and processing needs (or other needs as identified).

The space allocation for WWMF is an input into the WWMF Campus Plan, that was created to institute a framework for future land use changes and growth for buildings outside the protected area of WWMF and for ensuring that spatial planning accommodated OPG's vision for the site.

The current forecasted in service dates for buildings and structures requested in this licence are found in Addendum A.

3.0 Safety and Control Areas

3.1 Management system

The Management System establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its performance against the objectives and fosters a healthy safety culture. The management system defines the organizational structure, roles and responsibilities, applicable program elements and the interfaces between them.

3.1.1 Relevance and management

The OPG Nuclear Management System defines the organizational structure, roles and responsibilities, applicable program elements, and the interfaces amongst them and applies to all OPG nuclear facilities. The Management System is compliant with the requirements of CSA N286-12 and establishes the processes and programs required to ensure the OPG Nuclear Waste Management organization achieves its safety objectives by continuously monitoring performance against the objectives and fostering a healthy safety culture. WWMF staff understands and manages work and financial liabilities to accurately plan and forecast expenditures, ensuring value for money.

Nuclear Safety Policy

OPG's Nuclear Management System receives its direction from the Nuclear Safety Policy set by the OPG Board of Directors.

OPG's Nuclear Safety Policy was established in recognition that nuclear power poses unique hazards due to the enormous energy in the reactor core, radioactive material and decay heat produced by the fuel. The objective of this policy is to ensure the protection of our workers, the public and the environment from these hazards.

The Nuclear Safety Policy sets expectations for all OPG employees. The policy states that:

> *"Nuclear safety shall be the overriding priority in all activities performed in support of OPG nuclear facilities. Nuclear safety shall have clear priority over schedule, cost and production."*

To meet this expectation, OPG's Board of Directors establishes that everyone shall demonstrate respect for nuclear safety by:

- Knowing how their work impacts on Controlling power, Cooling fuel and Containing radioactivity (known as the 3 C's);
- Applying Event-Free tools and defences to prevent events; and,
- Reporting adverse conditions so they can be corrected.

It is also an expectation that OPG employees will embrace and exhibit the traits of a healthy nuclear safety culture. Based on industry best practice, the following traits of a healthy nuclear safety culture are included in the Nuclear Safety Policy:

- Personal Accountability
- Questioning Attitude
- Effective Safety Communication

- Leadership Safety Values and Actions
- Decision-Making
- Respectful Work Environment
- Continuous Learning
- Problem Identification and Resolution
- Environment for Raising Concerns
- Work Processes.

These traits are continuously reinforced, promoted, and applied by staff in all work performed. Many of the daily meetings that occur at WWMF involve a discussion of the nuclear safety traits and a sharing of good practice respecting the application of the trait or an experience where application of the trait could have been better utilized.

Other policies set by the OPG Board of Directors are also applicable to operations of the WWMF. For example, the Employee Health and Safety Policy sets the expectations for the protection of workers, across OPG, from the conventional hazards associated with the operation of the facilities, and the Environmental Policy establishes expectations both for the protection of the environment and its enhancement through biodiversity initiatives. The implementing management system documents for these policies are applied to the WWMF operations, as described in the applicable sections of this application.

Nuclear Management System Charter

OPG's Nuclear Safety Policy is implemented through a series of governing documents which together form the Nuclear Management System. The first implementing governing document is the Nuclear Management System Charter. The Charter establishes the programs that provide the specific measures that are applied in the day to day, safe, reliable operation of the OPG nuclear facilities. The Charter defines the organization responsibilities, interfaces, and applicable program elements to achieve the requirements of:

- *General Requirements for Pressure-retaining Systems and Components in CANDU Nuclear Power Plants,* CSA Standard N285.0;
- *Material Standards for Reactor Components for CANDU Nuclear Power Plants,* CSA Standard N285.6; and,
- *Management System Requirements for Nuclear Facilities*, CSA Standard N286-12.

The programs identified in the Charter describe the measures that are applied as activities are performed in the facilities or in support of ongoing safe operation.

The Nuclear Management System implementation is monitored through a series of activities, including external and internal audits, performance metrics designed to measure and monitor the key outcomes of the programs, management assessments, and the corrective action and continuous improvement processes, including benchmarking of industry best practices. All of these activities allow OPG to identify opportunities to seek continuous improvement in its performance and make its operations safer and more reliable.

Nuclear Waste Management Program

Activities at the WWMF are largely performed in accordance with the same processes as are applied at the other OPG nuclear facilities; however there are instances where it has been necessary to develop specific procedural documents to address the unique aspects associated with nuclear waste operations, such as transportation. The Nuclear Waste Management Program identifies the specific procedural documents, together with any necessary exceptions to the generally applicable nuclear management system procedures. Most of the specific procedural requirements apply to the handling of waste at the WWMF, such as the operation of the L&ILW waste processing systems, and the handling and storage of the used fuel dry storage containers.

As with all other parts of the OPG nuclear management system, implementation of the management system for WWMF is assessed on an on-going basis.

Organization

During the licensing period, OPG adopted a centre-led organizational model. Under this structure, there are two types of functional organizations: those accountable for delivering company-wide programs; and those accountable for operations.

Centre-led groups establish one point of accountability for an entire business function in order to fully support all business units. Examples of such central functions include Health & Safety, Human Resources, Supply Chain, Finance, Records, Environment and Corporate Relations and Communications. These central functions ensure best practices are implemented across all of OPG's facilities, and enable the development of the expertise necessary to provide operations support.

The Vice-President, Nuclear Waste Management has the authority to act for OPG in dealings with the Commission, and is responsible for the management and control of licensed activities at the WWMF. The day-to-day operations and management of the WWMF is the responsibility of the Operations Managers for Low & Intermediate Level Waste and Used Fuel, who report to the Director of Western Waste Operations. Only those persons authorized by the Operations Managers supervise operations at the WWMF. The operations organizations receive direct support from the central functions.

Organizational changes are managed following OPG's Organization Design Change procedure. OPG submits updates to CNSC on persons authorized to act on behalf of OPG in dealings with the CNSC, as required per subsection 15(c) of the *General Nuclear and Safety Control Regulations*. The organization chart for WWMF and supporting center-led organizations is shown in Figure 21.

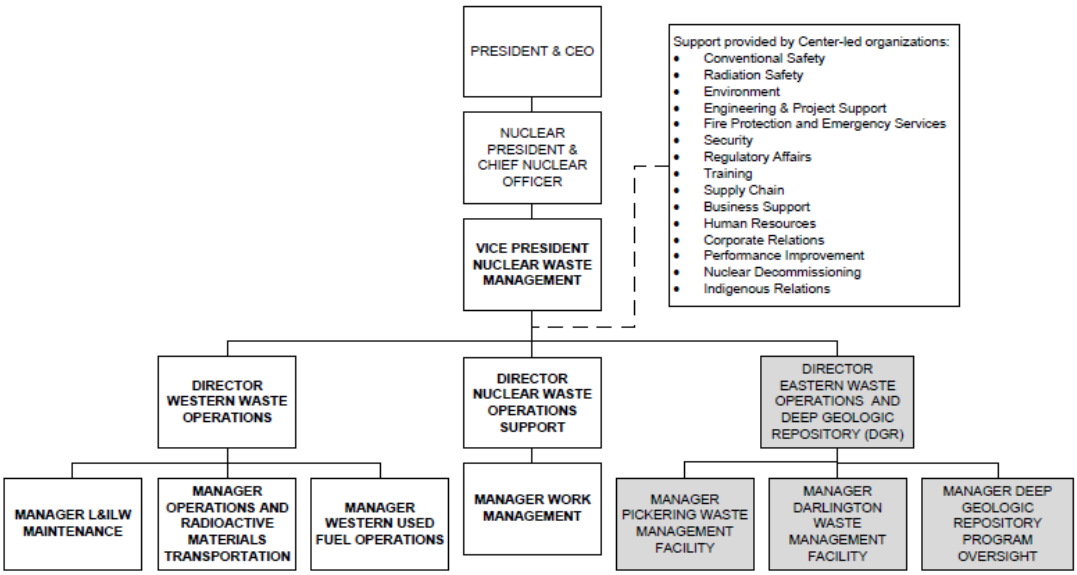


Figure 21: WWMF Organization Chart

3.1.2 Past Performance

During the current licensing period, WWMF achieved several improvement objectives targeted at making the management system more effective and efficient.

In 2011, OPG's Nuclear Waste Management transitioned from a complete set of stand-alone governance and processes and adopted applicable OPG nuclear fleet processes. A team was created to ensure a smooth transition to the OPG Nuclear governance framework. The Governance Simplification project was a major undertaking as it worked towards reducing, simplifying and aligning the number of governing documents that are maintained.

The Nuclear Waste Management Governance Simplification Project mandate included:

- Reducing the number of program documents for nuclear waste operation;
- Superseding or obsoleting Nuclear Waste Management governance by adopting OPG Nuclear governance where appropriate and where it makes good business sense; and,
- Streamlining the Nuclear Waste Management processes to avoid duplication of procedures and instructions throughout the Nuclear Waste Management facilities.

During the licensing period, all programs transitioned to N286-12. This helped build on the strengths of the Nuclear Management System, including implementation of industry best practices. Although, this initiative is complete, Nuclear Waste Management routinely assesses its governance for opportunities to improve.

Fleetview Program Health and Performance Reporting

Fleetview program health and performance reporting is an OPG Nuclear fleet-wide process by which individual programs within the overall Nuclear Management System can be monitored for effectiveness.

Each program executing the Nuclear Management System is reviewed in accordance with management system principles in three defined areas including oversight and leadership, execution performance, and program action plan. This review is conducted by the Nuclear Executive Committee on a pre-established review schedule, and enhancements or new initiatives are identified based on performance.

The Nuclear Waste Management Program and the Transportation Program are included in the Fleetview Program Health and Performance Reporting process and results are reported to the Nuclear Executive Committee on an annual basis, as a minimum.

Business Continuity

The objectives of the OPG Business Continuity Program are to ensure approved response strategies and recovery priorities are in place for critical functions during incidents that threaten continuity, and recovery guidance is in place for recovering from incidents. Examples of such incidents could include pandemic illness, natural disasters, loss of infrastructure, labour disruptions or loss of critical suppliers.

Approved strategies are intended to:

- Protect employee and public health and safety;
- Limit significant impacts to the environment as well as to OPG's assets, reputation and operational continuity; and
- Maintain financial viability.

To ensure OPG's business continuity, OPG performs Business Impact Analyses and develops Continuity Plans in response to that analysis. This involves conducting a risk analysis of the impacts that a temporary disruption of the processes would have on the company. Continuity Plans are established to mitigate the identified risks, if necessary.

Pursuant to this process, Nuclear Waste Management has conducted a Business Impact Analysis. The activities performed by Nuclear Waste Management were all assessed as being capable of being unavailable for more than a week (including several weeks or months) without resulting in significant consequences to the generating stations. As the impact of delays to these activities were assessed to be low risk, Continuity Plans were not required to be developed.

Nuclear Safety Culture

OPG routinely monitors the health of its nuclear safety culture through Nuclear Safety Culture Monitoring Panels. These panels were established based on the industry best practices documents in the Nuclear Energy Institute's NEI-09-07, *Fostering* a *Strong Nuclear Safety Culture.* The Nuclear Safety Culture Monitoring Panel examines information from a variety of the processes that have been implemented, such as the corrective action process, the human performance program, audits and self-assessments, external inspections such as CNSC inspections or industry evaluations,

employee concerns, and business performance monitoring. This information is evaluated against the traits of a healthy nuclear safety culture to identify strengths and areas for focused attention within the organization. The panel, which is composed of all of the managers and senior leadership within Nuclear Waste Management, jointly evaluate the information and approve any initiatives or re-enforce communications as needed.

In 2015 a Nuclear Safety Culture Assessment was performed based on information from a review of Station Condition Records and other documents, an 81-question survey sent to all NWM personnel, and interviews and field observations. The Assessment found that Nuclear Waste Management has a healthy Nuclear Safety Culture. Areas for improvement included improving the communication of OPEX, enhancing employee awareness of the processes for the effective escalation and timely resolution of issues, and improving the communication between work groups. Nuclear Waste Management's Nuclear Safety Culture will be assessed again in 2018, in accordance with the three year cycle required by OPG's Nuclear Safety Culture Assessment Procedure.

Independent Assessments

OPG evaluates the effectiveness of the management systems and controls on key business and operating risks. This is accomplished through management self-assessments, internal audits and nuclear oversight audits and assessments. The Internal Audit organization's annual audit plan identifies the specific audits to be conducted in the coming year and is approved by the OPG Board of Directors. The annual audit plan is based on key risk areas, legal and regulatory requirements.

The Nuclear Oversight Organization audits OPG's Nuclear Management System as required by CSA N286-12 and in accordance with OPG's Independent Assessment program. Nuclear Oversight has implemented a risk informed scheduling process for audits of programs under the OPG Nuclear Management System which ensures that the highest risk programs and activities receive the greatest level of oversight.

Findings from the independent audits and assessments are resolved through OPG's Corrective Action Program. Improvements arising from the independent assessments are noted in the specific safety and control areas.

Self Assessment and Benchmarking

The OPG Nuclear Self Assessment and Benchmarking procedure requires that Directors and Managers plan and schedule divisional and departmental level Self Assessments and Benchmarking for each upcoming year.

OPG participates in a number of industry peer groups, facilitating good opportunities to benchmark our nuclear management practices with other utilities. Similarly, peers from other utilities visit OPG facilities to gain insights. These relationships are important to ensure OPG continues to gain insight on industry best practice in all areas.

The focus of OPG's recent benchmarking is on the experience with emerging technologies that could minimize the volume of waste that requires storage at the WWMF. For example, industry experience in decontamination of metal components and in large object segmentation has been sought by OPG and is under consideration for application as part of the radioactive waste handling processes.

Management of Contractors

OPG has extensive practice in the use of contractors to design, procure, and construct new facilities or to implement design improvements to our existing facilities.

Contractors are qualified by OPG Supply Chain Quality Services under a process that ensures that the contractor has developed and implemented a management system that meets the applicable requirements outlined in the CSA Standard N286-12.

The contractors OPG uses have a long history of working in the nuclear industry and with OPG in particular. They have proven capability to meet the quality standards necessary for a nuclear facility. OPG's Items and Services Management Program includes provisions for extending applicable requirements to sub-contractors. OPG requires that any sub-contractors must work under the contractor's quality program to ensure there is an assurance that the agreed quality standards and expectations will be met, regardless of who is performing the work in the field. Field verification / surveillance activities are performed by OPG personnel to ensure the quality program requirements are being achieved.

Where possible, OPG will temporarily turn the contractor work area over to the contractor as a Construction Island where the contractor assumes the role of 'Constructor' as defined in the *Ontario Occupation Health and Safety Act*. As Constructor, the contractor assumes responsibility and liability for conventional safety and environmental safety associated with the contractor work. The contractor produces a site specific Health and Safety Plan and Environmental Safety Plan which is accepted by OPG prior to the contractor work start. Radiation protection remains the responsibility of OPG.

Where a Construction Island is not feasible, OPG maintains the role of Constructor and provides oversight to the contractor. In this case, contractor work will be carried out in accordance with all OPG processes and procedures. OPG maintains responsibility and liability for conventional safety, environmental safety and radiation protection of the contractor work.

Event Reporting

For events at WWMF that are determined to be reportable to the CNSC, preliminary reports are submitted to the CNSC which include the location and circumstances of the situation and any action that WWMF has taken or proposes to take with respect to it in accordance with the *General Nuclear Safety and Control Regulations* subsection 29 (1). A full event report is then submitted to the CNSC in accordance with *General Nuclear Safety and Control Regulations* subsection 29 (2).

A listing of OPG's Waste Management Facilities' reportable events from 2010 to the present is posted on OPG's public website, opg.com.

3.1.3 Future Plans

WWMF will continue to make incremental improvements in work processes and program implementation through:

- Continued adoption of OPG Nuclear governance as appropriate;
- Ongoing use of Fleetview Program Health and Performance Reporting to assist with overall program effectiveness;

- Management of the business to ensure a focus on long-term sustainable performance excellence; and,
- Development of leadership and management capability at all levels of the organization with a bias toward teaching and learning moments.

OPG does not foresee, during the next 10 years, any substantive changes to the management system. The main focus for the next 10 years at the WWMF will be increasing focus and seeking opportunities to further sort, segregate and minimize low level waste volumes while addressing the increased volume of radioactive waste materials that will arise from the projects that are underway to extend the operational life of the nuclear power generating units at Darlington and at Bruce Power. This will result in new facilities being required.

The other focus at the WWMF would be preparedness for the anticipated transfer of the low and intermediate level wastes into the proposed Deep Geologic Repository. New operational processes are expected to be needed to address the handling of the waste in preparation for its placement in the repository; however, the majority of the management system will not be affected. Work on these changes would start after the Deep Geologic Repository has received the necessary site preparation and construction approvals.

3.1.4 Challenges

In 2011, OPG's Nuclear Waste management transitioned from a complete set of stand-alone processes into the OPG nuclear fleet processes. Prior to this transition, Nuclear Waste Management operated under its own set of governance within the nuclear environment. During the transition to OPG-Nuclear governance, Nuclear Waste Management created teams to collaboratively manage governance changes and to oversee a smooth transition and problems are addressed in a timely manner. These teams included stakeholders with representatives from senior management, OPG-Nuclear governance and operations. In addition, communications to staff have been bolstered with formal roll-outs to ensure staff alignment, and creation of a new website to post these changes.

3.1.5 Requests

There are no modifications being requested with respect to licence conditions associated with this Safety and Control Area at this time.

3.2 Human performance management

Human performance covers activities that enable the development and implementation of processes that ensure that staff is sufficient in number in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties. The objective of a Human Performance Program is to promote, reward and improve behaviours throughout the organization that support safe and reliable facility operations.

Nuclear Waste Management's goal is to reduce Human Performance events and errors by managing our defences in pursuit of zero events of consequence.

3.2.1 Relevance and management

Nuclear Waste Management, and hence the WWMF, follows the OPG Nuclear Human Performance Program. OPG's goal is to continually reduce the frequency and severity of events through the systematic reduction of human error and the management of defences in pursuit of zero events of consequence. The key principles that are the foundation for the OPG Nuclear Human Performance Program are:

- People are fallible;
- Error-likely situations are predictable, manageable, and preventable;
- Individual behaviour is influenced by organizational processes and values;
- People achieve high levels of performance based largely on the encouragement and reinforcement received from supervisors, peers, and subordinates; and,
- All events are preventable.

The Human Performance Program includes tools that have been developed to reduce error, to establish and maintain defences, to identify and resolve latent organizational weaknesses, for early identification and response to precursors, and to identify and implement necessary improvements. By systematically identifying and addressing error-likely situations, reducing organizational vulnerability to errors and events and by questioning or enhancing the integrity of defenses, WWMF is positioned to continually improve organizational effectiveness through the use of best practices, enhanced behaviours and learning.

An OPG fleet-wide strategic plan is developed each year in response to human performance trends and events noted in the previous year. The strategic plan is also influenced by industry developments and emerging best practices in sustaining high levels of human performance. The strategic plan focuses on individual, supervisory, and organizational enhancements.

Human Performance Program

The Human Performance Program includes the key behavioural expectations that guide worker activities, the supervisory activities that are applied to observe, recognize, and improve behaviours, and the reporting and evaluation activities that are used to assess performance and identify needed improvement initiatives. Activities within the program include the following:

- Pre-job and post-job briefing to identify expected outcomes and to drive ongoing improvement;
- Established expectations for procedural use and adherence;
- Tools to prevent errors in understanding, such as use of three-way communications and the phonetic alphabet;
- Self-checking and situational awareness before beginning an activity or when returning to an activity after a break;
- Conservative decision making; and,

- Identifying, evaluating, trending, and acting upon human performance issues and accomplishments.

Training

Compliant to the requirements in REGDOC-2.2.2, *Personnel Training*, OPG's Nuclear Training Program is used to develop and maintain competent personnel to safely operate, maintain, and improve plant performance, and to drive human performance improvements in a cost effective manner.

Through the Training Program, OPG personnel acquire the skills and knowledge required to discharge the responsibilities of their positions within the organization.

Operations, maintenance, and support staff are trained and qualified under OPG's Nuclear Training Program. The staff training and qualifications includes initial training, on-the-job training, and evaluation. This training is then maintained by periodic re-qualification and refresher training as appropriate.

A training plan is developed for each occupation using a systematic approach to training which identifies the training needed to meet the skill and knowledge requirements of the position. Specialized training is provided where appropriate. The employees' training status is maintained in a Training Information Management System.

The Training Program is closely linked to the Human Performance program. Enhanced or focused training is often utilized in the effort to improve safety and reduce errors at WWMF. The human performance expectations are built into the training courses; for example, the nuclear general employee training that is refreshed annually by all employees contains human performance content.

3.2.2 Past performance

Industry standard performance measures are used to monitor human performance. In addition, coding is applied to Station Condition Records created as part of the Corrective Action program that supports trending of human performance.

The overall effectiveness of the Human Performance Program is measured through the analysis of events that occur to determine whether the event free operations "clock" should be re-set. Targets are set every year based on previous performance to strive for ongoing reduction in the number of clock resets. The resets are divided into Site and Department levels based on their consequence. The more significant events that have consequences in terms of safety or production and that span several organizations or departments are identified as Site Event Free Day Resets. Less significant events are considered to be Department Event Free Day Resets. Each reset triggers a process of communication within the organization that identifies the underlying behavioural aspects of the event and the event-free tools that, if properly applied, may have prevented the occurrence.

Events that are not Event Free Day Resets are assigned Human Performance codes in the Station Condition Record process and trended to identify patterns of behaviour that are contrary to the expectations set by OPG. Trending of Station Condition Records in 2015 across all of the OPG nuclear fleet identified that Procedural Use and Adherence requires focused attention. The identified trend resulted in a specific campaign to re-communicate the behavioural expectation.

Each year for the resets that occurred, the results of the review of the trend codes, and other data collected through the implementation of the Human Performance Program is assessed and responding initiatives are developed. For example, as described above, efforts were undertaken to reinforce the importance of procedural use and adherence through communication opportunities such as:

- Observation and coaching by managers in the field;
- Pre- and post-job briefing; and
- Staff meetings.

In the licensing period there have been two Site Event Free Day Resets as a result of operations at the WWMF. Both events occurred in 2013. The first event involved damage to an outdoor glycol heat exchanger which led to an extended incinerator outage. The second event involved a crane coming into contact with an overhead power line. Detailed investigations were performed following these events and corrective actions to prevent recurrence implemented.

Procedure Use and Adherence

OPG staff is expected to follow procedures as written; requiring employees to stop and consult their supervisor where procedures cannot be followed as written.

Activities that support improvements in procedure use and adherence include the following:

- Observation and coaching by managers in the field;
- Pre- and post-job briefing process;
- Staff communication meetings; and,
- Training.

Observation and Coaching

Manager coaching in the field reinforces expectations of procedure use and adherence through observation at the work location. Observations are recorded by supervisors with the purpose of the identification of strengths and weaknesses in human performance behaviors. Strengths are positively reinforced. Results are collected to evaluate areas of excellence and areas needing improvement. Gaps to excellence are addressed through additional targeted improvements.

Pre-Job and Post-Job Briefings

The pre- and post-job briefing component of the Human Performance Program has been an essential element to provide the necessary review and focus for the job at hand. Pre-job briefings are routinely delivered, with enhancements provided by operating experience. Worker led pre-job briefings are being promoted, and found to be very successful due to increased employee interaction and adherence to the required procedures. Post-job briefings are either formal lessons learned exercises or informal in the form of operating experience delivered to the next crew.

Staff Communication Meetings

A variety of communication tools are used to establish and reinforce the expectations respecting procedural use and adherence. The most effective tool is face to face meetings between managers and their staff to discuss the events that have occurred at the facility, or in other facilities, that reinforce the importance of procedural use and adherence. Employees are engaged in the conversation and actively share their own experiences.

Situational Awareness

Situational Awareness involves improving the ability of individuals to recognize hazards by anticipating changes and taking action. It is being aware of the surroundings, recognizing changes, and ensuring new hazards are controlled. It is a frame of mind where individuals are actively looking for potential hazards, assessing the hazards, and ensuring controls are in place.

OPG expects that all employees perform a 2-minute job site drill when they reach their job site on first instance and after any breaks, to confirm that the hazards are as expected, the preventative measures identified in the pre-job brief are adequate, that they are on the right equipment and have the tools and protective equipment necessary to safely perform the assigned work activities. Any employee that has concerns is to stop and speak to their supervisor. Managers reinforce this expectation through field observations and perform coaching when necessary to ensure the expectation is being achieved.

3.2.3 Future plans

Going forward, WWMF will continue to implement the Human Performance Program and the Training Program. As described above, the programs include an ongoing aspect of reviewing performance and identifying the areas that would benefit from planned enhancements. Best practices from the nuclear industry will also continue to be evaluated and incorporated into the programs where there is an identified benefit.

3.2.4 Challenges

Human performance is a process of continued improvement and builds on experience. Annual self assessments of Human Performance are being completed to determine any gaps and provide actions driven by the corrective action program.

3.2.5 Requests

There are no modifications being requested with respect to licence conditions associated with this SCA at this time.

3.3 Operating performance

The Operating Performance Safety and Control Area includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.

3.3.1 Relevance and management

The objective of the used fuel management program at the WWMF is to safely and reliably transfer, process and store DSC's containing used fuel from the Bruce Power NGS until a long term waste management facility becomes available.

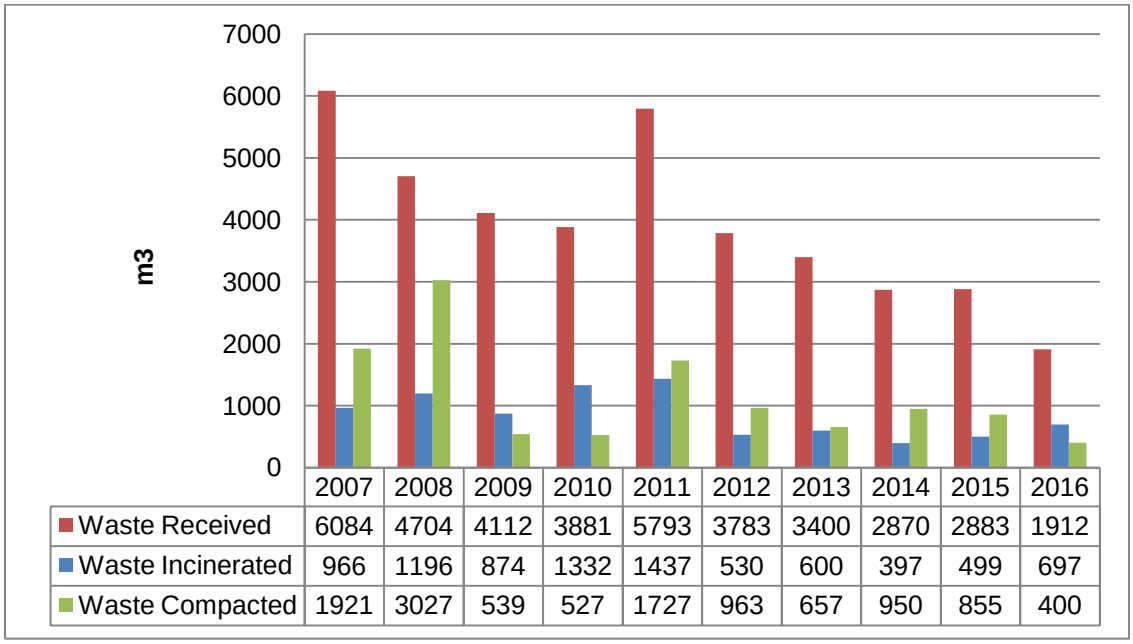
The objective of the L&ILW management program at the WWMF is to safely and reliably transfer, process, package and store L&ILW from the Pickering, Darlington and Bruce Power NGSs until a long term waste management facility becomes available.

OPG operates and manages the Nuclear Waste Operating Facilities in accordance with the facility licensing basis and applicable standards. WWMF uses procedures for all aspects of their operation, including safety related activities, plant and equipment operation and maintenance, work authorizations, equipment labelling, facility access, and plant status.

WWMF has procedures that provide direction on what waste is acceptable for processing and storage at the WWMF in accordance with its licensing basis and applicable standards. These waste acceptance criteria include a process for the review and acceptance of new and non-routine types of waste arising from the nuclear generating stations.

3.3.2 Past performance

Figure 22 shows the approximate total volume of L&ILW received each year and the amount processed at the WWMF from 2007 to Q2 2016. The general decline in volume of waste received over the years is mostly due to more effective waste reduction initiatives at the source and the reduction of waste received from Bruce Power.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Waste Received	6084	4704	4112	3881	5793	3783	3400	2870	2883	1912
Waste Incinerated	966	1196	874	1332	1437	530	600	397	499	697
Waste Compacted	1921	3027	539	527	1727	963	657	950	855	400

Figure 22: L&ILW Volumes Received, Incinerated and Compacted at WWMF

The following results were achieved over the period from 2007 to Q2 2016:

- Low Level Storage Buildings 11, 12, 13 and 14 were constructed and placed in service;
- 54 new IC18's were constructed and placed in service;
- Planned incinerator outages were completed in accordance with an improved outage process and schedules; and,
- Lighting upgrades were completed throughout the Waste Volume Reduction Building and yard areas.

Fire Hazard Analyses were completed for all L&ILW facilities and the recommendations were implemented, or planned for execution.

Incinerator Performance

Throughout the reporting period (2007- Q2 2016), the incinerator met all emissions requirements including successful completion of annual stack testing as required by the Ontario Ministry of Environment and Climate Change Environment Compliance Approval. The incinerator continued to perform very well in the environmental area, well below limits set for parameters such as dioxins/furans, metals and particulate.

There were two notable events, in 2013 and 2014, involving overheating of an air duct that is designed to provide combustion air to the incinerator's primary chamber for waste incineration. In response to these events, all incineration of solid waste was stopped until the system was modified in 2015 to prevent the potential for recurrence.

A comprehensive study was undertaken in 2013 to identify critical incinerator systems that required upgrades to improve overall system reliability and ensure long term performance. The execution of these upgrades began in 2015 and will continue for the next several years.

Compactor Performance

The previous compactor was replaced with a newer more reliable model in 2011. This compactor has operated reliably since installation and continues to be a key element of the total volume reduction for L&ILW.

In-ground Storage

54 new IC-18s were installed and commissioned in 2013. As part of the project, 54 short shield plugs were manufactured to replace the longer shield plugs currently in place on the IC's containing over-packed resin liners. With these shorter shield plugs, an additional resin liner can be placed in these IC's thereby optimizing the storage space previously lost due to the addition of the overpack.

To improve leak resistance and to ease removal of the IC-18 sample caps, these caps were modified in two batches starting in 2010 as described in section 3.6.2.

Large Metal Components

A pilot project in 2014 sent 3 heat exchangers off site to a licensed third party vendor for volume reduction. The ferrous components of the heat exchangers were put through a metal melting process and produced ingots for sale in the shielding block market. The non-ferrous components (such as copper tube internals) were returned to the WWMF for storage.

DSC's

In this reporting period, the safety performance of the WWMF used fuel processing and storage facilities has been excellent while meeting all production targets. This includes overcoming the technical challenges of weld wire quality and DSC base flange laminations as described below.

DSC Transfer

Empty DSCs, and those loaded with used fuel, are transported on site roads between the Bruce Power NGS and the WWMF by OPG. Since the inception of the WWMF Used Fuel Dry Storage Facility in 2002, there have been more than 1,200 on-site transfers of loaded DSCs without incident. Table 3 shows 1023 DSCs were processed and stored between 2007 and Q2 2016.

A new generation DSC Transporter vehicle (the Gen IV) has been designed. The first version of this new Transporter was tested in 2013. Modifications were completed on the first vehicle and a second vehicle was acquired in 2016. Both Gen IVs are now available for service at the WWMF.

DSC Reverse Loading

In the current licence period, OPG has demonstrated that we can perform all of the required DSC reverse loading steps to safely return fuel to a wet fuel bay should it be required. This demonstration included full weld removal using a combination of arc gouging, chipping and grinding. Full weld removal was confirmed by performing a freedom of movement check using a feeler gauge to confirm that the DSC lid was separated from the base. Removal of spent fuel from a DSC was performed where a partially loaded DSC was submerged in the wet fuel bay and one of the spent fuel modules was removed. A DSC drain port was successfully removed by grinding and unscrewing of the drain plug. The remaining steps in the reverse loading process include craning and transportation of the DSC which are routine operations performed regularly at WWMF.

DSC Weld Wire Quality

In 2013, 26 DSCs at WWMF (20% of production) had issues with the quality of the completed welds. These were discovered during the post welding inspection using Phased Array Ultrasonic Testing. The root cause was discovered to be a manufacturing change that introduced contaminates in the weld wire that directly influenced the quality. As a result, defects were detected. The specifications for the weld wire were revised by OPG and as a result there have been no further weld porosity issues that can be attributed to this issue. With the exception of the year 2013 the weld quality defects from 2007 through 2016 have been less than the internal rework target of 10%.

All the 26 DSCs that demonstrated porosity in the welds during Phased Array Ultrasonic Testing were repaired, processed and placed in storage by February 2014.

Phased Array Ultrasonic Testing

Phased Array Ultrasonic Testing was introduced for inspecting the DSC lid-to-base containment weld. Phased Array Ultrasonic Testing is a volumetric, non-destructive inspection method that involves electronically steering a beam of sound waves through the weld (and adjacent base materials) to inspect the weld. Phased Array Ultrasonic

Testing replaces radiographic inspection, thereby eliminating the health and safety hazards of the latter method's radiation exposure. Use of radiography to inspect DSCs ceased in 2011. The change in the inspection method was supported through a third party expert review and qualification of OPG's technical justification (which included the results of physical testing) and the inspection procedures by the CANDU Inspection Qualification Bureau in 2010 and accepted by the CNSC. The Phased Array Ultrasonic Testing method also improves inspection sensitivity.

DSC Base Flange Laminations

OPG first identified an apparent DSC base flange lamination issue in 2012. The laminations were initially attributed to original manufacturing defects, and OPG implemented repairs on the affected DSCs. During subsequent investigations when the base material was analyzed, it was found that OPG's interpretation of the Phased Array Ultrasonic Testing results had been overly conservative in identifying the material as having laminations to the degree originally indicated. As a result, OPG has developed an alternative process to review and evaluate the need for repairs to the base material should laminations be identified. Since its introduction, no DSCs have been identified for repairs.

Production History

The number of DSCs loaded at WWMF between 2007 and Q2 2016 is shown in Table 3. In 2009 Bruce Power identified the need to increase the number of DSCs processed and stored in order to reduce the quantity of used fuel stored in the Bruce B secondary fuel bay, and support Bruce Power in returning Bruce A Units 1 and 2 back to service. Based on this, the Western Used Fuel Dry Storage Facility increased production up to a maximum of 130 DSCs per year.

Table 3: DSCs Loaded at WWMF per Year

Year	Number of DSCs Loaded at WWMF between 2007- Q2 2016
2007	75
2008	77
2009	70
2010	130
2011	120
2012	130
2013	130
2014	110
2015	115
Q2 2016	66
TOTAL	**1023**

Spare Weld Head

A Divisional spare weld head for the DSC welding system was procured and commissioned at the PWMF in October 2016 and could be transferred to WWMF for use if needed. The spare weld head increases the reliability of the DSC welding system across the fleet**.**

Implementation of an Improved Work Management Process

Implementation of a Work Management process that closely aligns with the Nuclear Generating Stations, commenced in 2015, with the Low & Intermediate Level waste facility adopting this aligned process first. The Western Used Fuel Dry Storage facility then adopted the process in 2016. Work is in progress to establish the same common planning process for all Nuclear Waste Management facilities. The work management process promotes event-free execution of work, improves productivity, system and component reliability, and availability of facility systems. As well, the work management process enables alignment with the support organizations, such as Supply Chain and Engineering, to ensure operational excellence at each facility.

3.3.3 Future Plans

Future improvements at L&ILW Processing and Storage facilities are summarized below with respect to operational initiatives, and improving facility structures and storage containers.

Operating Initiatives

Operating initiatives planned for the next ten years to sustain and improve on the current operating processes include the following:

- Reduction in maintenance backlogs, to ensure a high availability for equipment required to process L&ILW;
- Improvements to the work management system to ensure more efficient execution of operations and maintenance activities;
- Ongoing Implementation of a more Operationally Focused organization whereby all groups including Centre-Led Functional Area Management and centre-led support groups are aligned around the facility and operating priorities;
- Execution of incinerator and auxiliary system modifications to improve both equipment and overall facility performance and reliability; and,
- Upgrades to the existing site sample stations to improve reliability and monitoring of surface and subsurface water runoff.

Improving Structures and Storage Containers

Initiatives aimed at improving structures and storage containers in the next ten years include the following:

- Re-packaging of L&ILW containers from some of the trenches. This re-packaging is based on the results of on-going aging management investigations to verify the material conditions of waste containers. This is to ensure that the waste containers can be easily and safely handled in the future;

- Upgrading of the fire detection systems in the Low Level Storage Buildings by installing more reliable linear heat detector systems; and,
- Continued sorting and segregating of stored wastes in Low Level Storage Buildings to identify opportunities for further processing and volume reduction or waste that can be free-released to conventional waste streams.

Going forward, the annual rate of DSCs being placed into storage at the WWMF is expected to remain up to 130 DSCs per year. This is based on Bruce Power operating 8 units.

3.3.4 Challenges

Nuclear Waste Management continually pursues efficiencies within the DSC production processes in order to meet future DSC loading targets without compromising safety.

3.3.5 Requests

By October 31, 2017, WWMF will be compliant with the requirements of CSA N292.0-14, *General Principles for the Management of Radioactive Waste and Irradiated Fuel*; CSA N292.2-13, *Interim Dry Storage of Irradiated Fuel*; and CSA N292.3-14, *Management of Low-and Intermediate-Level Radioactive Waste*.

3.4 Safety analysis

Safety Analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventative measures and strategies in reducing the effects of such hazards. The objective of the Safety Analysis is to evaluate the risk and consequences of abnormal and accident conditions to ensure that the facility does not pose an unacceptable risk to workers or the public. The results of the Safety Analysis are used in the development of the operating limits and conditions for a facility.

3.4.1 Relevance and management

Safety analyses and assessments of structures, systems, components or facilities are carried out to determine the impact on workers and the public. Safety assessments are presented in each nuclear waste facility safety report, which also provides an overview of the facility design and operations.

To assess the overall safety of the operation of WWMF storage buildings and structures, deterministic safety analyses are used. Computational tools are used for the dose consequence calculations when required. Bounding (worst-case) accident scenarios are conservatively identified, and the results of off-site dose consequence calculations are then compared against the regulatory dose limits.

In March 2015, Nuclear Waste governance was included in the Reactor Safety framework and now takes its authority from the Reactor Safety Program.

Upon completion of the Safety Analysis, using the safety analysis assumptions and results, the relevant Safety Report and Safety Design Envelope are updated. The operation documentation such as operation manuals and predefined maintenance on

specific equipment are assessed to determine if any revisions are required as a result of the new or updated Safety Analysis.

The Safety Report for the WWMF is reviewed every five years and updated as required to reflect changes in operational experience and information supporting the assumptions made in the assessments. The Safety Report update process encompasses the systematic identification of safety issues, their prioritization, their resolution, and the physical updates of the Safety Report.

3.4.2 Past performance

The current version of the WWMF Safety Report was submitted to the CNSC in 2012, and accepted in 2013. The Safety Report demonstrates that dose rates and emissions from the WWMF under normal and abnormal operating conditions as well as postulated accident conditions are within allowable limits, and operation of the facility continues to pose a negligible risk to the public, the workers, and the environment. The next update will be submitted in December 2017.

Safety Assessment Results for WWMF Structures

Low and Intermediate Waste Structures

Normal Operating Conditions

Waste structures are designed and constructed such that dose rate targets at exterior surfaces of the structures, at facility fences and at site boundaries are achieved. Routine emissions are monitored and shown to be within facility targets, resulting in minimal doses to the public that are well below regulatory limits.

Malfunctions and Accidents

Worst case bounding credible accidents are identified for each storage structure type, specific to the activity or type of waste stored in the facility. For example, in a low level waste storage building, fire has been identified as the worst case credible accident that could lead to the maximum radioactive release from these structures. For structures storing large, non-combustible components such as steam generators or re-tube components, a drop of the component is analyzed.

For all accidents considered, radiation doses to both workers and the public are predicted to be well below the regulatory dose limits.

Used Fuel Dry Storage Safety Analysis

Normal Operating Conditions

Shielding Analysis is performed to determine dose rates from individual DSCs, and both inside and outside of the storage buildings. Dose rates external to the buildings are determined for workers on site and for members of the public off site. In all cases, predicted dose rates at the site boundary and for the nearest resident are estimated to be well below the CNSC regulatory public dose limit of 1 mSv/year.

Safety Assessment of Malfunctions and Accidents

The assessment of malfunctions and accidents considered the following main stages of the out-of-station used fuel dry storage operations:

- On-site transfer operations;

- Operations inside the DSC Processing Building; and
- Storage.

Each potential event was screened to establish if it could result in any radiological impact to the public and workers. Common mode incidents such as seismic events, flooding, etc. were also considered. Design provisions and procedural measures that could prevent the event or mitigate its consequences were also evaluated.

Although considered unlikely, for on-site transfer and processing of DSCs (e.g. welding, inspecting, testing, sealing and moving to storage), the bounding accident was identified to be a drop of the DSC with subsequent 100% fuel sheath failures. The total doses to the public at the Bruce site boundary (750 m from WWMF) and the occupational doses due to this event were assessed to be below the regulatory dose limits.

During the DSC storage phase, the bounding dose consequences are associated with a hypothetical event in which 10% of the DSC seal-welds fail. During storage, both the fuel sheath and the DSC seal-weld must fail for a release of radionuclides to occur. Used fuel with a known damaged or defective sheath is not loaded into a DSC, as this is not within the Waste Acceptance Criteria for the facility. Failure of the sheath is not expected to occur during the operating life of the storage facility. The total doses to the public at the Bruce site boundary and the occupational doses due to this event were also assessed to be below the regulatory dose limits.

In March 2010, OPG identified potential abnormal scenarios regarding fires involving multiple vehicles in DSC Processing and Storage Buildings. OPG performed the appropriate assessment and confirmed that the consequences of the postulated fire scenarios involving multiple vehicles inside these buildings are within the safety and design envelope.

A second new DSC transporter (Gen IV) has been manufactured and delivered to the WWMF. An assessment confirmed that the new transporter can be operated within the waste management facility's safety and design envelope. The new DSC transporter is now available for service at WWMF.

Criticality

Criticality assessments have been completed for the used fuel stored in DSCs for the WWMF. Consistent with expectations for irradiated natural uranium fuel, the analyses and assessments have yielded adequate sub-criticality margin and have demonstrated that there can be no criticality of used CANDU fuel.

Used fuel stored in DSCs cannot achieve criticality under normal conditions or under any postulated accident scenario at the WWMF.

OPG's Response to Fukushima

Following the 2011 event at Fukushima, OPG assessed the impact of consequential event sequences on the existing WWMF safety envelope. The initiating and consequential events considered included a seismic event, fire, explosion, loss of power, tornado and thunderstorm. In all scenarios assessed for the WWMF, the consequences of the resulting events were found to be within the existing safety envelope as defined in the safety report for the nuclear waste facility. Further details of OPG's response to this event are described in Section 4.8.1.

3.4.3 Future plans

Safety Analysis Methodology

In keeping with OPG's objective for continuous improvement, the methodology for performing safety assessments is routinely assessed and updated in order for the methodology to be as up-to-date and accurate as possible. DSC shielding analysis methodology is being updated to incorporate the use of the Monte Carlo N-Particle transport code for dose rate calculations. DSC models (including fuel) are being updated to better represent actual geometries, and analysis assumptions are being reviewed to ensure reasonable conservatisms exist. These improvements are expected to be used for the 2017 Safety Report update.

Support for Additional Facilities

In the current WWMF operating licence, there is provision and authorization for additional storage structures remaining to be built at the WWMF site.

The impact on the safety case from these additional buildings will be assessed in the planning phase in order to demonstrate that the construction of the buildings does not threaten regulatory dose limits. The building designs are expected to be similar to existing L&ILW structures, so the impact on safety analysis results is not expected to be significant. If there are significant changes to the design of these structures, an assessment will be performed to confirm that the design of the required structures is adequate and all radiological safety requirements provided in the *Nuclear Safety and Control Act* and its Regulation, and the WWMF licence are met.

Detailed safety assessments for the proposed Large Object Processing Building and a Waste Sorting Building will be performed once additional design and location information is available. This will ensure that the designs are adequate and that all radiological safety requirements provided in the *Nuclear Safety and Control Act* and its Regulations, and the WWMF licence are met.

Safety Analysis Update

Safety Analyses will be reviewed and/or performed as necessary prior to requesting permission to construct and prior to Safety Report updates, to confirm that facility operations will not result in any significant radiological consequences to the health and safety of the workers and the public under normal and abnormal operating conditions as well as postulated accident conditions.

3.4.4 Challenges

OPG is always striving to use the most up to date methodologies for determining dose to public and workers from normal operations and in accident scenarios.

3.4.5 Requests

There are no modifications being requested with respect to licence conditions associated with this SCA at this time.

3.5 Physical design

Physical Design relates to activities that impact on the ability of systems, components and structures to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

Nuclear Waste Management has robust processes to ensure that the physical design of the WWMF complies with the current safety basis and that all changes are authorized and performed in a controlled manner, and in accordance with the WWMF Operating Licence.

3.5.1 Relevance and management

Design Programs

Management of the design basis at the WWMF is now governed by the OPG Nuclear Conduct of Engineering Program. This program provides the framework for performing engineering work in a consistent manner across all OPG Nuclear facilities.

Engineering activities, including design management, are implemented via procedures and work instructions to satisfy the following requirements:

- The WWMF configuration is maintained in accordance with the design basis and the facility is operated within its safety envelope;
- All modifications to the facility are designed, constructed, installed, and commissioned in accordance with the design basis;
- Essential facility systems, structures, and components perform their functions safely and reliability within the design basis;
- All relevant legal and regulatory requirements are met; and,
- Continuous improvement is encouraged and fostered to improve facility performance.

The Conduct of Engineering Program is supported by the Design Management Program, Engineering Change Control Program, and Pressure Boundary Program.

The Design Management Program provides the requirements to manage existing and new designs in accordance with the requirements of the licence, regulations, and industry best practice. It includes specific requirements for creating or modifying design basis documents, performing design verification and assurance activities, and providing the appropriate content and format of design basis documents. The Design Management Program provides direction for preparing detailed designs within OPG or managing design agencies that prepare designs on behalf of OPG.

The Engineering Change Control Program provides requirements to ensure that modifications to systems, structures, and components are designed correctly. Modification designs are reviewed by stakeholders and authorized by the Nuclear Waste Management Design Authority before they are implemented. Modifications are installed in accordance with approved procedures and commissioned and tested to demonstrate that the design requirements have been met. The commissioning results are reviewed and accepted by the appropriate stakeholders before the modified system, structure, or component is placed into service.

The Pressure Boundary Program provides a managed process for performing repairs, replacements and modifications on pressure retaining systems and components, and reflects the requirements of a pressure boundary quality assurance program. Work on WWMF pressure boundary systems meets the requirements of CSA N285.0-08 (including Update 1 & Update 2), and additional requirements per Appendix D of the WWMF Operating Licence. OPG also maintains a pressure boundary roadmap in compliance with Annex N of CSA N285.0-12 and Update 1. The CNSC has regulatory jurisdiction over pressure boundary requirements, including approval of any deviations from those requirements. OPG's Authorized Inspection Agency is currently the Technical Standards and Safety Authority.

3.5.2 Past performance

Nuclear Waste Management adopted OPG Nuclear Conduct of Engineering governance effective December 31, 2012, including the associated programs for Design Management, Engineering Change Control and Pressure Boundary. The transition from legacy Nuclear Waste Management governance was accomplished through a managed process of governance management records that ensured a controlled and thorough adoption process.

During the current licensing period, OPG also implemented improvements for its pressure boundary related activities including code classification for all pressure retaining systems.

The following codes and standards are currently used in design:

- NRCC NBCC (2005), *National Building Code of Canada*;
- NRCC NFCC (2005), *National Fire Code of Canada*;
- ASME B31.1 (2010), *Power Piping*;
- CSA B51 (2009 & Update 1), *Boiler, Pressure Vessel and Pressure Piping Code*, and
- CSA N285.0 (2008 & Updates 1 and 2; and 2020 Annex N), *General Requirements for Pressure Retaining Systems and Components for CANDU Nuclear Power Plants*.

OPG has executed various small and large modifications with no impact on the WWMF's ability to operate within its safety envelope. These modifications have been undertaken to improve the overall performance of the WWMF and to improve safety in design and operations, or to correct legacy deficiencies that affect the design basis. The significant modifications in the last licence period are listed below.

(1) A modified design of the DSC was introduced at the WWMF. Principal changes from the original DSC design include the removal of the vent port and a smaller drain port. These changes took into account operating experience. Elimination of the vent port also simplified the containment boundary of the DSC. Commissioning of the new design was completed at the WWMF in 2009.

(2) Phased Array Ultrasonic Testing was introduced for inspecting the DSC lid-to-base containment weld in 2011.

(3) In June 2012, staff identified that fire alarms in certain locations of the Waste Volume Reduction Building did not meet audibility requirements per the applicable *National Building Code of Canada*. A modification to install appropriate audible and visual alarms that comply with code was completed in the fourth quarter of 2013.

(4) In July 2013 and February 2014, there were two events involving overheating of an air duct that is designed to provide combustion air to the incinerator's primary chamber for waste incineration at WWMF. The design of the incinerator allowed waste residue to drip down from the primary chamber into the under fire air duct during incineration, leading to elevated temperatures in the duct. Modifications to the underfire air system which eliminated the pathway for accumulation of the waste residue and therefore would prevent recurrence were executed successfully in the third quarter 2015 and the incinerator was returned to service.

(5) Operating experience with the beam detector fire detection systems in Low Level Storage Buildings 1-11 has shown this technology to be less reliable than desired in the prevailing environmental conditions. A modification is underway to replace the beam detector systems with more reliable linear heat detection systems. Low Level Storage Building 11 was completed in fourth quarter of 2015 and work will continue through 2018 on the remaining buildings.

In 2012, Nuclear Waste Management adopted the standard OPG Nuclear fleet metrics for physical design. The current suite of metrics includes measures of the health of the Engineering Change Control process. Quality of design products is monitored using recorded verification results and cold-body design review boards. A monthly report card is used to record and track performance and to ensure that corrective actions are being taken to address any weaknesses or deficiencies that are observed.

3.5.3 Future plans

OPG plans to complete the remainder of the Low Level Storage Building Fire Detection Upgrade modifications on Low Level Storage Buildings 1-10 to improve equipment reliability.

OPG will be compliant with the following new codes and standards or new editions of existing codes for any new designs at the WWMF upon issuance of the new licence and Licence Conditions Handbook:

- CSA N393 (2013), *Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances*
- NRCC NBCC (2010), *National Building Code of Canada*
- NRCC NFCC (2010), *National Fire Code of Canada*
- ASME B31.1 (2010), *Power Piping*
- B51-09 (2009 & Update 1), *Boiler, Pressure Vessel and Pressure Piping Code*, and
- CSA N285.0 (2008 & Updates 1 and 2; and 2012 Annex N), *General Requirements for Pressure Retaining Systems and Components for CANDU Nuclear Power Plants.*

WWMF follows the OPG Nuclear governance for pressure boundary. OPG Nuclear has a current agreement with the CNSC that freezes the code effective dates of applicable pressure boundary codes and standards throughout the duration of the Darlington NGS Refurbishment project. These frozen code effective dates are in place for WWMF as well. At the end of this project new code effective dates for applicable pressure boundary codes and standards, once accepted by CNSC staff, will be incorporated into OPG Nuclear governance. The anticipated WWMF Licence Conditions Handbook would reflect the new code effective dates as necessary at that time.

3.5.4 Challenges

No challenges to the Safety and Control Area of Physical Design are forecasted for the WWMF.

3.5.5 Requests

There are no requests for changes to licence conditions associated with Physical Design at this time.

3.6 Fitness for service

Fitness for Service covers activities that impact the physical condition of systems, components and structures to ensure that they remain effective over time. This includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.

3.6.1 Relevance and management

Fitness for Service ensures the safety of the public and site personnel, protects the environment and ensures that equipment reliability is maintained at high operating performance standards.

OPG is committed to maintaining all WWMF systems, structures, equipment and components that are critical to the safe, reliable and economic transportation, processing and storage of nuclear waste in a fit-for-service state. The implementation of OPG's Reliability and Aging Management Programs ensures the ongoing fitness-for service of these systems.

Equipment Reliability

Under OPG's Equipment Reliability Program, system performance monitoring is performed on critical WWMF systems (plant systems and transportation equipment) to ensure ongoing reliable operation.

System performance monitoring involves the trending of system performance and initiation of investigations or maintenance activities before failures occur. Process parameters, field observations, maintenance work order backlogs, Station Condition Reports, inspection results and spare parts status are some of the typical sources of data for performance monitoring. Where appropriate, equipment critical to system reliability are identified and maintenance strategies for these equipment are prepared. Actions to maintain or improve system health are also prepared.

Meetings with facility management, including representation from Operations, Maintenance, Performance Engineering, Design Engineering, Supply Chain, Radiation Protection and Licensing are routinely held to review system health status, maintenance strategies, and improvement plans, and ensure alignment between these work groups for the implementation of improvement plans. There are currently 23 systems at WWMF that are included in the system performance monitoring program. Other systems are monitored to address specific issues. Ongoing management oversight of these improvement plans provides assurance that the plans are being implemented and the improvements are being achieved.

Maintenance

Recurring preventive maintenance activities are planned, scheduled and executed according to the preventive maintenance program. The management and scheduling of preventive maintenance activities are completed using OPG's enterprise software system 'Asset Suite' which also retains records of all maintenance tasks completed. Feedback inputs from maintenance staff and changes to preventive maintenance activities are managed in the Preventive Maintenance Living Program.

Non-routine maintenance (corrective maintenance) activities are requested, planned and executed using Asset Suite as well. Significant corrective maintenance issues may be identified using the Corrective Action Program and tracked to completion in Asset Suite's Action Tracking module.

As part of system performance monitoring, the status of the maintenance program is routinely assessed and reported to facility management for their review. Metrics for the completion of preventive and corrective maintenance activities are presented, and Station Condition Records are issued to address adverse conditions related to equipment health or the execution of maintenance activities. Corrective actions to address maintenance issues are provided for management approval and are monitored to completion.

Structural Integrity

OPG conducts various activities to ensure the structural integrity of the L&ILW storage structures at WWMF to protect the health and safety of persons and the environment.

At the Western L&ILW Storage Facility, OPG verifies the structural integrity of its storage structures by checking for the presence of water in the structures on a routine basis and monitoring radioactive contamination levels in the water collected. As well, OPG monitors surface and sub-surface water in the areas immediately around the storage structures for contamination. Any observable trend in surface water or groundwater contamination would be an indicator of possible leakage from or into a storage structure.

Groundwater monitoring has identified higher tritium levels in the groundwater north of the Low Level Storage Buildings, as detected at Water Sample Hole WSH231 Follow-up investigations identified a pathway for contaminated condensation to migrate from older Low Level Storage Buildings into the below-grade electrical conduit system and then to groundwater. Stored waste currently blocks access to these conduit penetrations. They will be sealed during the Low Level Storage Building Fire Detection Upgrades in 2017, as they become accessible. In the interim, a program of regularly scheduled pump-outs of the affected below grade electrical conduit system

has been implemented, and groundwater tritium concentrations in this area have started to decline.

Due to the inaccessibility of buried heat exchangers for visual inspection, the vessels are filled with nitrogen and pressure tested annually in order to find leaks. A small leak would be the first sign of loss of structural integrity of the heat exchanges. Over the past 10 years these in-ground heat exchangers have all passed their annual pressure tests, providing assurance of their structural integrity.

3.6.2 Past performance

Aging Management Program

Aging is effectively managed if aging effects are understood and controlled, and if aging related degradation mechanisms are mitigated through implementing appropriate corrective actions to prevent the loss of primary safety functions through the asset's service life.

Compliant to the applicable requirements of RD-334, *Aging Management for Nuclear Power Plants*, OPG has implemented an Integrated Aging Management Program at WWMF for safety-related structures. Under this program the DSC and L&ILW Aging Management Plans have been developed.

Dry Storage Containers Aging Management Program

The DSC Aging Management Plan addresses aging mechanisms, such as corrosion, which could potentially affect DSCs.

Current aging management activities include:

- General visual check of the condition of the protective coating on the exterior of the DSC, with emphasis on the condition of the coating on the containment welds;
- Periodic inspection and re-inspection of the base plates of a baseline population of DSCs;
- Ultrasonic inspection of indications in the metal of the base perimeter flange;
- Monitoring of chloride levels which have the potential to accelerate corrosion; and,
- Dry Storage Container corrosion monitoring.

To date:

- Condition of the coating on the containment welds and the Dry Storage Containers themselves remain in good-to-excellent condition. Very few areas on the containment welds have required re-coating (i.e. touch-up)
- No changes have been observed in the condition of the base plates between the time of their initial inspection and re-inspection; the CNSC is provided with annual summary reports of the inspections
- Measured chloride levels to date have a negligible effect on the potential corrosion of the DSC external surfaces

With the ongoing implementation of this Aging Management Program, OPG is confident of DSC integrity throughout and beyond the next licence period.

Transportation Packages

The current aging management activities for transportation packages include:

- The periodic non-destructive examination of containment and load-bearing welds.
- The periodic sampling, property testing and trending of test results for the rigid polyurethane foam used in the packages for impact and thermal protection.

Results to date:

- The packages (some are 20+ years old) are in good condition; there are no unacceptable indications in the welds.
- There has been no significant change or degradation of the polyurethane foam properties.

This monitoring will continue, and OPG is confident in the fitness for service of the transportation packages.

Low & Intermediate Level Waste Storage Structures

The L&ILW Storage Structures Aging Management Plans address the aging mechanisms that could lead to degradation of the L&ILW structures. These plans integrate various routine monitoring and testing programs with inspections to assess each structure's overall condition and to provide basis for the corrective actions required to maintain each structure's fitness for service.

In the current licensing period, a number of inspections, structure improvements and program improvements have been completed:

- Low Level Storage Building roof inspections were completed in 2008.
- Roof membranes for Low Level Storage Buildings 1 to 5 were replaced in 2011 and 2013 based on the 2008 inspection and life assessment results.
- Internal inspections of WWMF trenches were completed in 2007 and follow-up inspections were completed in Q3 2015. During the 2015 inspection water was found in the bottom of Trench 3-2 and corrosion was observed on the surfaces of the waste drums stored in the trench. The trench was pumped out and the source of the water is being investigated. An internal condition assessment inspection of trench 3-2 was completed in Q4 2016 with remote camera equipment. The inspectors observed that the trench was generally in good condition, and they identified the probable ingress pathway. In conjunction with the trench structure condition assessment inspection, a remote camera was used to visually inspect the accessible trench 3-2 waste drums. Approximately 50% of the drums could be inspected. In general, the drums were found to be intact with no loss of integrity. Condition assessments and the monitoring programs are continuing. Repairs will be completed as required by the ongoing fitness for service programs.
- The tile hole condition assessment inspections, which were originally planned for 2017, were also completed while the inspectors were on-site in 2016. A

Stage 1 tile hole and a Stage 3 tile hole were inspected. The inspectors observed that the tile holes were generally in good condition and they also identified pathways for recent water ingress to these two structures. While the planned condition assessment inspections of the tile holes have now been completed, condition assessment inspections for selected in-ground containers are still planned between 2017 and 2019.

- To address corrosion concerns for carbon steel resin liners identified in previous studies, 350 carbon steel resin liners were removed from IC-18 storage, over-packed in stainless steel containers and then returned to the IC-18 storage in 2007 and 2008.
- To improve leak resistance and to ease removal of the IC-18 sample caps, these caps were modified in two batches: Camlock sample caps were installed on 92 IC-18s in 2010 to improve accessibility for routine water checks; improved Victaulic caps were installed on 54 IC-18s in 2015 to improve leak tightness and accessibility for routine water checks. The remaining 146 of 252 IC-18s already had either Camlock or screw-on sample caps, both of which have proven to be leak-tight and accessible. All IC-18 sample caps are now complete.
- A condition monitoring life assessment was completed in 2013 on low level waste containers that were considered at some risk of not reaching their 50 year design life. Container wall thicknesses were measured and small sections of the container walls were cut-out for metallographic analysis. The oldest container assessed in the 2013 condition monitoring life assessment was stored in 1981. The study concluded that all of the assessed containers will reach their 50 year design life.
- Aging Management Plans have been updated for the in-ground Low and Intermediate Level Waste storage structures to include periodic visual inspections in the preventive maintenance program.

Monitoring will continue and repairs or replacements will be performed as needed throughout the next licence period to ensure the ongoing fitness for service of the L&ILW Storage Structures.

3.6.3 Future plans

OPG has planned a number of initiatives to address aging, obsolescence and to ensure ongoing fitness for service of critical structures, systems and components through the next licence period:

Used Fuel Dry Storage Facility

- Liftking transporter upgrades are planned to address reliability and obsolescence issues. There are no safety issues with the Liftking transporter.

Transportation Packages

- Two new Multi-Purpose Transportation Packages will be placed in-service by 2018, to replace existing heavy water (tritiated deuterium oxide) packages. The Multi-Purpose Transportation Package design offers an improved seal testing capability over the older package design.

- Nine new ISO transportation packages will be placed into service in 2017 and 2018.

Low & Intermediate Level Waste Storage Facility

- Obsolete overhead doors will be replaced on older Low Level Storage Buildings;
- Upgrade fire detection systems in the Low Level Storage Buildings; and,
- Roof membranes will be replaced for Low Level Storage Buildings 6, 7 and 8.

Waste Volume Reduction Building

Starting in 2017, a number of replacements are planned to improve incinerator reliability and address obsolescence concerns including replacement of:

- Motor Control Centre 2/3,
- Service air compressor,
- Programmable Logic Controller/data handling system,
- Uninterruptible Power Supply,
- Solid waste feed system Programmable Logic Controller,
- Major components of the Continuous Emissions Monitoring system, and
- Induced Draft fan.

A number of incinerator modifications in the areas of the spray cooler elbow, ash bin venting system, feed ram cylinder, and lime and carbon delivery system will be completed to improve reliability.

Planned Inspections and Improvements

Condition assessments and the monitoring programs are continuing. Repairs will be completed as required by the ongoing fitness for service programs.

Other plans include condition assessments of selected In-ground Containers between 2017 and 2019 using remote camera inspection techniques.

3.6.4 Challenges

To address aging, obsolescence and to ensure ongoing fitness for service of critical structures, systems and components, OPG has planned a number of initiatives outlined in section 3.6.3 in upcoming years.

3.6.5 Requests

WWMF will be compliant with REGDOC-2.6.3, *Aging Management* by July 15, 2017, as part of continuous improvement.

3.7 Radiation protection

The Radiation Protection program implements a series of standards and procedures for the conduct of activities within OPG Nuclear sites, and with radioactive materials, intended to achieve and maintain high standards of radiation protection including the following objectives:

- controlling occupational and public exposure,
- preventing the uncontrolled release of contamination or radioactive materials from OPG Nuclear sites through the movement of people and materials, and
- demonstrating the achievement of the two previous objectives, through monitoring.

These objectives are achieved through a rigorous approach to facility design and operation, with the intent that exposure to radiation is minimized through effective engineering barriers first and foremost, followed by administrative controls and worker training and personal protective equipment.

3.7.1 Relevance and Management

OPG has established a comprehensive Radiation Protection Program to protect workers and the Public. This program is in place to support OPG's nuclear waste facility operations and to assure compliance with the *Nuclear Safety and Control Act* and its Regulations, applicable provincial legislation, and OPG's Management System.

The Radiation Protection Program is implemented through a series of standards and procedures for the conduct of activities within nuclear sites and with radioactive materials intended to achieve and maintain high standards of Radiation Protection including the achievement of the following objectives:

(1) Controlling occupational and public exposure by:
    - Keeping individual doses below regulatory limits;
    - Avoiding unplanned exposures;
    - Keeping individual risk from lifetime radiation exposure to an acceptable level; and,
    - Keeping collective doses As Low As Reasonably Achievable.

(2) Preventing the uncontrolled release of contamination or radioactive materials from the nuclear sites through the movement of people and materials.

(3) Demonstrating the achievement of (1) and (2) through monitoring.

Radiation Protection Program Monitoring and Oversight at WWMF

Established performance indicators include Radiation Protection Program effectiveness measures commonly used in the nuclear industry and OPG defined indicators established for the purpose of monitoring particular program elements. These are captured in OPG's Electronic Performance Reporting systems as well as Nuclear Waste Management Scorecards and Radiation Protection Indices. Specific

measures include: personnel contamination incidents, regulatory infractions as well as dose performance versus dose targets.

In addition to Fleetview reporting and assessments, the design and execution of the Radiation Protection Program is subject to ongoing monitoring through mechanisms including but not limited to:

- Management review and assessment which includes:
  - Joint Committee on Radiation Protection
  - Nuclear Waste monthly Safety Oversight Meeting
- Exceptional dosimetry and dose control device measurement results.
- Dose trends.
- Annual review of As Low As Reasonably Achievable targets;
- Worker and worker representative's input to the Radiation Protection Program through their local Joint Health and Safety Committees.
- Radiation Protection program self-assessments.
- Independent audits.
- Investigation of events in which an Action Level has been exceeded.
- Improvements to the Radiation Protection Program, such as enhanced alpha monitoring through workplace controls and specialized alpha radiation protection equipment.
- Trending of Radiation Protection Program measures commonly used in the nuclear industry.
- Benchmarking of OPG practices with the rest of the nuclear industry.
- Reviews of industry operating experience.

Management Control over Worker Practices for Dose and Contamination Control

Performing radioactive work within WWMF requires a systematic approach and is managed via the OPG Radiation Protection Program which includes the following processes:

- Limiting individual worker dose.
- Managing dose as a resource, in terms of constraints on work activities.
- Establishing facility design consistent with As Low As Reasonably Achievable principles.
- Assessing hazards for planning and maintaining knowledge of conditions.
- Controlling the use of licensed radioactive devices and equipment.
- Planning all radioactive work taking into account personnel, hardware, procedures, supervision, and the physical environment of the job.

The planning process includes the anticipation and evaluation of radiation hazards and the selection of appropriate protective measures and dosimetry. The degree of

formalization of the planning process and the approval levels for a job is proportional to the potential for exposure. Plans include backout conditions and contingencies. Radiation protection planning decisions are documented in a radiation exposure permit.

The program elements described in this section ensure compliance with the regulatory requirements to keep exposures As Low As Reasonably Achievable, implement control of occupational and public exposure, and plan for unusual situations.

Radioactive contamination controls are in place to reduce occupational and public exposure, and to minimize the release of radioactive materials to the environment. The objectives are to prevent a loss of radioactive contamination control, to minimize the area affected if contamination occurs, and to restore the condition to acceptable levels as soon as possible.

3.7.2 Past performance

Dose and Contamination Control

During the reporting period there have been no action level exceedances related to worker dose at WWMF, or any loss of contamination control events in excess of WWMF's contamination control action levels.

The action levels for dose to workers and for contamination control are as follows:

Application	Action Level	Observations
DOSE TO WORKERS Individual worker external whole body radiation dose received on a job greater than planned.	1 mSv (100 mrem)	The Action Level is exceeded if a person receives an external whole body radiation dose of greater than 1 mSv above the planned dose per shift.
CONTAMINATION CONTROL Beta-gamma surface contamination levels greater than a predetermined activity in the Dry Storage Container Storage Area.	3.7×10^4 Bq/m^2 (1 µCi/m^2)	The Action Level is exceeded if 2 or more Beta-Gamma Surface Contamination Events exceeding 3.7×10^4 Bq/m^2 (1 µCi/m^2) occur per quarter.

OPG is currently reviewing the above action levels.

During the current licence period, OPG has had three Radiation Protection related reportable events. In October 2011 and February 2012, there were two reportable events that involved reversed airflow between radiation protection zones in the Waste Volume Reduction Building. Both events were due to incorrect positioning of air dampers. In September 2016, loose contamination was found on two radioactive waste bins stored outdoors in Zone 2. This event did not cause any personnel contamination events. For all three reportable events, measures have been implemented to prevent reoccurrence.

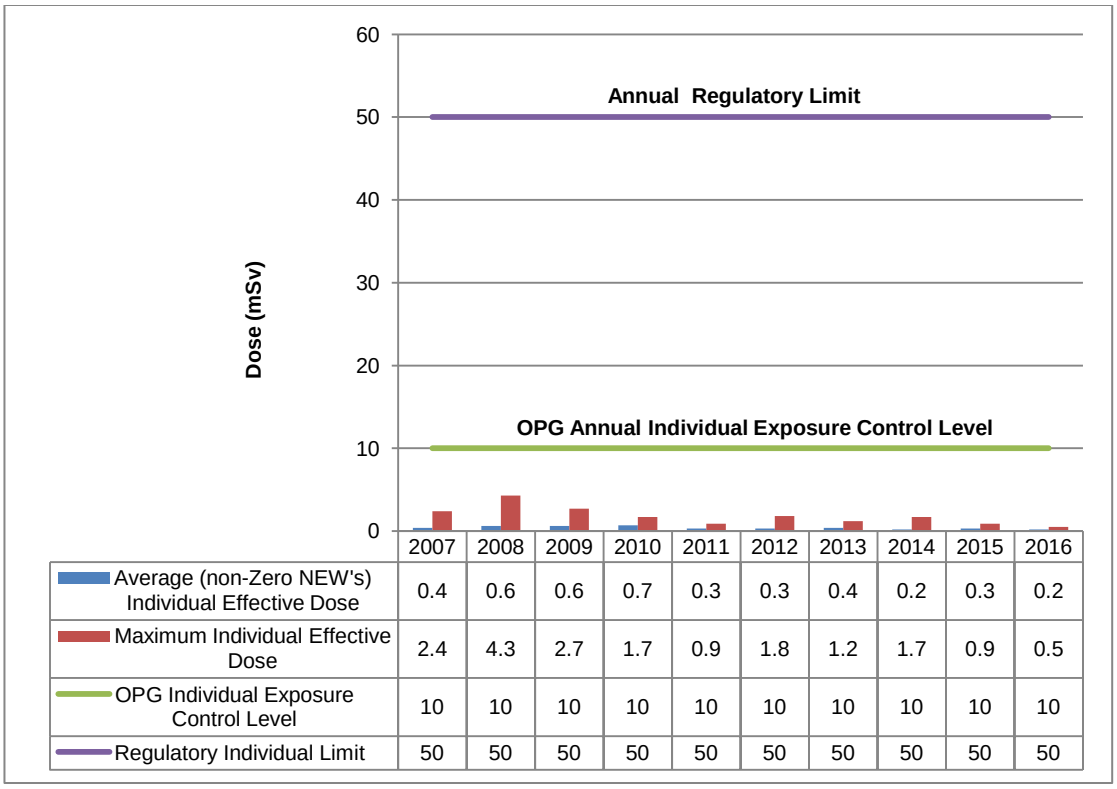
Collective Dose and Maximum Individual Dose per Year

OPG's administrative limits include two control levels for exposure: (1) the Exposure Control Level is 10 mSv/year, and (2) the Administrative Dose Limit is 20 mSv/year. Exposure control levels are set below administrative control levels, which are in turn below the regulatory limits. In particular, the OPG individual exposure control level of 10 mSv (1 rem) per calendar year is significantly below the single year regulatory limit of 50 mSv (5 rem) per year, and the five-year regulatory limit of 100 mSv (10 rem) averaged over five years for a nuclear energy worker. Use of exposure control levels encourage As Low As Reasonably Achievable performance at the individual level and the distribution (sharing) of exposure across the workers. As Low As Reasonably Achievable targets are generated on a yearly basis and are based on outages, normal operations, and waste to be received on a volume basis along with special projects (such as movement of waste to accommodate fire detection upgrades).

Figure 23 and Table 4 outline the key dose statistics for OPG's WWMF. Worker doses were maintained consistently below OPG Individual Exposure Control Levels and well below regulatory limits in the *Radiation Protection Regulations* over the current licensing period.

OPG's exposure control program continues to be in full compliance with regulatory requirements. In the last licence period, enhanced radiological contamination monitoring equipment has been procured and installed at OPG's WWMF to increase OPG's capability and reliability to detect low levels of radioactive contamination. This consists of new personnel whole body contamination monitors and enhanced gamma sensitive portal monitors, as well as large object monitors to detect extremely low levels of radioactivity.

The Health Physics Department has recently commissioned a Whole Body Counter (used to assess and assign dose from internal uptakes of radioactivity) as part of its licensed dosimetry services to the WWMF. This provides enhanced efficiency for the monitoring of staff and visitors.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average (non-Zero NEW's) Individual Effective Dose	0.4	0.6	0.6	0.7	0.3	0.3	0.4	0.2	0.3	0.2
Maximum Individual Effective Dose	2.4	4.3	2.7	1.7	0.9	1.8	1.2	1.7	0.9	0.5
OPG Individual Exposure Control Level	10	10	10	10	10	10	10	10	10	10
Regulatory Individual Limit	50	50	50	50	50	50	50	50	50	50

Figure 23: Average and Maximum Dose at WWMF

Table 4: Key Dose Statistics for OPG's Western Waste Management Facility

Calendar Year	Total Number of Staff Monitored	Total Number of NEW's* Monitored	Collective Dose	Average (total) Individual Effective Dose	Average (non-Zero NEW's) Individual Effective Dose	Maximum Individual Effective Dose
Unit:	**#**	**#**	**Person-mSv**	**mSv**	**mSv**	**mSv**
2007	180	175	20.09	0.1	0.4	2.4
2008	181	181	25.30	0.1	0.6	4.3
2009	203	198	12.48	0.1	0.6	2.7
2010	246	227	33.8	0.1	0.7	1.7
2011	241	225	15.6	0.1	0.3	0.9
2012	242	229	17.7	0.1	0.3	1.8
2013	207	197	18.8	0.1	0.4	1.2
2014	220	205	13.5	0.1	0.2	1.7
2015	200	197	8.67	<0.1	0.3	0.9
Q1 & Q2 2016	170	168	6.0	<0.1	0.2	0.5

* NEW – Nuclear Energy Worker as defined by the *Nuclear Safety and Control Act*

Perimeter Dose Monitoring

WWMF has a perimeter dose monitoring program where Environmental Thermoluminescent Dosimeters are mounted on the perimeter fence of the WWMF as shown on Figure 24 and are changed and analyzed quarterly.

A dose rate of 0.5 µSv/h for 2,000 hours of exposure would result in a hypothetical dose to the most exposed member of the public of 1 mSv, the regulatory limit. The average actual perimeter dose rate at the WWMF has consistently been less than the 0.5 µSv/h, with an overall average less than 0.1 µSv/h. The maximum potential dose at the site boundary over the course of a year to a member of the public is well below the regulatory annual dose limit of 1 mSv.

Since 2007, all measured dose rates have been better than target. Annual performance is reported as the average of all dose rates. Any contributions from WWMF to offsite public dose are captured as part of the Bruce Power Radiological Environmental Monitoring Program.

Results of Corporate-wide Radiation Protection Audit

A corporate wide Radiation Protection audit was completed in 2015. A formal corrective action plan was prepared and approved at the corporate level. No major non-conformances were found specific to the WWMF; however, improvements in the application of Radiation Protection Fundamentals (use of personal protective equipment) were cited. In particular, opportunities for improvement were noted in clarifying the requirements of when respiratory protection was to be worn (and could be removed) as captured on the Radiation Exposure Permits.

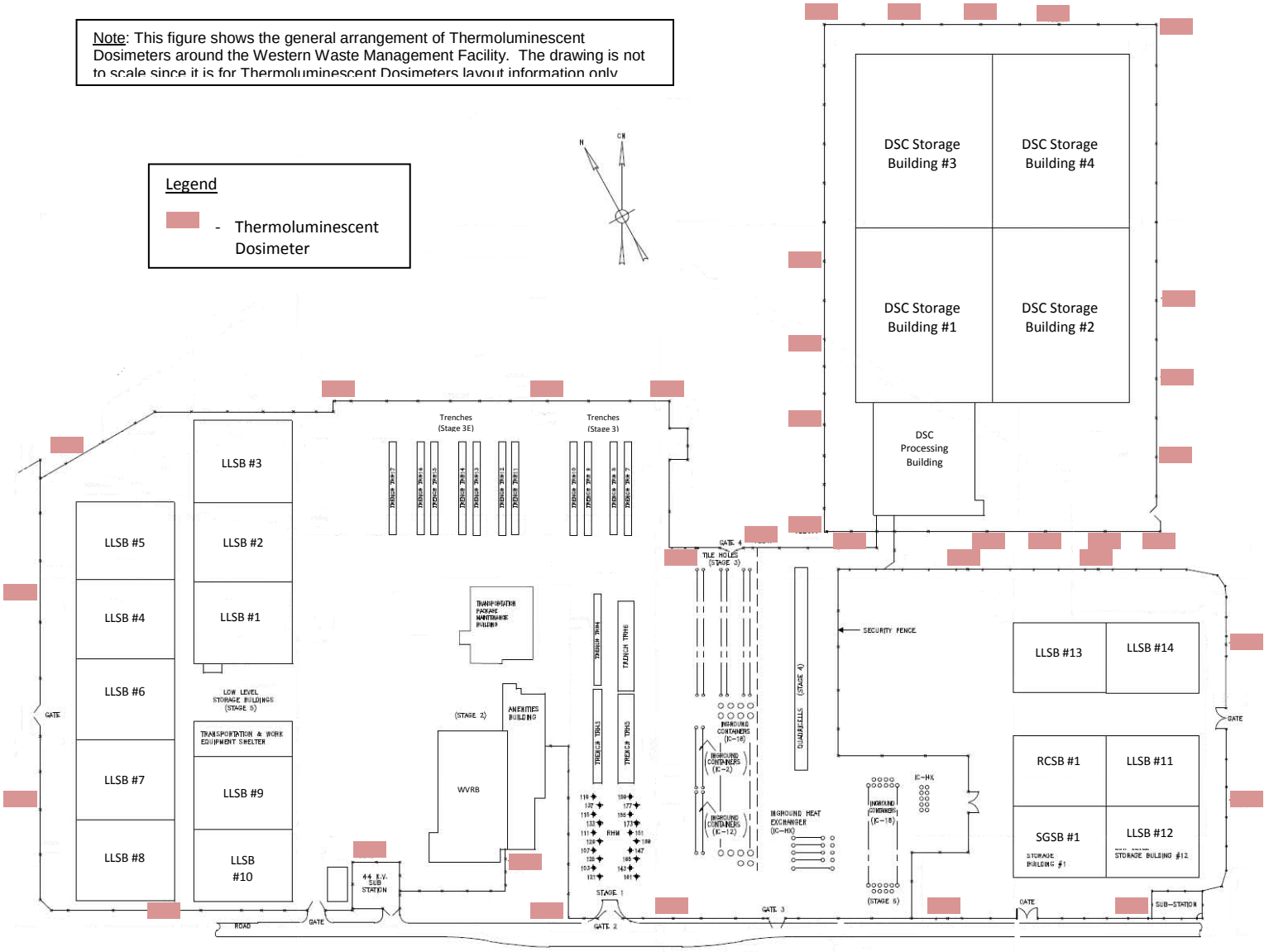


Figure 24: Location of Thermoluminescent Dosimeters at WWMF

Other CNSC Licenses

OPG holds the following Nuclear Substances and Radiation Devices Licences:

- Licence # 12861-2-20 for consolidated uses of nuclear substances (815) for nuclear substances and prescribed equipment.
- Licence # 12861-15-17 for temporary possession – no use (918) for nuclear substances (currently under renewal), and,
- Licence # 12861-17-20 for servicing, installation and dismantling of devices – basic servicing (822) for prescribed equipment.

OPG also holds Dosimetry Service Licence # 12861-11-25 for in-house dosimetry services – consolidated (598) for the operation of a dosimetry service.

3.7.3 Future plans

Based on industry best practices, OPG's WWMF will implement new whole body contamination monitors to lower count times and reduce false alarm rates due to radon progeny.

Development of a Nuclear Waste specific Radiation Protection Action Level document has been prepared and will be submitted to the CNSC by end of February 2017.

In addition, appropriate controls and systems (fume hoods, tents, High-Efficiency Particulate Air filtration, sorting tables, and sensitive gas-flow alpha/beta detectors) are in place to allow for aggressive decontamination and free release of large items to reduce the environmental impact.

3.7.4 Challenges

No challenges to the Safety and Control Area of Radiation Protection are forecasted for the WWMF.

3.7.5 Requests

No requests in terms of changes to licence conditions associated with Radiation Protection are forecasted for the WWMF.

3.8 Conventional health and safety

The goal of OPG's Conventional Safety Program is to ensure a healthy and injury-free workplace by managing risks resulting from the activities, products, and services associated with OPG's nuclear waste facilities operations. Risk reduction is primarily achieved through compliance, by competent workers, to operational controls, developed through risk assessment and safe work planning. OPG's Conventional Safety Program ensures alignment with a number of internal and external specifications or standards such as OPG's Health and Safety Policy and the British Standards Institution's Occupational Health and Safety Assessment Series 18001, Management System Specification. OPG's occupational, health and safety management system is certified to Occupational Health and Safety Assessment Series 18001 by QMI-SAI Global and is documented in the Environment, Health and Safety Program and the Health and Safety Manual.

3.8.1 Relevance and management

The goal of OPG's Conventional Safety Program is to ensure the safety and well-being of its workers. This is achieved by ensuring that safety is the number one priority and by managing conventional risks in the workplace associated with WWMF's operations. The Conventional Safety Program is designed to be an integrated system with OPG Nuclear business managed processes, where appropriate, and considers the current organizational structure.

The *Employee Health and Safety Policy* states that:

- OPG shall meet or exceed all applicable health and safety legislative requirements, as well as, other associated health and safety standards to which OPG subscribes. OPG shall require that its contractors maintain a level of safety equivalent to that of OPG employees while at OPG workplaces;
- OPG shall ensure that employees are involved in decisions that have an impact on their health and safety, either individually, as a group, or through their employee representative groups;
- OPG shall ensure that work is planned and performed to protect workers. It shall provide its employees with the information, training, tools, procedures and support required to do their jobs safely; and,
- OPG shall set health and safety targets as part of its annual business planning process. Health and safety performance against these targets shall be regularly measured and evaluated to ensure the effectiveness of OPG's health and safety systems.

The *Employee Health and Safety Policy* further commits to the prevention of workplace injuries and ill health, and to continuous improvement of its employee health and safety performance.

Additionally, the Internal Responsibility System is a system within an organization, applied consistently throughout OPG, where everyone has personal and shared responsibility for working together co-operatively, to prevent occupational injuries and illnesses. The duties for a healthy and safe workplace fall on every individual, to the degree they have:

- Authority to do so (based upon their position); and,
- Ability to do so (based upon their expertise and qualifications).

Each person is expected to take the initiative on health and safety issues, work to solve problems, and make improvements on an on-going basis. The Internal Responsibility System is based on the principle that employees themselves are in the best position to identify health and safety problems and identify solutions. The Internal Responsibility System outlines the appropriate resolution level for timely corrections.

To ensure that the overall objective of managing occupational hazards is met, OPG monitors the following indicators:

- All Injury Rate;
- Accident Severity Rate; and,
- High Maximum Reasonable Potential for Harm Events.

3.8.2 Past performance

The following section provides the results on All Injury Rate, Accident Severity Rate and high Maximum Reasonable Potential for Harm events for the reporting period. The performance indicators (All Injury Rate and Accident Severity Rate) identified in Figures 25 and 26 are inclusive for the entirety of Nuclear Waste Management. Specific safety events at WWMF that impact the All Injury Rate and Accident Severity Rate are discussed below.

The All Injury Rate is defined as the number of fatalities, lost-time injuries and medical treatment injuries multiplied by 200,000 hours, divided by the total exposure hours worked.

Nuclear Waste Management's All Injury Rate performance was better than target from 2010 through Q2 2016 as shown in Figure 25. There were three medically treated injuries in 2010 (rolled ankle, back strain, and back pain); one lost time accident in 2011 due to a welding arc flash; and one medically treated injury in each of 2012 (welding arc flash), 2013 (slip in a parking lot) and 2014 (elbow pain while working at computer workstation). There were no medically treated or lost time injuries from 2015 to Q2 2016. The target was reduced throughout the licence period to drive continuous improvement.

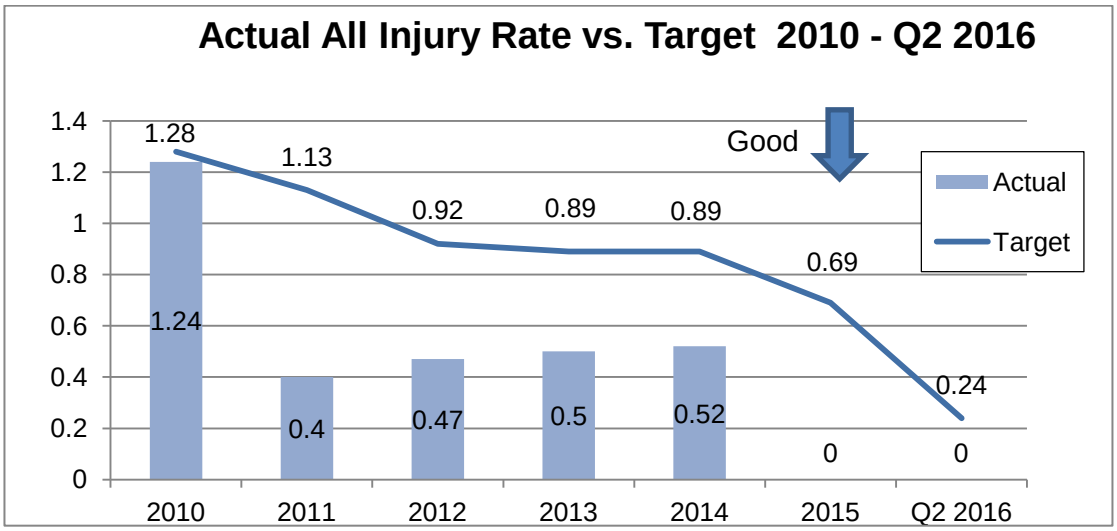


Figure 25: Nuclear Waste Management All Injury Rate vs. Target

Accident Severity Rate

The Accident Severity Rate is defined as the number of calendar days lost due to work-related injury multiplied by 200,000, divided by total facility hours worked.

Nuclear Waste Management's Accident Severity Rate was better than target from 2010 through 2015 as shown in Figure 26. Although there was no Accident Severity Rate target for 2016, the Accident Severity Rate continues to maintain its performance with no lost time injuries. There was one Lost Time Injury in 2011, where a worker was exposed to radiant energy from a welding arc flash which resulted in one missed

day of work. A root-cause investigation was conducted and corrective actions were implemented including training and procedural requirements for welding of DCSs.

Since that day in 2011, Nuclear Waste Management has showed its continued focus on safety performance by working over 1,825 days (or 5 years) without a lost time accident. Over the last 5 years, there has also been a steady decline in medically treated injuries up to Q2 2016.

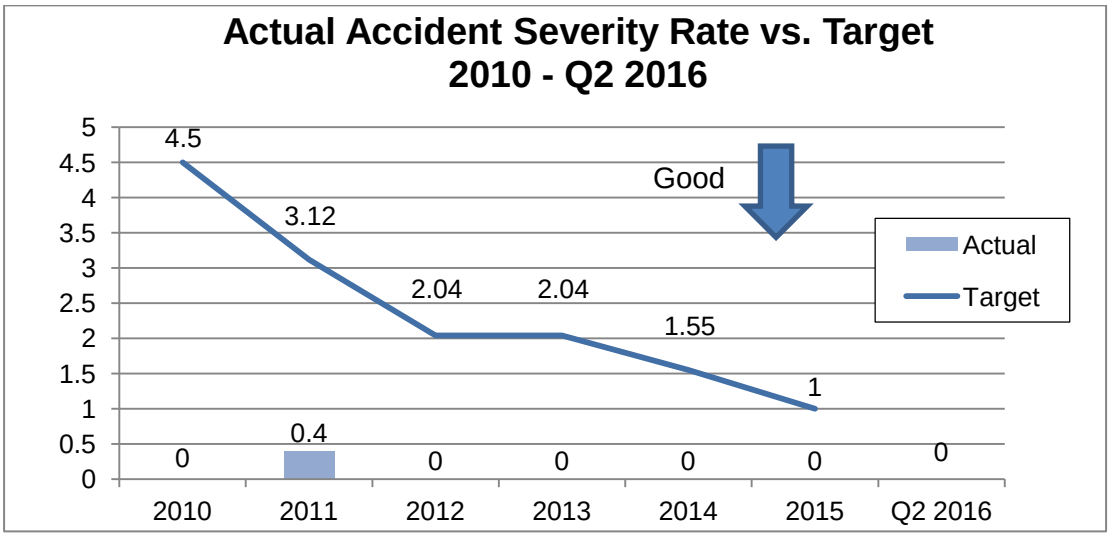


Figure 26: Nuclear Waste Management Accident Severity Rate vs. Target

High Maximum Reasonable Potential for Harm Events

The Maximum Reasonable Potential for Harm is a rating system used to classify incidents, and to determine the potential severity of safety incidents. These are incidents with potential for injury to personnel; however, no actual injury may have occurred. High Maximum Reasonable Potential for Harm incident investigations offer learning opportunities for continued improvement in safety performance.

During the current licensing period, there were eight High Maximum Reasonable Potential for Harm events that occurred at OPG's WWMF, as described below.

<u>Material Handling</u>

(1) In June 2011 an employee attempted to assist a fork lift operator with a stuck oil pallet when a steel frame suddenly moved and made contact with the individual's shoulder.

<u>Mobile Crane</u>

(2) In October 2013 a mobile crane contacted live overhead power lines while an employee was driving the mobile crane from a lay down area to the L&ILW Storage Facility.

<u>Falling Object</u>

(3) In February 2007 an overhead door was in the raised position to allow a worker to bring in a snow blower. A worker returned to lower the door, pressed the down button and the panel door crashed to the floor in an uncontrolled descent.

(4) In January 2014 a Genie lift caught against an uneven surface while being moved, and the lift came into contact with the Transportation Package Maintenance Building garage door and landed on the ground.

(5) In January 2016 a waste bin ejected from the incinerator bin dumper and became lodged on some pipe work at a height of approximately 60 cm above the incinerator conveyor.

Flying Object

(6) In August 2009, during post-maintenance testing, a fire hose became energized, breaking the cabinet glass and exiting the cabinet with considerable force.

Working at Heights

(7) In November 2014 the operator of a recycling truck, working for an external company, was at the WWMF climbing to the top of the truck and into the back of the truck exposing the operator to a potential fall from height.

(8) In January 2015 a contract scaffold worker slipped and fell while building a scaffold in the L&ILW zone 3 incinerator room.

Safety Enhancements

During the current licensing period, a number of safety enhancements have been made to equipment and systems at the WWMF. Some examples are listed below:

- Replacement of a unit heater to eliminate any risk of contact with heavy equipment operation in the vicinity;
- New 600V disconnect with visible contacts installed to enhance application of work protection;
- Facility housekeeping and storage improvements to ease access to tools and equipment;
- Emergency Lighting Unit enhancement at Waste Volume Reduction Building to cover additional areas;
- Emergency Lighting Unit replacements at LLSBs for facilitating cold weather operation;
- Ergonomic improvement by installation of jib crane to hoist materials to a mezzanine level rather than carrying materials up the stairway, and,
- Upgrades to the yard lighting for better visibility.

3.8.3 Future plans

A number of health and safety improvement initiatives will remain on-going for the WWMF as part of the continuous improvement cycle of the health and safety management system. These include:

- The “Total Health Initiative” which is aimed at fostering an environment where employees seek choices that align with their optimal health and whereby Supervisors and Managers support employees by providing resources, communicating with employees and educating them on programs that are available (i.e. implementation of a mental health training program for people leaders, mental health stigma awareness for all employees, access to

confidential personal health assessments, Employee Family Assistance Program resource awareness etc. as overseen by a tripartite 'Total Health Alignment Team');

- Focus on Situational Awareness, particularly around routine activities such as walking, and,
- Implementation of the OPG Nuclear Human Performance Program tools and processes.

In 2016, a new "'iCare" Safety Culture initiative was implemented at OPG. The iCare initiative is aimed at revitalizing and re-energizing OPG's safety culture in order to "break-through" to the next level of safety outcomes (behaviours and performance) by moving from a "Compliance-based" culture to a to a "Values-based" culture.

In addition, OPG's commitment to continuously improve performance is reflected by setting challenging targets for the All Injury Rate.

3.8.4 Challenges

There are no challenges related to the Safety and Control Area of Conventional Health at this time.

3.8.5 Requests

No modifications are being requested with respect to licence conditions associated with this Safety and Control Area.

3.9 Environmental protection

Environmental Protection includes activities that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as a result of licensed activities.

Specifically Nuclear Waste Management (WWMF) will continue to:

- Maintain environmental management systems registered to ISO 14001 Environmental Management specification;
- Meet all legislative requirements and voluntary environmental commitments, with the objective of moving beyond compliance;
- Monitor to ensure radiological emissions to air and water are compliant with regulatory limits;
- Monitor the concentrations of radionuclides in the offsite environment (air, water and foodstuffs) to confirm compliance with CNSC public dose limits;
- Monitor the concentrations of non-radioactive emissions to the environment to confirm compliance to environmental regulatory limits and Environmental Compliance Approval performance measures;
- Formally assess the ecological risks and environmental damage resulting from operations and act to remediate damage or control risks as required;
- Integrate environmental and social factors into our planning, decision-making and business practices; and
- Educate, encourage and empower employees to conduct their activities in an environmentally responsible and sustainable manner.

3.9.1 Relevance and management

Compliant to the requirements of REGDOC-2.9.1 (2013), *Environmental Protection Policies, Programs and Procedures*, WWMF has in place an environmental protection program.

The Environmental Policy states:

- OPG shall establish an environmental management system and maintain registration for this system to the ISO 14001 *Environmental Management System* standard;
- OPG shall work to prevent or mitigate adverse effects on the environment with a long-term objective of continual improvement in its environmental management system and its environmental performance;
- OPG shall manage its sites in a manner that strives to maintain, or enhance where it makes business sense, significant natural areas and associated species of concern. OPG will work with its community partners to support regional ecosystems and biodiversity through science-based habitat stewardship. Where disruption is required, OPG shall take reasonable steps to manage the residual impact to these areas and species;
- OPG shall set environmental performance targets as part of its annual business planning process. Performance against these targets will be monitored, and
- OPG shall communicate its environmental performance to employees, governments, local communities, and other stakeholders.

3.9.2 Past performance

Radiological Emissions and Effluent Monitoring Program

WWMF systems and equipment are designed to operate within regulatory limits and to ensure that radiological exposure to workers and the public and impacts to the environment are As Low As Reasonably Achievable. The Radiological Monitoring Program monitors site effluents to ensure releases are within the regulatory limits and provides confirmation that systems are performing as designed. The Radiological Monitoring Program at the WWMF is in accordance with CSA N288.5-11, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*. The effluent pathways monitored at the WWMF consist of the following:

- Liquid effluent discharged from the WWMF site (i.e., stormwater and subsurface drainage);
- Airborne emissions from the incinerator and building ventilation stacks;
- Ambient radiation dose rates at the perimeter of the WWMF; and
- Groundwater within, and in the vicinity of the WWMF.

The effluent monitoring program is used to ensure releases are within the regulatory limits and provides confirmation that systems are performing as designed.

The results of the effluent monitoring program are provided to the CNSC in the quarterly operations reports and are available to the public on the OPG website at

www.opg.com. A summary of the results since 2007 is provided in the following subsections.

Derived Release Limits

Derived release limits are derived using CSA N288.1, *Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities*, and accepted by the CNSC. Derived release limits are used to establish controls on the releases of radioactive materials. Derived release limits are calculated for radionuclides of potential dose significance in effluent streams, to facilitate the control, reporting, and regulation of radionuclide emissions.

The emissions from WWMF have been consistently less than 1% of the derived release limits. The derived release limits are shown in Table 5.

Table 5: WWMF Derived Release Limits

Release Category	Radionuclide	Derived Release Limit (Becquerel/week)
Air	Tritium (HTO)	5.67E+15
	Iodine(mfp)	3.64E+10
	Carbon-14	2.09E+13
	Particulate	4.48E+10
	Gross Alpha	6.43E+9
Release Category	**Radionuclide**	**Derived Release Limit (Becquerel/month)**
Water	Tritium	6.42E+14
	Carbon-14	5.64E+11
	Gross Alpha	2.44E+10
	Gross Beta-Gamma	3.80E+10

Action Levels

The *Radiation Protection Regulations* state that an *"action level"* means *"a specific dose of radiation or other parameter that if reached, may indicate a loss of control of part of a licensee's radiation protection program and triggers a requirement for specific action to be taken".* Action levels are set at a fraction of the derived release limits to provide early detection of a potential loss of control and to ensure appropriate action is taken to prevent emission from approaching a derived release limit. Exceeding an action level requires notification and reporting to the CNSC, investigation of the cause and corrective action as required.

Any proposed changes to the derived release limits and action levels are assessed to ensure they are within the existing safety and design envelope, and not likely to adversely affect the safe conduct of any licensed activities, nor outside the scope of the licence.

WWMF's current action levels are shown in Table 6.

Table 6: WWMF Environmental Action Levels

Release Category	Radionuclide	Action Level (Becquerel/week)
Air	Tritium (HTO)	5.90E+14
	Iodine(mfp)	3.79E+09
	Carbon-14	2.17E+12
	Particulate	4.70E+09
	Gross Alpha	6.69E+08
Release Category	**Radionuclide**	**Action Level (Becquerel/month)**
Water	Tritium	6.20E+13
	Carbon-14	5.41E+10
	Gross Alpha	2.34E+09
	Gross Beta-Gamma	3.60E+09

Radiological Airborne Emissions

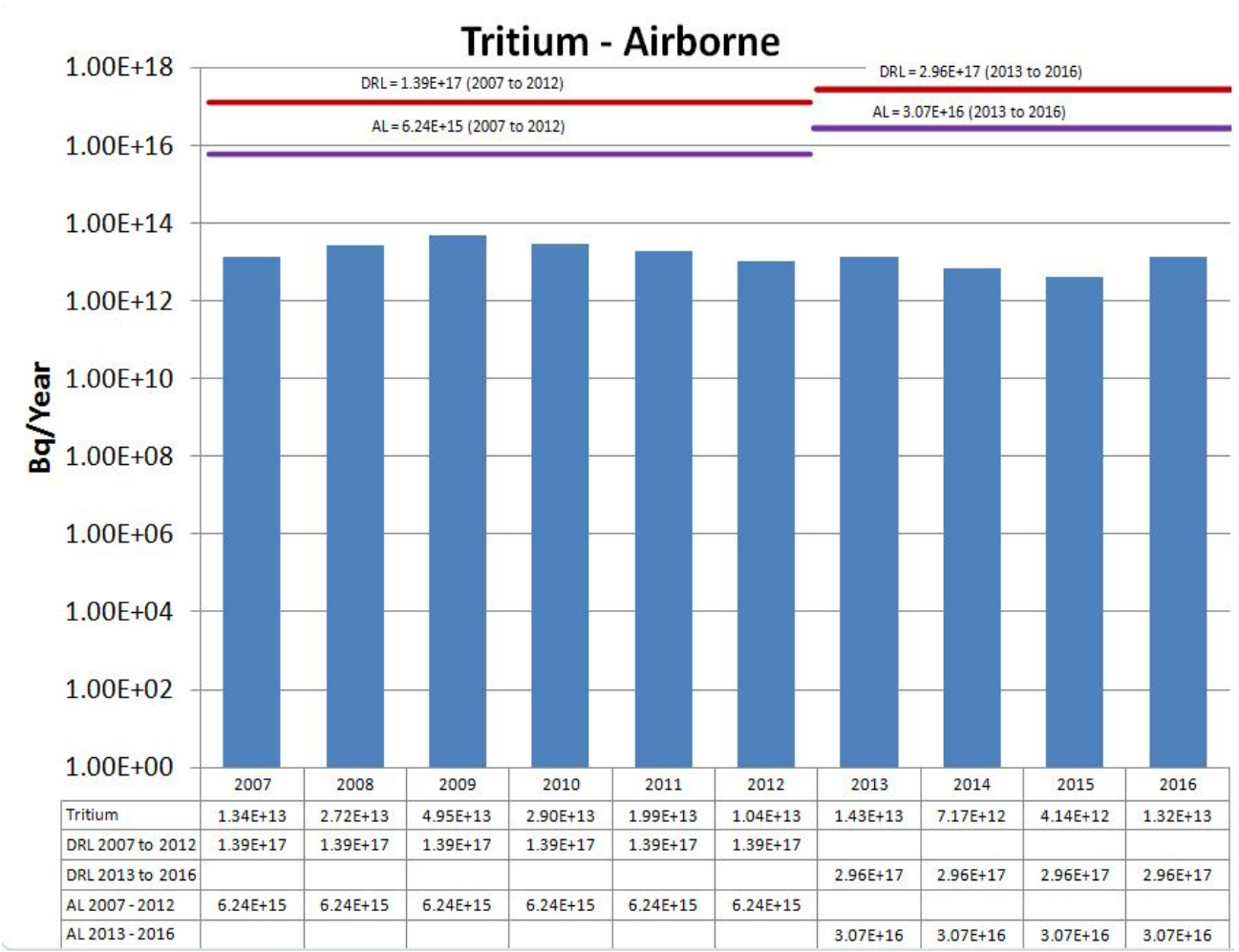
At the WWMF, the airborne emissions monitoring program consists of the following:

- Radioactive waste incinerator stack monitoring for tritium, carbon-14, particulate and Iodine-131 emissions.
- Waste Volume Reduction Building ventilation exhaust stack monitoring for tritium, particulate and Iodine-131 emissions.
- Transportation Package Maintenance Building ventilation stack monitoring for tritium and particulate emissions.
- DSC Processing Building ventilation exhaust stack monitoring for particulate emissions.

The results of the radiological airborne emission monitoring programs are reported in the WWMF's quarterly operations reports which are submitted to the CNSC. A summary of the annual radiological airborne emissions for WWMF is provided in the following figures.

As shown in Figures 27 to 30, the annual airborne emissions are orders of magnitude below the derived release limits and action levels with the overall trend in emissions being relatively stable over the current licensing period.

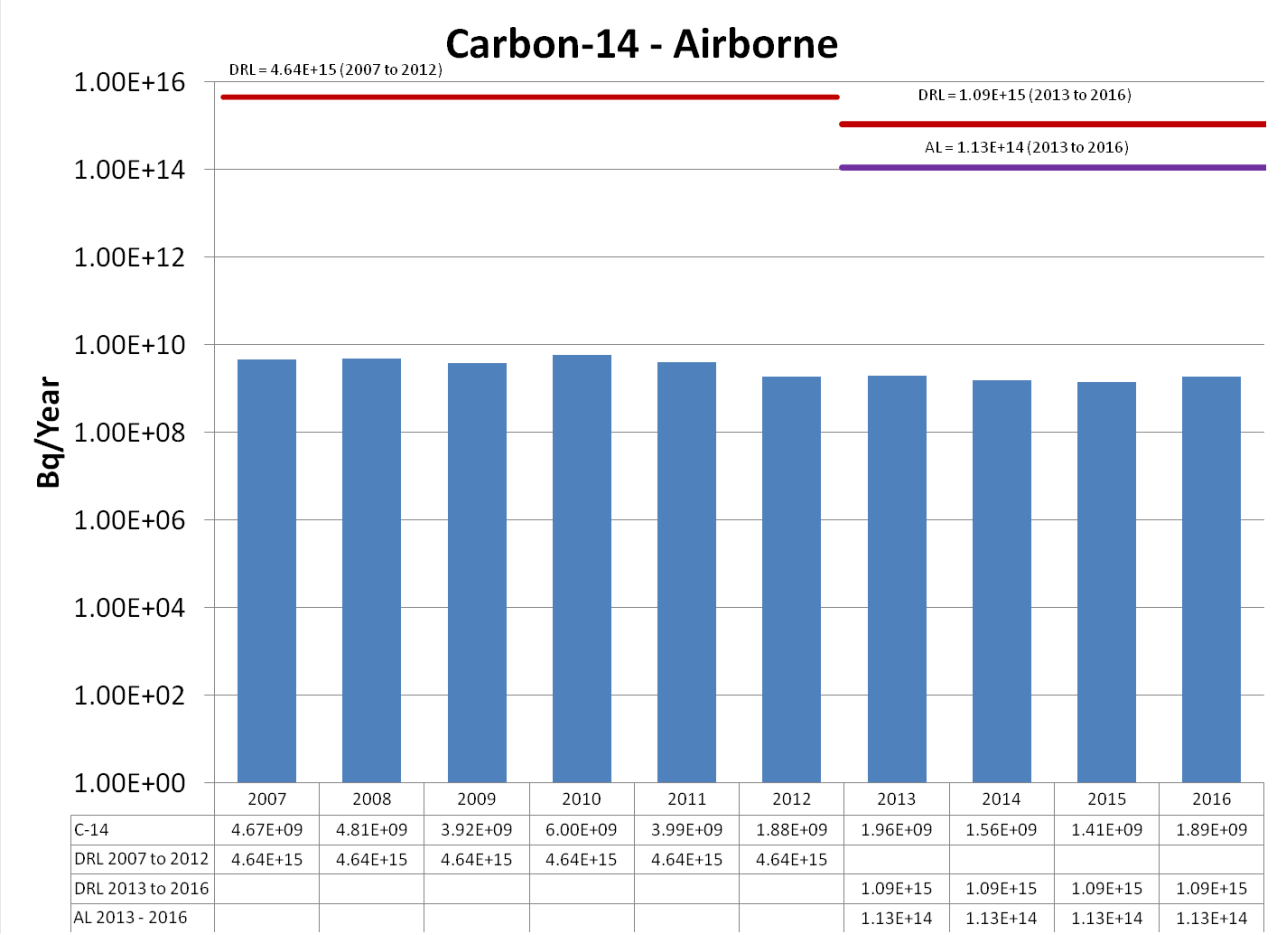
The airborne emissions reported for each parameter are reported as a combined emission from the respective sources. The primary contribution of emissions from the WWMF is associated with the operation of the incinerator.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Tritium	1.34E+13	2.72E+13	4.95E+13	2.90E+13	1.99E+13	1.04E+13	1.43E+13	7.17E+12	4.14E+12	1.32E+13
DRL 2007 to 2012	1.39E+17	1.39E+17	1.39E+17	1.39E+17	1.39E+17	1.39E+17				
DRL 2013 to 2016							2.96E+17	2.96E+17	2.96E+17	2.96E+17
AL 2007 - 2012	6.24E+15	6.24E+15	6.24E+15	6.24E+15	6.24E+15	6.24E+15				
AL 2013 - 2016							3.07E+16	3.07E+16	3.07E+16	3.07E+16

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/week for comparison to annual emissions. 2016 data is the sum of quarter 1 and 2 only

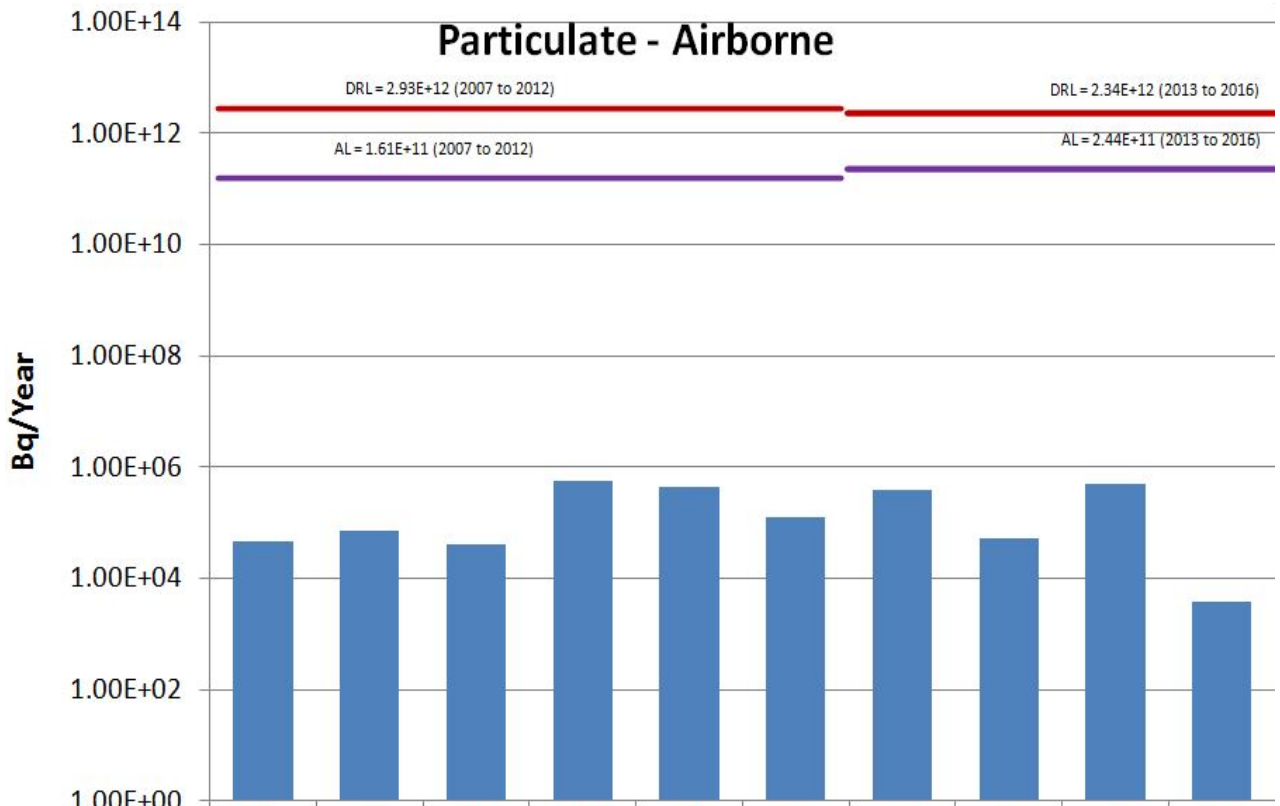
Figure 27: WWMF Annual Tritium Airborne Emissions, 2007-2016



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
C-14	4.67E+09	4.81E+09	3.92E+09	6.00E+09	3.99E+09	1.88E+09	1.96E+09	1.56E+09	1.41E+09	1.89E+09
DRL 2007 to 2012	4.64E+15	4.64E+15	4.64E+15	4.64E+15	4.64E+15	4.64E+15				
DRL 2013 to 2016							1.09E+15	1.09E+15	1.09E+15	1.09E+15
AL 2013 - 2016							1.13E+14	1.13E+14	1.13E+14	1.13E+14

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/week for comparison to annual emissions. No action levels were in place for Carbon-14 prior to 2013. 2016 data is the sum of quarter 1 and 2 only.

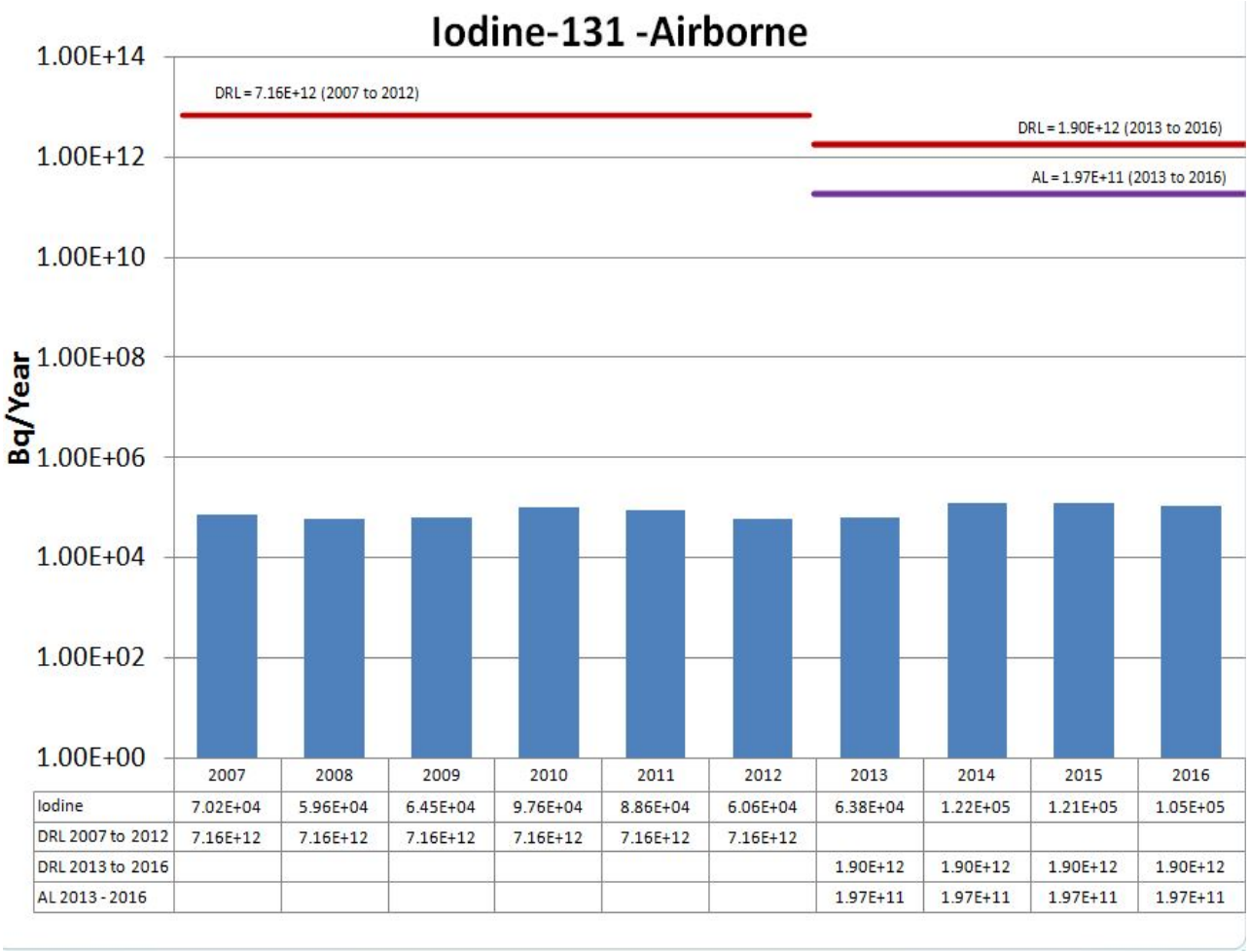
Figure 28: WWMF Annual Carbon-14 Airborne Emissions, 2007-2016



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Particulate	4.70E+04	7.23E+04	4.08E+04	5.61E+05	4.36E+05	1.26E+05	3.78E+05	5.12E+04	4.89E+05	3.91E+03
DRL 2007 to 2012	2.93E+12	2.93E+12	2.93E+12	2.93E+12	2.93E+12	2.93E+12				
DRL 2013 to 2016							2.34E+12	2.34E+12	2.34E+12	2.34E+12
AL 2007 - 2012	1.61E+11	1.61E+11	1.61E+11	1.61E+11	1.61E+11	1.61E+11				
AL 2013 - 2016							2.44E+11	2.44E+11	2.44E+11	2.44E+11

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/week for comparison to annual emissions. 2016 data is the sum of quarter 1 and 2 only.

Figure 29: WWMF Annual Particulate Airborne Emissions, 2007-2016



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Iodine	7.02E+04	5.96E+04	6.45E+04	9.76E+04	8.86E+04	6.06E+04	6.38E+04	1.22E+05	1.21E+05	1.05E+05
DRL 2007 to 2012	7.16E+12	7.16E+12	7.16E+12	7.16E+12	7.16E+12	7.16E+12				
DRL 2013 to 2016							1.90E+12	1.90E+12	1.90E+12	1.90E+12
AL 2013 - 2016							1.97E+11	1.97E+11	1.97E+11	1.97E+11

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/week for comparison to annual emissions. No action levels were in place for Iodine-131 prior to 2013. 2016 data is the sum of quarter 1 and 2 only.

Figure 30: WWMF Annual Iodine-131 Airborne Emissions, 2007-2016

2.9.2.3 Radiological Waterborne Effluent

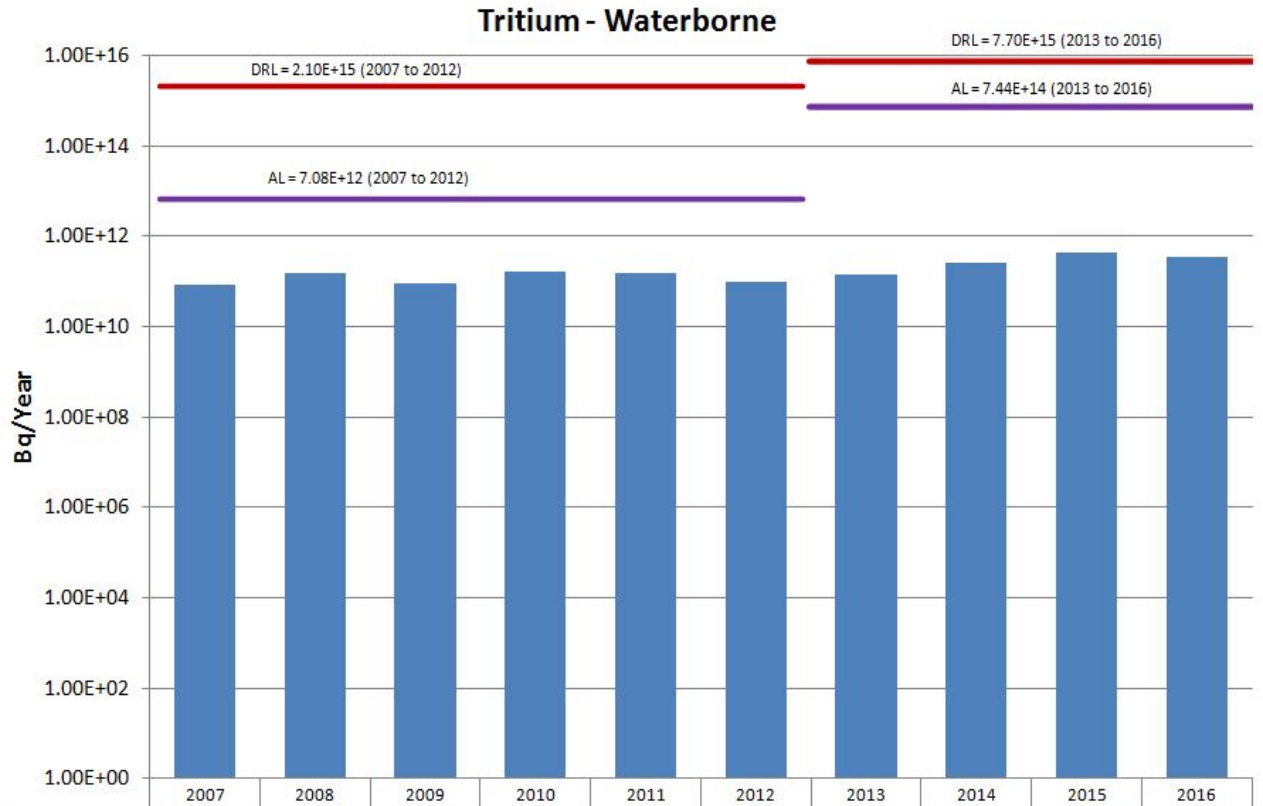
Waterborne radioactivity is monitored via the storm water runoff and via the sub-surface drainage systems at the WWMF.

The results of the radiological waterborne emission monitoring programs are reported in the WWMF's quarterly operations reports submitted to the CNSC. Over the current licensing period, nine exceedances of the monthly action level have occurred for gross beta waterborne emissions at the WWMF. These occurred between the first quarter of 2009 and fourth quarter of 2012.

As a result of the exceedances, an investigation was performed and the cause of the action level exceedances was found to be related to an increase in surface runoff volume as the WWMF site area expanded over time, as well as higher than normal minimum detection levels in the analysis. The increase in minimum detection levels was caused by interference in the gross beta activity measurement by the presence of dissolved road salt in the surface runoff water in the winter season. Subsequently, the derived release limits and action levels were updated in accordance with the CSA Standard to better reflect site conditions. There have been no action level exceedances since 2013, following the implementation of the revised derived release limits and action levels.

A summary of WWMF's annual radiological waterborne emissions is provided in the following figures. The action level exceedances as noted above are based on total monthly releases. These monthly exceedances are not directly visible in Figures 31 and 32 as the emissions are presented as annual releases not monthly.

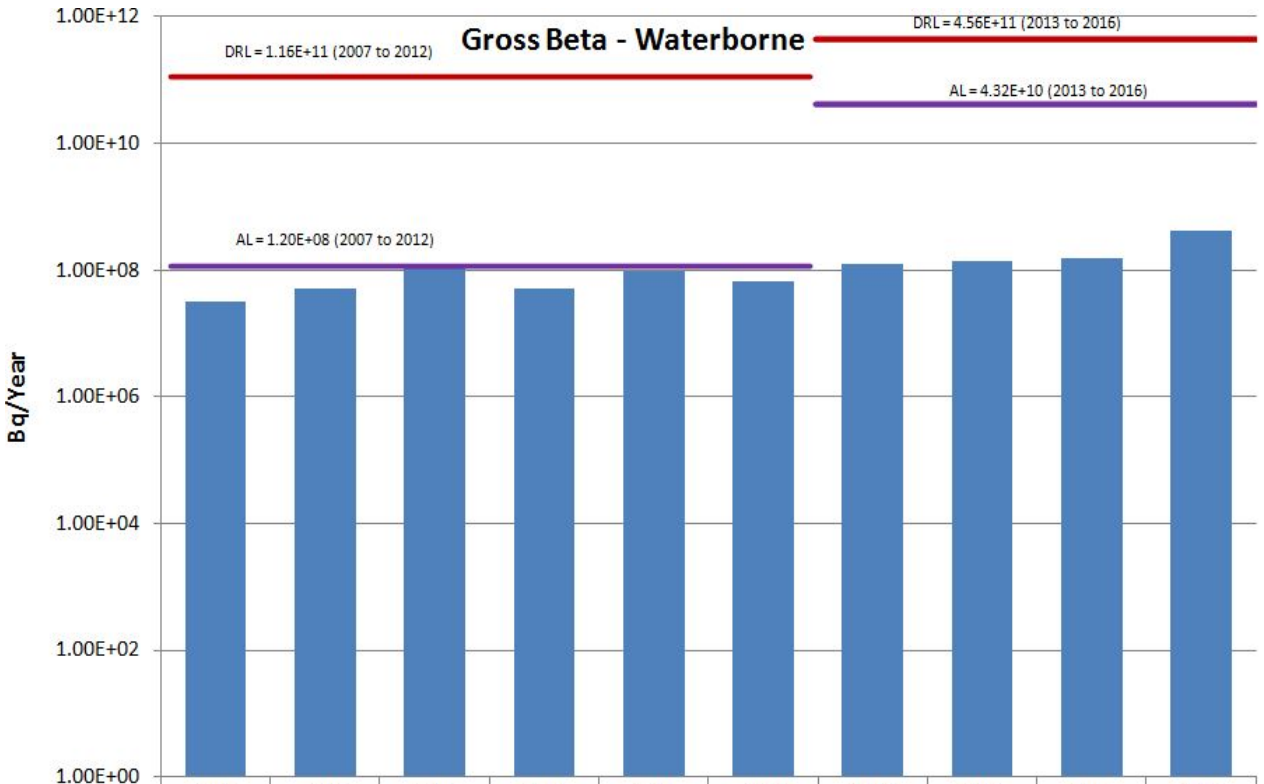
As shown in Figures 31 and 32, the annual waterborne emissions are orders of magnitude below the derived release limits and the current action levels. Although emissions are well below the derived release limits and action levels, annual total tritium and gross beta released through waterborne emissions from the site have shown an increase from 2012 to the present. During this time, the WWMF site underwent expansions in several areas. These additional storage structures have added to the site's surface area being monitored prior to release. During this time, the WWMF site continued to receive and store low and intermediate level waste adding to the total inventory of radioactive waste at the site. Given the expansions of the site and on-going operations, the increase in total tritium and gross beta is not unexpected. Waterborne emissions continue to be monitored and reported in the quarterly operations report, and remain well below the Derived Release Limits.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Tritium	8.08E+10	1.48E+11	8.82E+10	1.60E+11	1.54E+11	1.00E+11	1.42E+11	2.50E+11	4.28E+11	3.54E+11
DRL 2007 to 2012	2.10E+15	2.10E+15	2.10E+15	2.10E+15	2.10E+15	2.10E+15				
DRL 2013 to 2016							7.70E+15	7.70E+15	7.70E+15	7.70E+15
AL 2007 - 2012	7.08E+12	7.08E+12	7.08E+12	7.08E+12	7.08E+12	7.08E+12				
AL 2013 - 2016							7.44E+14	7.44E+14	7.44E+14	7.44E+14

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/month for comparison to annual emissions. 2016 data is the sum of quarter 1 and 2 only.

Figure 31: WWMF Annual Tritium Waterborne Emissions, 2007-2016



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gross Beta	3.13E+07	5.16E+07	1.23E+08	5.11E+07	9.55E+07	6.79E+07	1.26E+08	1.39E+08	1.56E+08	4.11E+08
DRL 2007 to 2012	1.16E+11	1.16E+11	1.16E+11	1.16E+11	1.16E+11	1.16E+11				
DRL 2013 to 2016							4.56E+11	4.56E+11	4.56E+11	4.56E+11
AL 2007 - 2012	1.20E+08	1.20E+08	1.20E+08	1.20E+08	1.20E+08	1.20E+08				
AL 2013 - 2016							4.32E+10	4.32E+10	4.32E+10	4.32E+10

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/month for comparison to annual emissions. 2016 data is the sum of quarter 1 and 2 only.

Figure 32: WWMF Annual Gross Beta Waterborne Emissions, 2007-2016

Groundwater Monitoring Program

The WWMF has an established groundwater monitoring program that has been in place for over two decades. The routine groundwater monitoring program consists of 20 groundwater wells that monitor overburden and bedrock aquifers in the vicinity of the WWMF for radiological parameters. The results of the groundwater monitoring program are included in the quarterly operations reports submitted to the CNSC.

In 2014, 22 additional wells were installed as part of a groundwater study and monitoring network assessment to increase the distribution of the groundwater data over a two-year period. An additional 13 existing monitoring wells (not part of the routine monitoring program) and 6 surface water sampling locations were also incorporated into the study/assessment. In July 2016 another 6 shallow groundwater wells were installed and incorporated into the study. The groundwater study and monitoring network assessment included eight sampling intervals completed quarterly to monitor seasonal variations in groundwater and surface water conditions with respect to radiological parameters (tritium, Carbon-14, cesium, etc.) as well as conventional parameters (e.g., metals, inorganics, hydrocarbons, etc.) and water levels. The data collection for the field study/data gathering was completed in July 2016 and the report was finalized in January 2017. Figure 33 shows the locations of all groundwater wells currently on the WWMF.

The results of the study are consistent with previous assessments with no evidence of adverse offsite impacts to groundwater or surface water.

As reported in the quarterly operations report, localized elevated concentrations of tritium are present onsite in the middle sand aquifer as identified at monitoring well location WSH231 (located directly down gradient of Low Level Storage Buildings 1 to 10). The source of the elevated tritium at WSH231 is understood to be from evaporation in the Low Level Storage Buildings. An extensive study was completed in 2010 to identify the migration pathway to WSH231. Based on the findings of the study, the most probable pathway was identified to be via an electrical manhole that intersects the groundwater table. The electrical manhole connection to the Low Level Storage Buildings is through electrical conduits that service the buildings. Particle traces in the groundwater completed during the 2010 study identified the preferential flow pathway from the electrical manhole to be towards WSH231 in the middle sand aquifer.

Since 2010, various mitigating measures have been taken including asphalt sealing, Low Level Storage Building sump sealing, monitoring and pump down of electrical man holes and sealing of some electrical penetrations. Based on the monitoring results from well WSH231, these mitigation measures appear to be improving the groundwater quality in the middle sand aquifer. Figure 34 shows the downward trend in tritium concentrations at WSH231 in recent years.

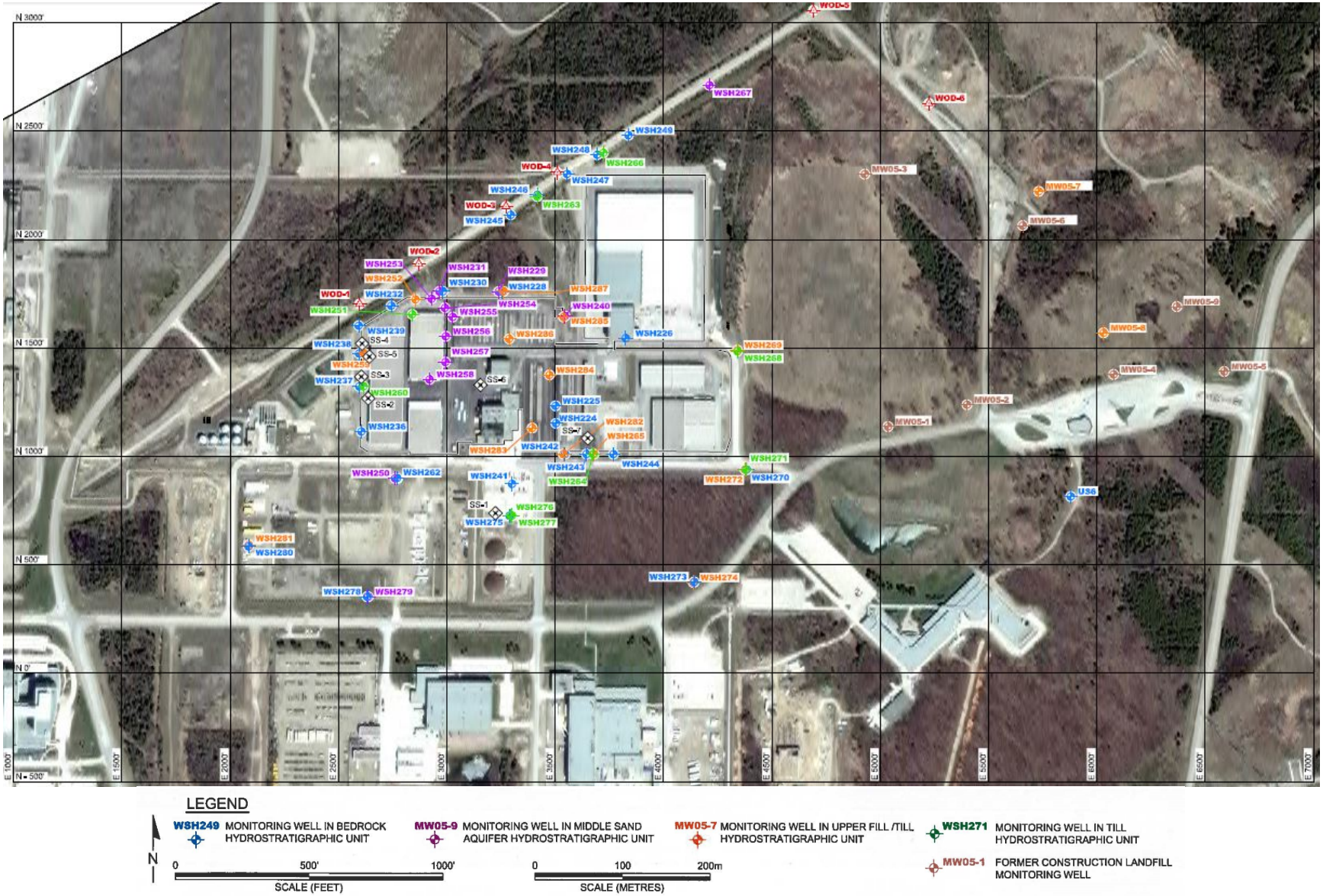


Figure 33: Groundwater Well Locations at the WWMF

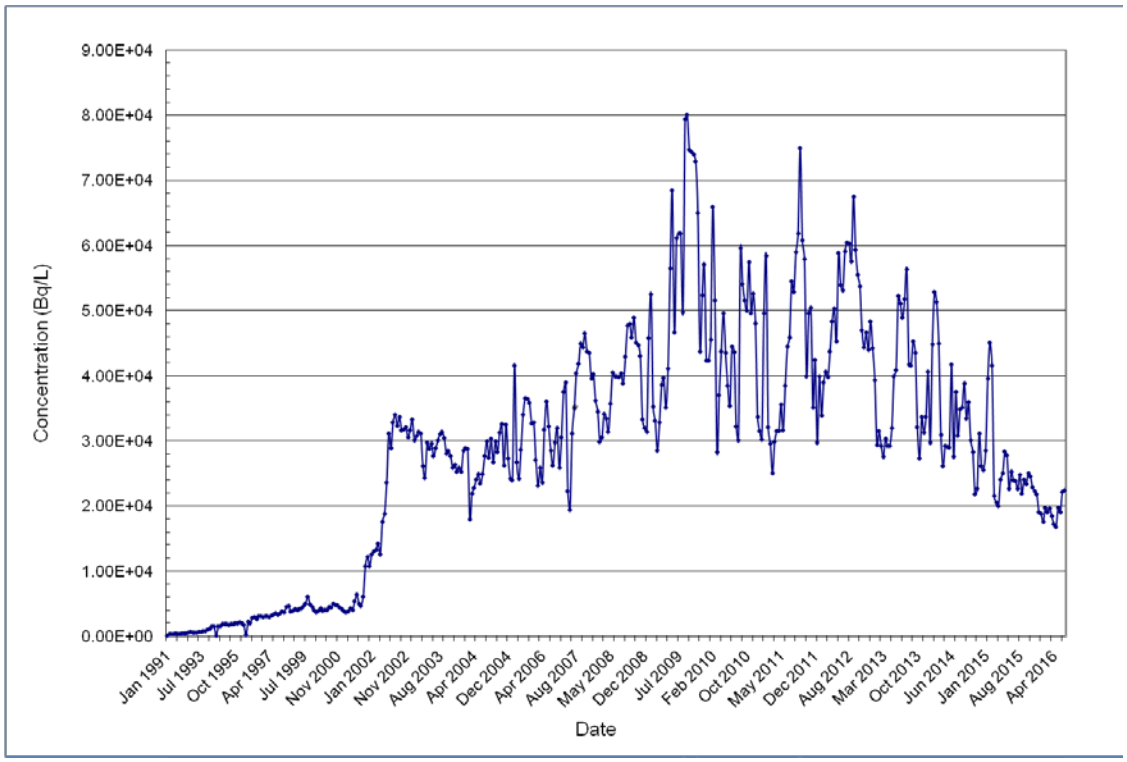


Figure 34: Tritium Concentration in WSH231 (1991 - 2016)

Non-Radiological Emissions

OPG's WWMF has Ontario Ministry of Environment and Climate Change Environmental Compliance Approvals for air emissions and storm water management.

Under the Air Environmental Compliance Approval, continuous emissions monitoring of the incinerator emissions are completed for carbon monoxide, nitrogen oxides, sulphur dioxide and hydrochloric acid to ensure point of impingement targets are met. Source testing of incinerator emissions is also completed once a year to quantify overall emissions rates of particulate matter, metals, polychlorinated biphenyls, dioxins, furans, polycyclic aromatic hydrocarbons and volatile organic compounds.

The annual source testing results indicate that incinerator emissions are well within the regulatory limits. Provided in Table 7 below is a summary of the source testing results since 2007 for incinerator stack emissions in comparison to the allowable limits specified in the Environmental Compliance Approval. Particulate matter, mercury and total hydrocarbons emissions are less than 0.5% of the allowable limits and dioxins and furans are just 5% of the allowable limits.

Table 7: Source Testing Results

Parameter		Particulate Matter	Mercury	Dioxins and Furans	Total Hydrocarbons
Units		mg/Rm^3	mg/Rm^3	pg TEQ/Rm^3	ppm
Allowable Limit		14	20	80	50
Measured Concentration	2007	1.49	0.17	6.30	3.20
	2008	0.78	0.32	10.4	6.80
	2009	0.64	1.15	4.73	2.37
	2010	0.60	<0.025	2.97	1.33
	2011	0.44	<0.40	1.79	1.13
	2012	1.47	0.038	3.03	2.43
	2013	0.85	0.17	1.80	0.75
	2014	No Data	No Data	No Data	No Data
	2015	0.29	0.27	4.82	0.33
	2016	0.31	1.52	3.15	1.7

Notes:

1. Emission source testing was exempted for 2014 with MOECC approval due to the unavailability of solid waste burning.
2. mg/Rm^3 = micrograms per dry cubic metre normalized to11 percent oxygen at a reference temperature of 25 degrees Celsius and a reference pressure of101.3 kilopascals.
3. pg TEQ/Rm3 = picograms per dry cubic metre in toxicity equivalent normalized to 11 percent oxygen at a reference temperature of 25 degrees Celsius and a reference pressure of 101.3 kilopascals.
4. ppm = parts per million

Stormwater is monitored under the industrial sewage works Environmental Compliance Approval for total suspended solids to ensure the quality of the effluent is consistent with design objectives. In 2013, significant improvements were completed on the “grassy swale” located east of the WWMF, which flows into the east wetland. Based on the monitoring results, the improvements to the “grassy swale” have resulted in an average total suspended solids reduction of over 80%.

The results of the monitoring programs are reported to the Ontario Ministry of Environment and Climate Change annually as per the conditions of the Environmental Compliance Approvals.

Estimated Dose to the Public from the Bruce Nuclear Site

Radiological emissions from the WWMF are a small fraction of the overall emissions from the Bruce Nuclear site. The offsite radiological impacts from the operation of the WWMF, in addition to the other facilities on the Bruce Nuclear site, are monitored under Bruce Power’s Environmental Monitoring Program. Bruce Power’s radiological environmental monitoring includes air, precipitation, water (municipal, well, lake/stream), aquatic samples (fish, sediment, sand), and terrestrial samples (animal products, vegetation, soil). Data gathered from this program, along with emissions data, are used to assess the annual radiological dose to members of the public living or working in the vicinity of the Bruce Nuclear site.

Results of monitoring and public dose assessment are published in Bruce Power's annual Environmental Monitoring Program report which is submitted to the CNSC and made available to the public. Dose to the public from operation of facilities on the Bruce nuclear site is a very small fraction of the public dose limit.

Environmental Management Program/System

OPG's Board of Directors has established an environmental policy that requires OPG to maintain an Environmental Management Program consistent with the International Organization for Standardization (ISO) 14001 *Environmental Management System Standard.* OPG's Environmental Management Program requires assessment of environmental risks associated with the facility's activities, and to ensure that these activities are conducted such that any adverse impact on the natural environment is As Low As Reasonably Achievable. This program includes OPG's approach to ensure compliance with applicable statutory and regulatory requirements.

OPG has implemented its Environmental Management System at the WWMF; it aligns with OPG Nuclear's Environmental Management Program and its Plan-Do-Check-Act business model. Through this model, objectives, targets and programs are established, executed, monitored and reviewed with the commitment to continual improvement.

OPG's Environmental Management System defines the requirements for:

- Planning the work;
- Implementing the requirements of the planning process;
- Monitoring and measurement of success of the planning, and
- Process and management review of the Environmental Management System and Environmental Performance.

The Environmental Management System provides the structure and processes to ensure implementation and follow-up on management programs needed to deliver the Environmental Policy are achieved. As part of OPG's Environmental Management System, environmental performance targets, including reportable spills, environmental compliance, and radioactive waste generation are reviewed annually to ensure that opportunities for continuous improvement are identified and implemented.

Identification of the OPG Significant Environmental Aspects which apply to WWMF allows for more focus on areas where there is the potential to have a negative (or positive) impact on the environment. The Significant Environmental Aspects that have been identified for the WWMF include the following:

- Habitat and Wildlife Biodiversity Conservation
- Carbon-14 Emissions to Air
- L&ILW Generation and Storage
- Spills
- Emissions of Tritium

Risks associated with these Significant Environmental Aspects are managed through either operational controls or specific programs. Examples include:

- Spills prevention and mitigation,
- Reduction of radioactive waste generation and volume for storage,
- Containment/minimization of emissions/releases from waste,
- Effluent, groundwater, surface water and ambient air monitoring,
- Wildlife habitat conservation, etc.

Performance measures are established to ensure the controls/programs perform as designed and are corrected/improved under the Environmental Management System framework.

For example, spill and compliance targets have been established and tracked during the licence period. Since that time, OPG has consistently met or bettered these targets. Over the past 9 years, only four spills and four environmental infractions have occurred at the WWMF. These events are summarized below. In all instances there were no impacts to the environment.

Reportable Spills

- On June 20, 2014, there was a leak in the domestic water supply resulting in a chlorinated discharge to the environment.
- On March 1, 2013, approximately 50 litres of mixed ethylene glycol and water spilled onto an asphalt surface with some residual ethylene glycol entering the ditch adjacent to the site.
- On May 7, 2010, 90 kg of powdered lime spilled onto an asphalt surface with some of the lime entering the ditch adjacent to the site due to rainfall.
- On September 16, 2009, approximately 200 litres of water with trace amounts of ethylene glycol spilled onto an asphalt surface with trace amounts of ethylene glycol entering the ditch adjacent to site.

Environmental Infractions

- On June 10, 2013, the frequency of groundwater sampling for the conventional landfill was reduced prior to receiving Ministry of Environment approval. Approval has since been granted.
- On October 29, 2008, a physical change to improve incinerator performance was completed without approval from the Ministry of Environment and Climate Change as required through the Environmental Compliance Approval process. The Environmental Compliance Approval was subsequently amended to address the change.
- On October 29, 2008, the incinerator emissions exceeded operational requirements for carbon monoxide and hydrogen chloride as per the Environmental Compliance Approval. Operational improvements were subsequently implemented to address these exceedances.
- On June 7, 2007, an Environmental Compliance audit showed that a number of waste manifests were not in compliance with Regulation 347. The Hazardous Material Control procedure was revised to include an instruction for the

shipping of Hazardous Waste and the control of Waste Manifests at the Western Waste Site. A roll out of the procedure was made to affected staff.

OPG is committed to maintaining registration of the ISO 14001 *Environmental Management System Standard*. Verification that the Environmental Management System Standard is effectively maintained is completed through annual internal audits and compliance audits.

Biodiversity Management

OPG has had a very extensive and diverse biodiversity program at the WWMF for many years. In 2012, OPG successfully re-certified the WWMF under the Wildlife Habitat Council's Corporate Wildlife Habitat certification. The WWMF was initially certified in 2007. The Wildlife Habitat Council's *Corporate Wildlife Habitat Certification and International Accreditation Program* recognizes commendable wildlife habitat management and environmental education programs at individual sites. The Wildlife Habitat Council certification adds value to programs by providing third-party credibility and an objective evaluation of projects. An ecological survey was completed in 2016 to identify further biodiversity enhancement initiatives for implementation at the WWMF in 2016 to 2018.

The major initiatives implemented to date at the WWMF under the Biodiversity Program are as follows:

- Designated grasslands onsite for migratory bird habitat by suspending mowing during nesting season. Signage was put in place to ensure designated habitat would not be disturbed during nesting season (2016);
- Constructed an in-ground snake hibernacula onsite (2016);
- A partnership with Laurentian University to study Endangered Species at the Bruce Site (2008 to 2015);
- Invasive species monitoring and control to maintain and enhance the ecological resilience of wildlife habitat (2008 to 2012);
- Landfill cap and WWMF Laydown Area Berm naturalization to promote local wildflower and grass biodiversity (2012);
- Completion of a Natural Heritage Study to identify species and features of ecological significance (2008); and,
- Donations to Conservation, Non-Government Organizations and interested parties to support habitat protection and stewardship through the corporate charity program (ongoing).

Environmental Risk Assessment

In 2016, OPG completed an Environmental Risk Assessment for the WWMF in accordance with the CSA Standard N288.6-12 *Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills* [R4]. The Environmental Risk Assessment considered previous studies, and includes a Human Health Risk Assessment, and an Ecological Risk Assignment, as described below.

Human Health Risk Assessment

The human health risk assessment evaluated the impact on human health of radiological and non-radiological contaminants in different media, as well as a physical stressor resulting from the operations at the WWMF.

For radiological emissions, individual dose to human receptors as the result of operation of all nuclear facilities at the Bruce nuclear site was less than 5 µSv/y for the period of 2009-2013. This represents approximately 0.5% of the public dose limit. Given that the emissions from the WWMF represent a small fraction of the overall emissions from the Bruce nuclear site, the dose to members of the critical group due to the operation of the WWMF is estimated to be less than 0.2 µSv/y. Therefore, the operation of the WWMF presents no radiological risk to the public.

Based on the screening level risk assessment, non-radiological emissions resulting from the operations at the WWMF are compliant with the standards protective of human health (such as Health Canada and Ministry of Environment and Climate Change standards) and therefore no human health effects are likely.

From the results of the field noise level measurements and modelling results, the noise levels generated due to the operation of the WWMF are compliant with the relevant standards. Therefore, it can be concluded that noise as a physical stressor poses no adverse effects to human health. Other than noise, no other physical stressor is considered for the Human Health Risk Assessment, which is consistent with CSA N288.6-12 *Environmental Risk Assessment for Class I Nuclear Facilities and Uranium Mines and Mills*.

Ecological Risk Assessment

The ecological risk assessment evaluated radiological and non-radiological contaminants in different media, as well as physical stressors resulting from the operations at the WWMF (Table 8).

Ecological receptors present at the WWMF included terrestrial plants and invertebrates (including insects), aquatic plants and invertebrates, fish, herpetofauna, birds, and mammals. In addition, off-site aquatic receptors residing in Lake Huron could potentially come into contact with surface water contaminants of potential concern at the site.

Table 8: Ecological Risk Assessment – Radiological and Non-radiological Contaminants

Medium	Soil	Surface Water	Sediment
Contaminants of Potential Concern	Dioxins and Furans	Dissolved Chloride (Cl)	Arsenic
	Sodium Adsorption Ratio	Aluminum	Copper
		Cobalt	Manganese
		Copper	Molybdenum
		Iron	Silver
		Phosphorus	Sodium
		Selenium	Strontium
		Sodium	Tungsten
		Strontium	Zinc
		Zinc	

The risk evaluation for ecological receptors identified the following:

- There are no adverse effects due to exposure to radiological contaminants.
- There are no effects from soil and surface water due to exposure to non-radiological contaminants for terrestrial plants and invertebrates, aquatic plants and invertebrates, fish, herpetofauna, and birds and mammals.
- Physical stressors including noise, bird strikes, and road kill pose no adverse effects to non-human biota.
- Risks to benthic invertebrates (e.g. insect larvae and mollusks) due to exposure to sediment were assessed based on the comparison of sediment chemistry to the Toxicity Reference Values and a qualitative evaluation of benthic invertebrate field data. The conclusions related to the benthic invertebrates in the WWMF are:
    (a) Copper and zinc in the South Railway Ditch (a human-made environment) exceeded the sediment Toxicity Reference Values, and there is the potential for low to moderate effects to benthic invertebrates in this ditch. However, it is difficult to distinguish whether the limited benthic invertebrate community in the drainage ditch, which consists primarily of pollution tolerant species, is strictly the product of the poor habitat quality the ditch provides or whether elevated metal concentrations are having an effect. The source of copper and zinc is not associated with WWMF operations. The ability to survive under low oxygen conditions during periods of low flow or no flow (stagnation) is probably the dominant factor governing the benthic invertebrate community in the ditch;
    (b) In the Wetland, downstream of the South Railway Ditch, sediment concentrations were below the Toxicity Reference Values and adverse impacts to the benthic invertebrate community are not anticipated in the Wetland; and,
    (c) Although silver in the West Ditch exceeds the sediment Toxicity Reference Value, only low potential for effects was identified. It should be noted that the West Ditch is not located within the WWMF, and the WWMF is not known to be a source of silver contamination to the West Ditch. Therefore, silver was not assessed further. However, the West Ditch was included to support future WWMF expansion which may direct stormwater into the West Ditch.

3.9.3 Future plans

The ISO 14001 standard embodies the expectation of continual improvement of the Environmental Management System and, as a consequence, environmental performance. To this end, there are regular reviews of environmental performance, objectives and targets to ensure that the environment is being protected.

OPG's WWMF has a program of improvement initiatives aimed at reducing the environmental and radiological risk associated with the handling, processing, and/or storage of used fuel and L&ILW. Initiatives planned to improve environmental monitoring/impact over the next five years include the following:

- Completion of the WWMF groundwater monitoring program enhancement and monitoring network assessment project; and,
- Continuation of biodiversity initiatives.

3.9.4 Challenges

There are no challenges associated with environmental protection at the WWMF at this time.

3.9.5 Requests

Consistent with OPG fleet plans and as part of continuous improvement, the WWMF will be transitioning to the following CSA Standards:

- By December 31, 2017, WWMF will meet the requirements of CSA Standard N288.3.4, *Performing Testing of Nuclear Air-Cleaning Systems at Nuclear Facilities*.
- By December 31, 2017, WWMF will conduct a gap analysis and prepare an implementation plan for meeting the requirements of CSA Standard N288.4, *Environmental Monitoring Program at Class I Nuclear Facilities and Uranium Mines and Mills*.
- By December 31, 2017, WWMF will conduct a gap analysis and prepare an implementation plan for meeting the requirements of CSA Standard N288.7, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills*.

3.10 Emergency management and fire protection

Emergency Management

Nuclear Waste Management's goals for Emergency Preparedness at WWMF are to protect the health and safety of all people (employees, public, and responders) and limit the damage to OPG and third party assets as well as the environment during emergencies and other non-routine conditions. Emergency Preparedness encompasses emergencies arising from both nuclear and conventional hazards.

Fire Protection

Nuclear Waste Management's goals for Fire Protection at WWMF are to minimize the risk of radiological releases that are a result of fire; protect facility occupants from death or injury due to fire; minimize economic loss resulting from fire damage to structures, equipment, and inventories, and minimize the impact of radioactive or hazardous material on the environment as a result of fire.

3.10.1 Relevance and management

Emergency Management

WWMF's Employee Emergency Response procedure identifies emergency response requirements at WWMF for fire, medical and radiation emergencies. In accordance with the contractual agreements between OPG and Bruce Power, Bruce Power provides Emergency Response Services to OPG for all fire, medical, rescue and spill emergencies that arise at the WWMF. Such services are available 24 hours a day.

In accordance with the Provincial Nuclear Emergency Response Plan and the Bruce Power Nuclear Emergency Response Plan, OPG staff at the WWMF would follow the emergency response instructions from Bruce Power for a Station Emergency at either Bruce Power NGS A or B.

Fire Protection

The fire protection provisions for WWMF are currently required to conform to:

- NFCC (2005), *National Fire Code of Canada*;
- NBCC (2005), *National Building Code of Canada*; and,
- OHSA, *Occupational Health and Safety Act*.

Nuclear Waste Management's facility specific Fire Protection Program has been incorporated into OPG Nuclear's Fire Protection Program to ensure a consistent approach to fire protection across all the nuclear sites. Fire protection procedures and other elements now derive their authority from the OPG Nuclear Fire Protection Program. A comprehensive Fire Protection Program ensures adequate fire protection by minimizing both the probability of occurrence and the consequences of fire at the facilities.

Nuclear Waste Management governance has been reviewed to ensure effective alignment with OPG Nuclear Fire Protection Program. The Fire protection Program ownership has been reviewed to ensure clarity in roles and responsibility. The new impairment standard W-STD-RA-0001, Fire Protection Availability, Impairment and Compensatory Measures for Nuclear Waste Management Division and new revision of Nuclear Waste Management's Impairment Manual and associated documentation have been updated to ensure alignment with the OPG Nuclear fire impairment process.

<u>Key Program Elements for WWMF</u>

The Fire Safety Plan at WWMF meets the requirements of the *National Fire Code of Canada*. This plan provides direction with respect to fire prevention, fire protection, emergency procedures, training and drills, and is reviewed on an annual basis to ensure it reflects current field conditions and practices and revised accordingly.

Annual emergency fire drills are performed at the WWMF, in accordance with the *National Fire Code of Canada*. Response from the Bruce Power Emergency and Protective Services organization is tested during this process. The interface between WWMF personnel and Bruce Power has been demonstrated as satisfactory. The drills have also been satisfactory with no major findings. Minor improvements to procedures and facilities have been recommended. These recommendations have been assessed and are being implemented as appropriate.

During the reporting period, independent third party reviews were completed biennially to confirm the WWMF fire systems have been operated, inspected, tested and maintained in accordance with the *National Fire Code of Canada* and the standards listed therein. The reports indicate that WWMF is in general compliance with the code requirements. Corrective actions included installing nameplates on equipment, ensuring records are maintained, changing frequencies of inspection, maintenance and testing activities to reflect changed frequencies in the codes and standards, and implementing additional work management tasks for hydrant and emergency lighting

unit inspection, testing and maintenance. Results of the independent third party reviews were submitted to the CNSC.

3.10.2 Past performance

Emergency Management

OPG and Bruce Power conduct three drill practices annually at the WWMF (2 fire and 1 medical) in accordance with an agreed drill schedule.

Bruce Power also provides personnel adequately trained in search and rescue, fire fighting, spill response, hazardous materials (i.e. HAZMAT) and first aid and will provide emergency equipment suitable to each emergency. Bruce Power provides OPG a letter confirming the inspections and maintenance of their emergency equipment each year.

OPG performs periodic due diligence assessment on Bruce Power's emergency response facilities, equipment, procedures and personnel to confirm the agreed services will continue to meet the requirements.

Hazardous Material spill drills are conducted annually for the WWMF. Upon completion of each drill, a report is issued which captures lessons learned, corrective actions and valuable operating experience. This is part of spill response improvement and organizational learning.

Response to Fukushima Event

OPG reviewed the initial lessons learned from the Fukushima event in Japan, and re-examined the safety case for the WWMF. In particular, OPG re-examined the underlying defence-in-depth concepts with a focus on external hazards such as seismic, flooding, fire, and extreme weather events, measures for the prevention and mitigation of severe accidents and emergency preparedness

For a complete summary of WWMF's response to the Fukushima event, refer to Section 4.8.1. No significant gaps and no compensatory actions were identified during these reviews; however, some additional technical studies were identified such as beyond design basis seismic event analysis and flood hazard assessment for the WWMF. The technical studies identified the following opportunities to improve the response to design basis events and beyond design basis events:

- For design basis events, OPG has enhanced the post-event worker response procedures.
- For beyond design basis events, internal programs and procedures were revised to improve the post event response (e.g. manual activation of the Low Level Storage Building fire suppression system). OPG also purchased additional emergency equipment such as satellite phones for the WWMF.

A mutual aid agreement that formalizes support among Canadian nuclear operators in the event of a major emergency at one of our nuclear installations was created between Bruce Power, OPG, Hydro Quebec, New Brunswick Power and Atomic Energy of Canada Limited.

Fire Protection

Fire protection and detection systems at the WWMF are designed and constructed to comply with applicable fire and building codes (e.g. *National Fire Code of Canada* and *National Building Code of Canada*). During the reporting period, these systems were required to comply with:

- Updated pressure boundary code requirements, such as CSA Standard N285.0-08, Update No. 2, *General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants*
- CSA B51 (2009) and Update No. 1, *Boiler, Pressure Vessel, and Pressure Piping Code*; and
- ASME B31.1, *Power Piping Code*, 2010 Edition.

All design modifications are reviewed for fire protection impact through the Engineering Change Control process.

A project is in progress to replace beam detectors in Low Level Storage Buildings 1 to 11 with linear heat detection to improve the overall fire protection system reliability at the Low Level Storage Buildings. This project was initiated in 2015, with linear heat detection being installed in Low Level Storage Building 11, and will continue to 2018. As part of this project, the CO2 fire suppression system for Low Level Storage Buildings 1 to 10 is being upgraded as well. This work is ongoing in 2017.

Other improvements with respect to improving fire protection or reducing risk included:

- Replacing the wooden framing surrounding the Waste Volume Reduction Building incinerator stack with a non-combustible material (2013);
- Installing appropriate audible and visual alarms in certain locations at the Waste Volume Reduction Building (2013);
- Installing a manual station (pull station) at the exit door of the High Efficiency Particulate Air filter room of the Waste Volume Reduction Building (2015);
- Redesigning the incinerator solid waste and combustion system to prevent localized heating of the air duct (2015);
- Installing a properly sized relief valve in the CO_2 fire suppression system to meet American Society of Mechanical Engineers (ASME) B31.1 code requirements (2015); and,
- Replacement of Emergency Lighting Units to a model which is more suitable for the facility environment (unheated outdoor buildings). This work has been commenced in 2016 and will be completed in 2017. The Emergency Lighting Unit replacement work includes all Low Level Storage Buildings, Steam Generator Storage Building, Retube Component Storage Building as well as the Used Fuel Dry Storage Facility Storage buildings.

In accordance with the WWMF licence, inspection, testing, and maintenance of the fire detection and protection systems is performed at the required frequency as stipulated in the *National Fire Code of Canada*. Personnel performing the inspections, tests and maintenance on fire protection systems are qualified to do so.

Internal audits of the Nuclear Fire Protection Program are conducted to evaluate effectiveness of the program. An audit conducted in 2013 identified three findings:

unclear Nuclear Waste Management Fire Protection program ownership; Nuclear Waste Management Fire Protection governance deficiencies; and WWMF fire predefines not consistently completed. The status of these findings is as follows:

- An organizational realignment to functionally move the ownership of the Fire Protection Program to one organization within OPG Nuclear has been implemented. This action resulted in OPG Nuclear's Fire Protection program becoming the governing program for the WWMF. This realignment ensures programmatic consistency, implementation of actions to address past challenges regarding managed system controls plus a unified approach across OPG Nuclear with program ownership housed within a single programmatic document.
- The Nuclear Waste Management Fire Protection program standards and procedures are being revised to address the deficiencies in Nuclear Waste Management Fire Protection governance.
- Predefine performance has improved.

As a result, the 2015 audit did not have any findings in the Nuclear Waste Management Fire Protection area. There was also a follow up assessment conducted in 2016 which indicated no findings and significant improvement was noted.

Fire Protection Response

The fire protection systems are capable of responding to emergency situations as per their design basis. The fire protection systems undergo routine maintenance and testing to ensure they meet the applicable codes and standards as well as their design requirements.

WWMF has procedures in place to address emergency situations. As an example of operator actions in response to a fire event, on July 11, 2013, the excess air duct located beneath the primary chamber of the incinerator at the WWMF experienced localized heating. Smoke was observed to be emanating from the surface. Operators properly responded as per procedures by suspending the solid and liquid waste feeds, cooling the area and initiating a response by the Bruce Power Emergency Response Team. Operator action was similarly appropriate when a similar event occurred in February 2014. Following this similar event in February 2014, a root cause investigation was completed. A design modification of the incinerator was completed and installed in 2015 to prevent recurrence of a localized heating event of the incinerator air duct.

There were no negative impacts on the health and safety of OPG personnel, members of the public, or the environment as a result of either incident.

Nuclear Waste Management Fire Impairment Manual and Standard

OPG has issued a new impairment standard and a new revision of its Nuclear Waste Management Division Fire Impairment Manual which describe how OPG manages fire protection systems' impairments in OPG's Nuclear Waste Management Facilities, including WWMF. This manual provides resource information to guide trained staff who are directly involved with planned and unplanned impairment to the fire protection system in evaluating, establishing, planning, controlling and executing outages on fire systems. The impairment standard provides clear direction of roles and responsibilities in Nuclear Waste Management. The impairment manual provides detailed compensatory measure information to ensure:

- fire protection systems are available when called upon to perform emergency functions;
- the number and duration of any impairments to fire protection systems are minimized, and,
- the risk is minimized for the duration of any fire protection system impairment.

3.10.3 Future plans

Emergency Management

The contractual agreements between OPG and Bruce Power for Bruce Power to provide Emergency Response Services will be reviewed and amended as required during the expansion of the WWMF. The emergency response for the new buildings is expected to be similar to that for existing buildings.

Fire Protection

Nuclear Waste Management anticipates new codes and standards or new editions of existing codes and standards to be referenced in the new licence. Nuclear Waste Management has performed gap analyses and formulated transition plans as necessary to ensure compliance. The codes and standards anticipated in the new licence are:

- CSA N393-13, *Fire Protection for Facilities That Process, Handle or Store Nuclear Substances;*
- NBCC (2010), *National Building Code of Canada, and*
- NFCC (2010), *National Fire Code of Canada.*

When the licensed area is extended as proposed, the new buildings within that area will comply with N393-13 and applicable fire codes and standards.

3.10.4 Challenges

Emergency Management

There are no challenges associated with emergency management at the WWMF at this time.

Fire Protection

The project to install linear heat detection to replace beam detectors in the Low Level Storage Buildings 1 – 10 (Low Level Storage Building 11 complete) will continue into the new licensing period.

Fire protection governance will be reviewed to further align the WWMF with OPG Nuclear.

3.10.5 Requests

Emergency Management

Consistent with OPG fleet plans and as part of continuous improvement, the WWMF will conduct a gap analysis and prepare an implementation plan for meeting the requirements of REGDOC-2.10.1 *Nuclear Emergency Preparedness and Response* (2016) by December 31, 2018.

Fire Protection

WWMF has completed a gap analysis and prepared an implementation plan for meeting the requirements of CSA N393-13. Execution of the implementation plan is in progress and includes completion of the following:

- Code Compliance Review;
- Emergency Response Needs Analysis;
- Fire Protection Program Audit;
- Site Condition Inspection; and
- Updated Fire Hazard Assessments.

OPG will provide the CNSC with a compliance date for transition to CSA N393-13 by September 15, 2017. Compliance to NBCC (2010) and NFCC (2010) will also be achieved with compliance to CSA N393-13.

3.11 Waste management

Waste management covers the waste generated during the operations of WWMF and L&ILW received by Pickering and Darlington NGS as well as Darlington Waste Management Facility and Pickering Waste Management Facility.

Waste management also covers decommissioning planning. The objective of decommissioning planning is to demonstrate the technical and financial feasibility of decommissioning WWMF in a manner that will ensure the health, safety and security of workers, the public and the environment. Decommissioning activities are required to conform to the requirements of the CSA Standard N294-09 *Decommissioning of Facilities Containing Nuclear Substances*. CNSC Guides G-206 *Financial Guarantees for the Decommissioning of Licensed Activities* and CNSC G-219 *Decommissioning Planning for Licensed Activities* are used as guidance.

3.11.1 Relevance and management

OPG Nuclear's Waste Management Program is aligned with, and based on OPG Nuclear's Environmental Management program. The Nuclear Waste Management Facilities work in collaboration with the OPG nuclear generating stations in order to implement strategies for waste minimization and waste management.

L&ILW generation and storage is identified as a Significant Environmental Aspect in OPG's Environmental Management System.

L&ILW is generated more significantly during nuclear power plant maintenance outages, but also arises from day-to-day operations. L&ILW produced is the volume of waste generated from nuclear operations that is shipped to the WWMF for processing and storage.

OPG's Decommissioning Program provides the requirements and processes required to safely and cost effectively decommission OPG owned nuclear facilities and provides assurance that decommissioning work will be performed in accordance with regulatory requirements.

3.11.2 Past performance

OPG Nuclear Waste Management Facilities have taken the lead in establishing an OPG Nuclear Fleetwide initiative related to waste minimization. The objective of this initiative is to implement waste strategies across the nuclear fleet, which will improve waste minimization, segregation, sorting and processing of Low Level Waste and ultimately reduce the amount generated and stored.

Employees at WWMF ensure that radioactive low level waste generated at the facility is segregated properly. Waste receptacles are located throughout the WWMF for likely clean and routine incinerable waste (Figure 35). Compactable and non-processible waste is collected in the staging area and the Transportation Package Maintenance Building only. Each waste staging area has various storage waste bins for likely clean, incinerable, and compactable waste.

OPG maintains its waste inventory using electronic records and an Integrated Waste Tracking System.

In 2013, the WWMF instituted a “Likely Clean” waste segregation initiative to improve its own performance in the area of waste minimization. Specific waste collection stations were set up at the WWMF facilities. Through enhanced radioactive contamination monitoring and procedures, low-level waste that was once considered radioactive by default, is now thoroughly monitored and released if clean. As shown in Figure 36, the volume of waste generated decreased by about 40% since this initiative was implemented. The only exception was in November 2016 where WWMF had to remediate a section of asphalt and gravel in Zone 2 and the asphalt and gravel are now being stored as radioactive waste.

In 2014, targets were developed for the OPG Nuclear stations specifically related to the non-processible waste stream, since this waste stream cannot be further volume reduced at WWMF through either incineration or compaction. This enables focus to occur on waste reduction at the source. These indicators continue to be used across the fleet to increase awareness and drive improvement.

Likely Clean Metal

Contaminated Low Level Waste - incinerable

Contaminated Low Level Waste - compactable

Figure 35: Waste Receptacles

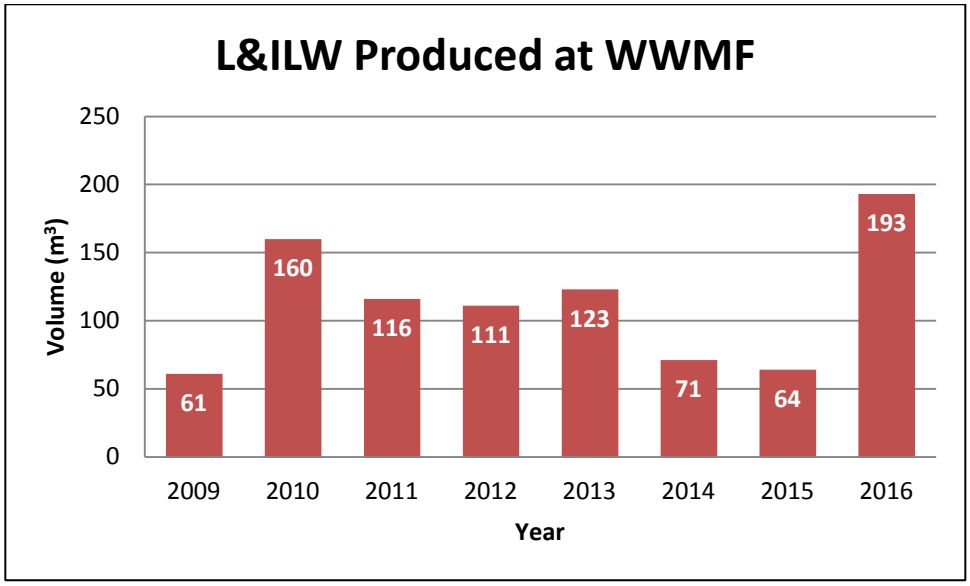


Figure 36: L&ILW Produced at WWMF

Pilot Projects

External Waste Reprocessing

In 2012 and 2013, OPG explored some external opportunities for waste reprocessing. Pilot projects were completed to confirm opportunities for volume reduction of large metal components such as heat exchangers, to verify contents of stored non-processible waste and to identify opportunities for further reprocessing. The pilots provided valuable data in terms of validating options available on the external market for large metal components. The pilots also validated that opportunities exist to reduce currently stored volumes of non-processible wastes.

The pilot project itself is now complete. OPG will continue to send some waste to a licensed external provider for processing. OPG has sent legacy baled waste and some waste oil. OPG will continue to send waste for external processing where it makes business sense.

Waste Sorting

In 2014, the WWMF began a waste sorting pilot project. Bins of stored non-processible Low Level Storage Building wastes and new non-processible waste arising are opened and physically sorted into various streams as shown in Figure 37. Incinerable and compactable materials are segregated for further processing at the WWMF. Metals are segregated and either surveyed, decontaminated and free released or if not able to be decontaminated they are stored for future processing or interim storage.

In 2015, through this initiative 719 m^3 of low level waste was sorted resulting in further volume reduction opportunities through incineration and compaction, as well as being able to free release approximately 73 m^3 of metals. This program continued into 2016.

Figure 37: Waste Sorting Pilot Project

Decommissioning

Planning for the eventual decommissioning of the WWMF is an ongoing process, taking place throughout each stage of the licensed facility lifecycle. The Preliminary Decommissioning Plan is the proposed plan for decommissioning and is prepared in accordance with CSA Standard N294-09 *Decommissioning of Facilities Containing Nuclear Substances* and using CNSC's Regulatory Guide G-219 *Decommissioning Planning for Licensed Facilities* as a guide. The Preliminary Decommissioning Plan is updated and submitted every five years or when required by the Commission.

OPG's strategy for decommissioning its nuclear waste facilities, including WWMF, is to dismantle the facilities once all the waste is removed and the facility is no longer required. Since all the wastes will be removed from the facility prior to decommissioning, little residual radioactivity is expected to be present at WWMF and as such there will be no radiation hazard driver for deferral of decommissioning. In some cases however, decommissioning activities may be deferred to align with other related activities on site.

At this time, OPG plans to place L&ILW generated during decommissioning in the L&ILW Deep Geologic Repository expected to be located in Kincardine should this be approved. Under the Nuclear Waste Management Organization's Adaptive Phased Management program established by the federal government, the long term disposal facility for used fuel is currently anticipated to be in service no earlier than 2043, at which time used fuel would start to be transferred from the interim storage location at WWMF to the Adaptive Phased Management facility.

The WWMF Preliminary Decommissioning Plan describes the activities that will be required to decommission and restore the site for other OPG uses. It demonstrates that decommissioning is feasible with existing technologies and it provides a basis for estimating the cost of decommissioning. The Preliminary Decommissioning Plan includes schedules and cost estimates based on the assumptions that form the basis for the plan. OPG will update this plan as required to incorporate lessons learned, updates to regulatory requirements, and industry best practices.

3.11.3 Future plans

Waste Management

Nuclear Waste Management has developed a strategic initiative to determine options for volume reduction of large metal components, for waste arising from refurbishment and operations of the nuclear generating stations. This could also provide input into plans for future wastes arising from decommissioning.

Through the OPG waste minimization initiative, specific objectives will continue to be brought forward and implemented. These include:

- Ongoing fleet-wide communication campaigns;
- Reviewing and improving waste sorting practices, and,
- A focused Steering Committee to oversee Darlington Refurbishment waste issues to ensure minimization is implemented appropriately through the execution of the project.
- Validation of opportunities for further processing of large metal components such as through segmentation and decontamination.

Decommissioning

OPG is updating the WWMF Preliminary Decommissioning Plan in support of the 2018 to 2022 Financial Guarantee submission. The requirements of CSA N294-09 as well as any relevant domestic and international experience obtained in the previous five years were incorporated into this revision.

OPG continuously monitors and incorporates best practices from the industry and has a high degree of confidence that the current plans are appropriate and sufficient.

New Buildings

The Waste Sorting Building will allow OPG to have a larger facility to further sort and segregate waste that has been stored at WWMF for a number of years. This will allow OPG to further reduce the volume of L&ILW stored on site by separating waste that can be diverted to a conventional disposal or free release, subject to meeting the established clearance level.

The Large Object Processing Building will allow OPG to safely process the steam generators and other large components into segments, in order to reduce the volume required to be stored, thereby increasing storage efficiency on site.

3.11.4 Challenges

At this time, OPG does not foresee any challenges with respect to this safety area during the next licensing period.

3.11.5 Requests

By October 31, 2017, WWMF will be compliant with the requirements of CSA Standards N292.0-14, *General principles for the management of radioactive waste and irradiated fuel*; 292.2-13, *Interim dry storage of irradiated fuel*; and 292.3-14, *Management of low- and-intermediate-level radioactive waste.*

3.12 Security

The nuclear security program supports OPG's need to protect nuclear materials, respond to threats, and comply with legislative requirements, while minimizing the adverse impact on legitimate staff and plant operations. The objective of the program is to establish a state of security readiness to ensure safe and secure operation of OPG nuclear facilities.

3.12.1 Relevance and management

The OPG Security Program supports OPG's need to manage residual risk to the public created by the operation of its facilities, protect assets, and respond to security events that impact operations and the public. Key elements of this program include response to threats and maintaining compliance with legislative requirements, while minimizing the adverse impact on legitimate staff and plant operations. The objective of the program is to establish a state of security readiness to ensure safe and secure operation of OPG stations and facilities. OPG's security program includes measures to protect against unauthorized disclosure of prescribed information.

WWMF is in compliance with:

- RD-321 (2010), *Criteria for Physical Protection Systems and Devices at High-Security Sites;*
- RD-363 (2008), *Nuclear Security Officer Medical, Physical and Psychological Fitness*;
- RD-361 (2010), *Criteria for Explosive Substance Detection, X-Ray Imaging and Metal Detection Devices at High-Security Sites*, and
- REGDOC 2.12.2 (2013), *Site Access Security Clearance*

The OPG physical security program for the WWMF is implemented through contracted security services provided by Bruce Power Security. Bruce Power Security implements OPG's Security Program at WWMF in accordance with OPG's policies and procedures.

OPG's cyber-security program protects the cyber-critical assets for nuclear safety, physical protection and emergency preparedness functions from cyber-attacks.

The cyber-security program includes the following elements:

- Roles and responsibilities;
- Policies and procedures;
- Staff training and awareness;
- Overall approach to cyber security;
- Configuration management;
- Incident response and recovery;
- Periodic self-assessments;
- Security controls; and,
- Identification and classification of cyber-critical assets.

3.12.2 Past performance

OPG's program ensures the security of the WWMF's assets through physical and administrative security measures utilizing equipment, personnel, and procedures. The security program at the sites has continued to evolve to meet industry best practices and all regulatory requirements.

The OPG security Program includes the following:

- Security measures for WWMF's Used Fuel Dry Storage Facility are evaluated against annual OPG threat and risk assessments to ensure credible threats are mitigated;
- Training programs are in place to enhance and sustain improved performance of both OPG and Bruce Power Security Divisions;
- A comprehensive drill program is in place as a means of validating security practices, ensuring regulatory compliance, and identifying areas for improvement in security operations. CNSC-evaluated force on force exercises, conducted at the nuclear generation sites, provide performance testing of the nuclear security program. Lessons learned through both OPG and Bruce Power security drills and exercises are applied to enhance the program at WWMF.
- OPG continues to participate in an Inter-Utility Security Working Group, which includes representation from all nuclear power operators in Canada. This group provides benchmarking opportunities to ensure that the program meets industry standards;
- OPG conducts regular meetings with CNSC staff to ensure open communication and that evolving security requirements are understood, and
- Security requirements, in accordance with the *Nuclear Security Regulations,* are in effect at OPG's High Security Sites, including Western Used Fuel Dry Storage Facility.

Details of the Security Program for Western Used Fuel Dry Storage Facility, including the measures to prevent loss or illegal use, possession or removal of nuclear substances, prescribed equipment or prescribed information, are contained in the site Security Report.

OPG has upgraded its security search equipment at the Western Used Fuel Dry Storage Facility replacing aging weapons detection, explosive detection and baggage x-ray devices with devices utilizing industry leading technology.

OPG is in compliance with REGDOC-2.12.3 *Security of Nuclear Substances – Sealed Sources* in relation to Category 1, 2 and 3 sealed sources. OPG does not have any category 1, 2 or 3 sealed sources at the WWMF. OPG does have lower activity category 4 and 5 sealed sources at WWMF. The Prudent Management Practices in REGDOC-2.12.3 will be assessed for the storage and transportation of category 4 and 5 sealed sources. Sealed sources are not included in the WWMF Operating Licence, but are separately licensed under a Nuclear Substance and Radiation Device Licence (Consolidated Uses of Nuclear Substances (B15), Licence No. 12861-2-20.3).

3.12.3 Future plans

Construction of Additional Protected Area for Used Fuel

OPG is planning on building four additional storage buildings for used fuel in the construction laydown area as shown in Figure 20. Two storage buildings for used fuel are planned for completion in 2019.

These additional buildings will be enclosed within a separate protected area that will be constructed to meet the requirements of the *Nuclear Security Regulations* and CNSC Regulatory Documents, RD-321 and RD-361.

OPG will submit a security-protected Security Report Annex to detail the measures that will be put in place for these new structures at WWMF prior to their construction.

3.12.4 Challenges

At this time, OPG does not foresee any challenges with respect to this safety area during the next licensing period.

3.12.5 Requests

OPG plans on conducting an assessment of the storage and transportation of category 4 and 5 sealed sources with respect to the Prudent Management Practices in REGDOC-2.12.3 prior to the compliance date of May 31, 2018 as required by OPG's Nuclear Substances and Radiation Devices Licence 12861-2-20.3, licence condition 16(b).

3.13 Safeguards and non-proliferation

The objective of OPG's Safeguards Program is to support OPG compliance with the governing agreement made between the Government of Canada and the IAEA. This is done in connection with the Treaty on the Non-Proliferation of Nuclear Weapons and any arrangement between Canada and the IAEA made under that agreement. It also provides additional protocols to the agreement between States and the IAEA for the application of safeguards.

3.13.1 Relevance and management

Compliance with the governing agreement made between the Government of Canada and the IAEA is done in connection with the *Treaty on the Non-proliferation of Nuclear Weapons* and any arrangement between Canada and the IAEA made under that agreement. It also provides additional protocols to the agreement between member States and the IAEA for the application of safeguards.

The OPG nuclear safeguards program includes the following elements:

- A communication protocol between the IAEA, the CNSC, and OPG;
- Obligations to meet applicable regulatory requirements and the requirements of safeguards agreements; and,
- Reporting to meet applicable regulatory requirements and the requirements of safeguards agreements.

3.13.2 Past performance

As of March 1, 2007, in accordance with the IAEA requirements, OPG has adopted the integrated safeguards protocol. Under the integrated safeguards protocol, all safeguards commitments were met at the WWMF for the current licensing period.

WWMF has met all safeguards conditions in its operating licence, and the terms of the agreement between Canada and the IAEA pursuant to the *Treaty on Non-proliferation of Nuclear Weapons*. The WWMF staff has fully co-operated with the IAEA and facilitated achievement of IAEA safeguards goals. All reports and information necessary for safeguards implementation and compliance continue to be provided on a timely basis. No compliance issues have been identified by IAEA or CNSC staff.

Since 2007, there have been six reportable events at WWMF under the Safeguards Regulations, one regarding a broken IAEA seal and five related to IAEA loss of communication with their monitoring equipment.

In 2014, an IAEA paper seal was broken when a facility operator attempted to open a storage cabinet which had been sealed by the IAEA. This OPG storage cabinet was normally used by the operators, but the IAEA Inspectors were on site for a 2 week inspection and were using the cabinet to store their equipment. The operator broke the IAEA seal when attempting to access the cabinet, but was not able to get into the cabinet as it was also locked by the IAEA. The IAEA were notified immediately and they were able to verify that their equipment remained undisturbed. OPG is no longer allowing the IAEA to use OPG cabinets. The importance of IAEA seals was reinforced with staff.

Of the five losses of IAEA communication events, 2 were the result of failures of the IAEA's modem used for remote monitoring, and 3 were the result of failures of IAEA equipment inside the IAEA cabinet. The IAEA cabinet is under IAEA lock and seal, and facility staff cannot access the cabinet.

The IAEA Fuel Verification Program includes material accounting, IAEA monthly remote monitoring report and the use of surveillance equipment such as core discharge monitors, bundle counters, cameras, portable verification equipment and containment equipment.

WWMF's compliance with the IAEA's Fuel Verification Program is met through the following, ongoing activities:

- Complying with the Safeguards Agreement and the Additional Protocol;
- Providing services and assistance for IAEA staff tasks and equipment operation;
- Disclosing any records to the IAEA upon request;
- Installing, servicing and operating Safeguards equipment;
- Not interfering in any way with Safeguards equipment, samples or seals;
- Making no changes to operations, equipment or procedures that would affect Safeguards implementation without prior written CNSC approval; and,
- Preparing and submitting nuclear inventory reports per CNSC Regulatory Document RD-336, *Accounting and Reporting of Nuclear Material.*

WWMF staff completes an annual Physical Inventory Taking as part of licence conditions pursuant to the implementation of safeguards by the IAEA. A Physical Inventory Taking is a snapshot of the fuel physical inventory at any given time. Canadian facilities are selected at random by the IAEA for a Physical Inventory Verification that follows the

Physical Inventory Taking. If a facility is not chosen for Physical Inventory Verification then CNSC Safeguards Staff performs limited confirmation activities following the annual Physical Inventory Taking process. The IAEA completed a Physical Inventory Verification at WWMF in July 2014.

These IAEA inspections are attended by CNSC staff to review the facility's support for IAEA inspectors, including: escorts and equipment; the provision of accountancy information and supporting documents; the facility compliance with safeguards licence conditions relevant to the inspection activity; and the IAEA's adherence to its rights and obligations relevant to the inspection. No significant compliance issues were identified.

WWMF performs annual self-assessments to ensure OPG adherence to the safeguards program.

As of June 2012, WWMF has been in full compliance with the CNSC Regulatory Document, RD-336, *Accounting and Reporting of Nuclear* Material. CNSC Guidance Document, GD-336, *Guidance for Accounting and Reporting of Nuclear Material* is also used. This includes updating to the *Nuclear Fuel Location and Storage History* (NuFLASH) program to support RD-336 reporting requirements.

OPG stays current with the IAEA's safeguards requirements and is committed to meeting OPG's safeguards obligations in an efficient and timely manner.

Trilateral Working Group meetings between the IAEA, CNSC Safeguards Division, and Industry have been initiated and continue to be held to discuss improvements and to address stakeholder issues.

Figure 38 shows DSCs in storage with their IAEA wire seals in place.

Figure 38: DSCs in Storage with IAEA Wire Seals

3.13.3 Future plans

OPG plans to continue to perform annual self-assessments at WWMF to ensure adherence to the safeguards program. Findings will be addressed in a timely manner.

Safeguards personnel will continue to be trained to OPG qualification requirements for safeguards. Safeguards governance will be updated, as required, to reflect any new regulatory standards or guides related to implementation of safeguards measures.

The *Design Information Questionnaire* (DIQ), which provides a detailed account of facility design information to the IAEA is updated, as required, based on changes to WWMF.

Laser Mapping Container Verification System

WWMF has finished field trials for a new IAEA technology intended to become a new seal verification system. The IAEA are now analyzing the data to determine if this system is feasible for large scale implementation. The Laser Mapping Container Verification system (Figure 39), designed by the IAEA, is a digital weld identification scanner created to verify and uniquely identify DSC in-situ, a powerful tool for acquiring and verifying the “weld fingerprint” of the DSC.

Since 2012, OPG has been working closely with the CNSC International Safeguards Division and the IAEA, and recently applied the Laser Mapping technology to the DSCs at WWMF.

If accepted for use in Canada, this scanning will replace the current metal seal system on the DSC which is costly for the IAEA and labor intensive for both IAEA and OPG during seal replacement activities.

Figure 39: Laser Mapping Container Verification System

The IAEA are informed of expansion plans to the WWMF in the Annual Additional Protocol which is electronically submitted to the CNSC who then forward it to the IAEA. During the design phase of an expansion to the WWMF, OPG will request the IAEA to identify any IAEA measures required for the expansion.

3.13.4 Challenges

WWMF does not foresee any challenges with respect to safeguards during the next licensing period.

3.13.5 Requests

There are no modifications being requested at this time with respect to Safeguards SCA.

3.14 Packaging and transport

OPG's nuclear material transportation program to or from OPG's other licensed facilities are performed in accordance with the OPG Nuclear Radioactive Material Transportation program. This program is supported by the OPG Nuclear Radioactive Materials Transportation Emergency Response Plan. OPG's Radioactive Materials Transportation program has a fleet of tractors, trailers, packagings, and Transportation of Dangerous Goods Class 7 Carriers (drivers). All OPG radioactive materials transportation packagings are compliant with the requirements of the *Packaging and Transport of Nuclear Substances Regulations.*

3.14.1 Relevance and management

The objective of the OPG Nuclear's Radioactive Materials Transportation Program is to ensure safe and efficient transportation of radioactive material. The program includes controls and procedures for the handling, packaging, shipment, carriage and receipt of radioactive material, and verification that emergency response for transportation incidents is appropriately established. Multiple checks and balances are provided, as well as a quality assurance program that is compliant with the quality assurance requirements of *Packaging and Transport of Nuclear Substances Regulations*. The program is supported by OPG Nuclear's Radioactive Materials Transportation Emergency Response Plan. Activities related to packaging and transport are performed under OPG's Nuclear Generating Station Power Reactor Operating Licences and the WWMF Operating Licence.

OPG Nuclear's Packaging and Transport Program specifies packaging and transport requirements including training, preparation for shipment, loading and unloading, and maintenance and design requirements for waste packages. While the *Packaging and Transport of Nuclear Substances Regulations* and OPG's Radioactive Material Transportation Program apply to off-site transportation, OPG's practice is to provide an equivalent level of safety to workers, the general public, and the environment for on-site transfers. On-site transfers of materials are conducted in accordance with OPG Nuclear's Radiation Protection Program. OPG maintains records of its transport activities in accordance with the *Packaging and Transport of Nuclear Substances Regulations*.

There is no off-site transportation of used fuel to or from the WWMF. Transfer of used fuel from Bruce Power NGS to WWMF is done within the Bruce Power Nuclear site using an OPG approved transfer route.

3.14.2 Past performance

OPG has been safely transporting radioactive materials for over 43 years, and has never had an accident resulting in a radioactive release or serious personal injury. There have been no dangerous occurrences, accidental releases or imminent accidental releases reportable under the *Packaging and Transport of Nuclear Substances Regulations* and

Transportation of Dangerous Goods Act during the reporting period. OPG drivers transporting radioactive materials have an excellent safety record on the roads.

OPG typically performs over 700 radioactive shipments per year. During the current licence period, there was only one minor motor vehicle collision in March 2012, involving an OPG radioactive shipment from which there was no release of radioactive material to the environment, and no serious injuries. OPG was not at fault for this motor vehicle collision. An OPG Radioactive Material Transport vehicle carrying empty waste bins (classified as a Class 7 radioactive, excepted empty shipment) was rear-ended on a 400 series highway by a private driver who was then charged. OPG drivers have travelled over 3 million kilometers over the last 9 years without any at fault incidents.

OPG's Radioactive Material Transport Program has a fleet of tractors, trailers, packagings, and Transportation of Dangerous Goods Class 7 Carriers (drivers) for the transportation of:

- L&ILW to the WWMF;
- Non-waste radioactive materials (tools, sources, tritiated heavy water); and,
- Single bundles of used fuel to Canadian Nuclear Laboratories (previously AECL Chalk River Laboratories) for examination and analysis.

All OPG radioactive materials transportation packaging is compliant with the requirements of the *Packaging and Transport of Nuclear Substances Regulations*. The designs of packaging for the most hazardous radioactive materials (Type B) are certified by the CNSC. OPG's Radioactive Material Transportation Program tracks and maintains package certificates and registered user status for all Type B packaging used by OPG.

OPG's Transportation Emergency Response Plan is activated when there is an incident involving a radioactive material shipment by road resulting in the potential or actual release of radioactive material to the environment. OPG's radioactive material transportation emergency response capability is tested on an annual basis to validate the effectiveness of the Transportation Emergency Response Plan capability to ensure safety of the public, environment and employees in the event of a transportation emergency. OPG's Radioactive Materials Transport and Emergency Response communication program has been presented to emergency responders in communities across the province where our transportation vehicles travel. In an effort to continue to build community and stakeholder understanding, OPG has conducted a number of face-to-face discussions on radioactive material transportation and emergency response with provincial and municipal first responders and municipal leaders along the transportation routes. During the current licence period, OPG has provided 50 training presentations to over 887 emergency personnel.

The on-site transfer of used fuel in DSCs from the Bruce Power NGS to the WWMF is conducted on designated transfer routes in accordance to OPG's procedures. As of Q2 2016, OPG has safely transferred 1229 loaded DSCs from the Bruce Power NGS to the WWMF for processing and storage since 2002.

Package Design and Maintenance

Packages used to transport higher risk radioactive materials require certification and registration by the CNSC. While packages designed for the transport of low risk radioactive materials do not require certification by the CNSC, these packages are still required to comply with the *Packaging and Transport of Nuclear Substances Regulations*. OPG retains documentation demonstrating all of its packages are in compliance with the regulations. OPG Nuclear's Radioactive Material Transportation Program specifies requirements for training, preparation for shipment, loading and unloading, and maintenance and design requirements for waste packages.

To meet WWMF's responsibilities under the Radioactive Material Transportation Program, each work group must maintain an adequate complement of trained Class 7 Handler/Receivers and receive sufficient oversight from their line management to ensure compliance with Radioactive Material Transportation procedures. In addition, all Type A or Type B radioactive shipments are reviewed by a Radioactive Material Transportation Officer prior to leaving site as a final check before travelling on public roadways.

3.14.3 Future plans

The Radioactive Material Transportation Program includes a strategic equipment replacement plan to ensure that radioactive material transportation packages and their trailers are replaced or supplemented as required. Aging management studies will continue to be conducted on the components most vulnerable to aging, to calibrate the equipment replacement plan on an ongoing basis.

Nuclear Waste Management is in the process of replacing its older radioactive material transportation packages based on these aging management assessments. The designs of the new packages incorporate improvements based on operating and maintenance experience, and utilize industry best-practices.

Program improvements include:

- Procurement and integration into the Radioactive Materials Transport fleet by 2018 of:
    - Two Type B(U) Multi-Purpose Transportation Packages for transporting tritiated heavy water; and,
    - Two Type B(U) Multi-Purpose Transportation Packages for Shielded Flask for transporting radioactive filters and components.

  The above packages will supplement and eventually replace, respectively:
    - Two Tritiated Deuterium Oxide Packages for transporting tritiated heavy water; and,
    - Two Radioactive Filter Transportation Packages for transporting radioactive filters and components.
- Trailers for several radioactive materials transportation packages have been replaced or refurbished as required.
- Six new Type A ISO-40 and three ISO-20 packages are planned for construction to augment the existing fleet of seven Type A ISO packages. These are expected to be in service in 2017.
- Additionally, the existing Work Management System is being adopted to better integrate and coordinate workgroups that are closely tied to the Radioactive Materials Transport activities. This improvement project will consolidate the

existing logistics and planning systems previously used to manage the Radioactive Materials Transport activities.

OPG maintains (renews and amends, as necessary) a Certificate for Transport Package Design (CDN/2054/B(U)-96) issued by the CNSC for the DSC Transportation Package. The Transportation Package design consists of a DSC plus a reusable protective packaging for impact resistance. The protective packaging is composed of a stainless steel shell filled with rigid polyurethane foam. Maintaining the certificate ensures that a valid means of off-site transportation exists to support the long-term planning for used fuel management. Since the inception of WWMF, no off-site shipments of DSCs have occurred.

3.14.4 Challenges

DNGS Refurbishment and Bruce Power Major Components Replacement will increase the amount of L&ILW shipped, processed and stored at WWMF. More drivers and Transportation Officers have been hired to accommodate the increase in waste shipments while ensuring that the program maintains safety as its primary focus.

3.14.5 Requests

There are no modifications being requested with respect to licence conditions associated with this SCA at this time.

4.0 Other Matters of Regulatory Interest

4.1 Environmental assessment

4.1.1 Studies under the Canadian Environmental Assessment Act

There have been two relevant Environmental Assessments under the Canadian Environmental Assessment Act that support this licence renewal.

A screening level environmental assessment for the construction and operation of Low Level Storage Buildings 9, 10 and 11 was conducted. A draft Environmental Assessment was submitted to the CNSC in Nov 2003. After considering the screening report, the mitigation measures, and comments filed from the public, the CNSC Designated Officer accepted that the project would not cause significant adverse effects.

A screening level environmental assessment was completed in 2006 to provide additional low and intermediate level waste storage capacity to accommodate wastes resulting from reactor refurbishment activities, and from on-going operation of the reactors. The scope of the project included construction and operation of 12 above ground storage buildings for low and intermediate level waste, 270 in-ground containers of type 18 m^3 (IC-18s), and 30 in-ground containers of type HX (IC-HXs).

The environmental assessment considered the impact to the environment which included the biophysical and social features that have the potential to be affected by the project.

The Environmental Assessment study report and four technical supporting documents for Terrestrial, Geology Hydrogeology and Seismicity, Radiation and Radioactivity, and an Ecological Risk Assessment were submitted to the CNSC in October 2005. After considering the screening report, the mitigation measures, and comments filed from the public. In March 2006, the CNSC Commission accepted that the project would not cause significant adverse effects.

The Environmental Assessment follow-up and monitoring activities associated with the Refurbishment Waste Storage Environmental Assessment included stormwater and sediment, groundwater, and soil sampling, and identification of active crayfish borrows. Similar to earlier follow-up monitoring results, these sampling results demonstrated that there were no significant adverse environment effects on hydrogeology, ground water, sediment or surface water quality.

Deep Geologic Repository Project for Low and Intermediate Level Waste

In 2005, OPG initiated the regulatory approvals process for site preparation and construction, operation, decommissioning, abandonment and long-term performance of a L&ILW Deep Geologic Repository for the long-term management of low and intermediate level wastes. The proposed site for the Deep Geologic Repository is on lands located adjacent to the WWMF.

The Deep Geologic Repository will be constructed at a nominal depth of 680 m beneath the surface in low permeability limestone overlain by a 200 metre thick cap of low permeability shale. It will accommodate operational and refurbishment low and intermediate level waste from OPG owned or OPG operated nuclear reactors.

In April 2011, OPG submitted its Environmental Impact Statement and nine technical support documents to the CNSC which were intended to comply with all the requirements of the Environmental Assessment guidelines, issued in January 2004. The

Environmental Impact Statement and supporting documents were reviewed under a Joint Review Panel.

The Joint Review Panel held 33 days of Public Hearing in 2013 and 2014 in Kincardine and Port Elgin, Ontario. In May 2015, the Joint Review Panel submitted its Environmental Assessment Report to the federal Minister of the Environment and Climate Change, recommending acceptance of the Environmental Assessment, citing that there would be no measurable effects on the environment with mitigating measures in place. In February 2016, the federal Minister of the Environment and Climate Change directed OPG to conduct additional studies. These were completed and submitted in December 2016. OPG is currently awaiting the Minister's decision.

4.1.2 Environmental Studies under the *Nuclear Safety and Control Act*

4.1.2.1 Predictive Effects Assessment (2016)

OPG conducted a Predictive Effects Assessment for the WWMF expansion project to determine the impact of the proposed new activities on human health and on non-human biota. The WWMF expansion will consist of site preparation, construction, operation and maintenance of the following facilities:

- Four Used Fuel Dry Storage Buildings,
- Four Low and/or Intermediate Level Waste Storage Buildings,
- One Waste Sorting Building
- One Large Object Processing Building, and
- Repurposing an existing Low Level Storage Building or using one of the new Low Level Storage Buildings for staging and overpacking of L&ILW.

Human Health Risk Assessment

The Human Health Risk Assessment evaluated the impact on human health of radiological and non-radiological contaminants in different media, as well as physical stressors, resulting from the WWMF expansion.

For radiological emissions, it is estimated that the highest potential dose to a member of the public from the Project is 0.25 µSv/y. Taking into account the operation of the existing facilities at the Bruce nuclear site, the dose to a member of the public remains less than 5 µSv/y. This is less than 0.5% of the regulatory limit for a member of the public of 1 mSv/y, or 1000 µSv/y. Therefore, it is concluded that there are no adverse radiological effects to the public.

For non-radiological emissions, of all the environmental media considered (including the atmospheric environment [air quality and noise], surface water, sediment, soil, and groundwater), the only non-radiological contaminant which was estimated to exceed the assessment criteria was airborne particulate at the Bruce nuclear site boundary, during the construction period only when developing the site in two different areas. However, the concentrations were estimated based on conservative assumptions and the adverse effect is immediately reversible with cessation of emission-generating activities. In addition, the frequency of occurrence is low. For example, the exceedances of Ambient Air Quality Criteria at the Bruce nuclear site boundary were predicted to occur less than 1% of the time while construction activities are taking place. Furthermore, the concentrations of these indicators at all specific human receptor locations are below the

Ambient Air Quality Criteria values. Therefore, it is concluded that there are likely no adverse effects to human health due to the elevated airborne particulate concentrations.

Consistent with Canadian Standard Association N288.6-12 *Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills*, noise is the only physical stressor considered for the purposes of the Human Health Risk Assessment. The noise levels were modelled for the nearest human noise receptors during the site preparation and construction phase, and during the operation and maintenance phase of the Project. During the site preparation and construction phases, the increases in noise levels are not considered to have an adverse effect on human health as the increase from each Project phase is less than the 5 dB above baseline noise level criterion. During the operation and maintenance phase, the modelled noise levels are well below the NPC-300 criteria. Therefore, it is concluded that there are likely no adverse effects to human health due to increased noise.

Ecological Risk Assessment

The Ecological Risk Assessment evaluated radiological and non-radiological contaminants in different media, as well as physical stressors resulting from the Project.

The effects from radiological contaminants emitted from the WWMF were determined for indicator species across all trophic levels. The total radiological doses received by the indicator species, taking into account the existing conditions and the emissions from the Project, were estimated to be in the range of 0.53 µGy/h to 3.57 µGy/h, which is well below the benchmark values given in CSA N288.6-12 *Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills*. Therefore, it was concluded that there are likely no adverse radiological effects to the ecological receptors.

Through the ecological risk characterization, it was determined there are no adverse effects to air quality, soil and groundwater. No adverse effects from predicted air emissions are anticipated since the levels are below screening levels and/or are short in duration. No adverse effects are expected from exposure to soil contaminants. For groundwater there is no direct pathway to receptors; there is potentially a reduction in recharge to the aquifers but this effect is negligible on a regional scale.

The largest changes to surface water quantity are expected in the South Railway Ditch in the event that drainage from all expansion areas is directed to the South Railway Ditch. However, no adverse effect to the biological integrity of the aquatic systems within the South Railway Ditch is expected. Changes in surface water quality as a result of increased total suspended solid loading during clearing and construction phases are expected to have no likely adverse effect to aquatic receptors. Under the scenario where all surface run-off is directed to the South Railway Ditch through a stormwater management facility, a small increase in water temperature in the drainage ditch is predicted. However, this is based on a conservative estimate prior to in-design mitigation and is not expected to constitute an adverse effect to the aquatic environment, Valued Ecosystem Components or indicators. Overall, no adverse effect to the biological integrity of the aquatic systems within the South Railway Ditch is expected.

Quantitative analysis shows that the Project is unlikely to represent a noise disturbance beyond tolerance on species currently occurring within the vicinity of the WWMF. It is concluded that there are likely no adverse effects on ecological receptors from changes in noise levels that may arise from the Project.

A qualitative assessment was performed to determine the adverse effects associated with lighting, road kill, and bird strikes resulting from the Project. No likely adverse effects were identified for these physical stressors.

The ecological risk characterization on the Valued Ecosystem Components and associated receptors concluded that there is no adverse effect on aquatic receptors from loss of habitat, and the potential adverse effects due to the loss of habitat on Eastern White Cedar, the Wetland Complex, Eastern Wood-Pewee, and Little Brown Myotis are acceptable. The adverse effects identified for Butternut trees are acceptable if the identified mitigation measures are implemented.

The Human Health Risk Assessment and Ecological Risk Assessment concluded that no adverse effects are expected provided that mitigation measures to minimize the environmental impacts of the project on human and ecological receptors are implemented. Changes to the WWMF Environmental Monitoring Program are proposed to confirm the accuracy of the Predictive Effects Assessment and the effectiveness of the mitigation measures to be implemented.

Mitigation Measures and Environmental Monitoring Program for the Project

Mitigation measures to minimize the potential environmental impacts of the Project on human and ecological receptors have been identified for the following disciplines:

- Air Quality: Implementation of dust management plan;
- Noise: Implementation of Good Industry Management Practices;
- Surface Water: Application of a standard Stormwater Management Facility design, application of appropriate erosion and sediment control measures during construction activities;
- Soil: Implementation of a soil management plan and the utilization of silt fences;
- Groundwater: Various measures in relation to minimizing risk to groundwater across the expansion areas, including appropriate location and design of buildings, maintaining the present hydraulic function of the silt till aquitard, limiting the stormwater infiltration in areas with recharge windows or thin silt till above the bedrock, and installation of low permeability barriers; and,
- Terrestrial environment: Various measures to minimize the impacts on terrestrial species and habitat, such as development of a compact WWMF expansion site, erection of exclusionary fencing, revegetation, avoiding vegetation clearing during the breeding bird season, and compensation offsets as per *O. Reg. 242/08 General Regulation – Endangered Species Act, 2007* for removal of category 2 Butternuts.

The following environmental monitoring program requirements have been identified:

- Air quality: Monitoring of Particulate Matter of 10 µm in diameter or smaller (PM_{10}) during construction;
- Soil: Soil monitoring as set out in the Soil Management Plan;
- Surface water and sediment: monitoring of TSS during Site Preparation and Construction as per Ministry of Environment and Climate Change requirements for the Stormwater Environmental Compliance Approval. Stormwater monitoring during Operations and Maintenance; and,
- Radiation and radioactivity: Monitoring of ambient dose rate along the expanded fence line during the operation and maintenance.

4.2 Aboriginal consultation

OPG is committed to engaging with Indigenous communities about its nuclear waste operations and future projects. OPG is directed by a corporate-wide Indigenous Relations policy that provides a framework for engaging with Indigenous peoples and supporting community programs and initiatives.

OPG also maintains a Public Information and Disclosure Program to comply with the *Nuclear Safety and Control Act* and associated Regulations. OPG's programs are in accordance with CNSC RD-99.3, *Public Information and Disclosure* and OPG has an Indigenous Relations program in accordance with *REGDOC-3.2.2 Aboriginal Engagement.*

Over the licensing period, OPG continued to build long-term mutually beneficial working relations with Indigenous communities proximate to our operations. OPG continues to build these relationships on a foundation of respect for the languages, customs, and political, social and cultural organizations of Indigenous peoples.

Additionally, seven site visits and tours of the WWMF have been conducted in 2016 and more are planned over the course of licence renewal process for community members and citizens to better understand and see first-hand, the current waste operations and proposed licensed activities.

4.2.1 Indigenous Relations Program

An Indigenous relations work plan is developed and executed on a yearly basis between the Indigenous Relations Division and Corporate Relations Communications, due to the shared touch points these functions have with Indigenous communities.

Over the past five years OPG has continued to work with over 11 communities and held numerous meetings (approximately 15 per year) on a yearly basis on OPG's waste operations to share information, to consult on issues and concerns, and to work collaboratively on areas of common interest. Participation agreements and memorandums of understanding have also been put in place with a number of Indigenous communities to enable the sharing of information on OPG's waste operations, the Deep Geologic Repository and undertake discussions to address concerns. This has allowed for structured and ongoing opportunities for open and constructive dialogue.

OPG meets with those Indigenous communities who have a right and/or interests in OPG's nuclear operations, including the WWMF Waste Facility Operating Licence renewal application and the longer term WWMF operating licence, in order to ensure that they are informed in a timely manner and that they can engage in these licensing processes, if desired. The meetings also cover topics such as current and future facility operations, the Deep Geologic Repository project and opportunities for procurement from Indigenous suppliers, skills training and employment.

Over the past reporting period OPG met regularly to discuss waste operations with:

- Saugeen Ojibway Nations;
- Williams Treaties First Nations representatives; primarily the Mississauga Nations of Scugog, Hiawatha, Curve Lake, Alderville;
- Métis Nation of Ontario Region 7: including the Métis Councils of Georgian Bay, Moon River and Great Lakes; and,
- Historic Saugeen Métis.

Information meetings/community sessions or briefings were also held concerning nuclear and waste operations with:

- Métis Nation of Ontario – Region 6 and Region 8;
- Mississauga of New Credit First Nation;
- Mohawks of Akwesasne First Nation;
- Mohawks of the Bay of Quinte;
- Six Nations of the Grand River
- Aamjiwnaang First Nation; and
- Communities on Manitoulin Island.

In support of Indigenous community relations and the licensing process, OPG continues to:

- Inform Indigenous communities about future site operations proposed in the licence;
- Take appropriate steps for local Indigenous engagement and consultation, and
- Address and resolve concerns as appropriate.

Based on work undertaken through Indigenous engagement, OPG believes the following communities continue to have a primary interest with respect to OPG's waste operations at the WWMF:

- Saugeen First Nation (Joint council Saugeen First Nation and the Chippewas of Nawash Unceded First Nation);
- Métis Nation of Ontario (represented by Georgian Bay Traditional Territory Consultation Committee; and,
- Historic Saugeen Métis.

Further information sharing on current operations, events of significance and the licence renewal process for WWMF, including the transportation of waste to the facility, will continue with the above communities and any others that identify an interest.

OPG has undertaken early engagement with appropriate Indigenous communities beginning in early 2015, to raise awareness about its nuclear operations and its nature and scope. Discussion of potential timing of the WWMF operating licence process, how to access the Participant Funding Program from the CNSC and determination of a community's level of desired engagement, was also included. Preliminary information on the nature and scope of the proposed activities over the licence period and how communities would like to be engaged throughout the licence period have been on-going since early 2015.

Engagement with communities during the re-licensing process will include timely communication by e-mail, phone, in-person meetings, community information sessions and presentations. To facilitate this level of contact, quarterly meetings will continue to be held with the Saugeen Ojibway Nation, the Métis Nation of Ontario Georgian Bay Traditional Territory Consultation Committee, and the Historic Saugeen Métis.

As noted previously, seven site tours of the WWMF have been conducted with twenty-nine community members of the Saugeen Ojibway Nation and tours will continue to be accommodated and encouraged.

4.2.2 Future Plans for Improvement

OPG continues to build upon its relationships with Indigenous communities regarding the WWMF.

At the annual general meeting OPG holds with MNO's Georgian Bay Traditional Territory Consultation Committee, MNO identified that it would like to participate in OPG's environmental monitoring of the WWMF site and the vicinity. This participation will assist MNO in its ongoing Valued Ecological Component (VEC) study, which complements OPG's own various environmental and risk assessment studies. OPG will accommodate this request.

Also, in the summer of 2015, OPG was independently recognized for the work completed with Aboriginal communities. The Canadian Council for Aboriginal Business awarded OPG a silver designation. Our Progressive Aboriginal Relations assessment will assist OPG to take further steps over the next three years towards improving our program further to obtain a gold certification. The Canadian Council for Aboriginal Business is a national non-profit organization that offers knowledge, resources, and programs to both mainstream and Aboriginal owned companies that foster economic opportunities for Aboriginal people and businesses across Canada.

4.3 Cost recovery

OPG has provided timely payments during the licensing period, to the CNSC on a quarterly basis based upon receipt of invoices. OPG will continue to make timely payments as required. There is no special request or inquiry about cost recovery at this time.

4.4 Financial guarantees

WWMF is included in OPG's consolidated financial guarantee for all the costs of implementing proposed decommissioning plans for all its Class I and Waste Nuclear Substance licensed facilities.

Cost Estimates

Cost estimates are prepared based on the WWMF Preliminary Decommissioning Plan to determine the liability to be incurred during decommissioning. In 2011, OPG completed a comprehensive review and update of the Ontario Nuclear Funds Agreement Reference Plan and associated lifecycle cost estimate for nuclear waste management and stations and waste facilities decommissioning as part of the five-year update cycle as required by Ontario Nuclear Funds Agreement. The updated Ontario Nuclear Funds Agreement Reference Plan was approved by Ontario Minister of Finance effective January 1, 2012. The updated and approved cost estimates form the basis of OPG's 2013-2017 CNSC Consolidated Financial Guarantee requirement submission accepted by the CNSC in December 2012.

In November 2016, OPG submitted an updated Ontario Nuclear Funds Agreement Reference Plan to the Province of Ontario for review. It was approved by the Ontario Minister of Finance in December 2016 and became effective on January 1, 2017. The updated and approved cost estimates will form the basis of OPG's 2018-2022 CNSC Consolidated Financial Guarantee submission.

Financial Guarantee

In December 2012 the CNSC accepted OPG's proposed 2013-2017 Consolidated Financial Guarantee. The sources to satisfy the consolidated financial guarantee requirement are the *Ontario Nuclear Funds Agreement* segregated funds augmented by a Provincial Guarantee. CNSC access to these funds is provided by the *CNSC Financial Security* and *Ontario Nuclear Funds Agreement Access Agreement* between the CNSC, OPG and the Provincial of Ontario, and the *Provincial Guarantee Agreement* between the CNSC and the Province of Ontario. The WWMF is included within this consolidated financial guarantee scope. The consolidated financial guarantee is normally updated on a five-year cycle using the guidance set out in CNSC regulatory documents G-219 and G-206.

Financial Guarantee Reporting

In addition to the five year update cycle, OPG provides an annual financial guarantee report to CNSC detailing the status of the guarantee including the amounts accumulated in segregated funds and the value of the Provincial Guarantee required. The report compares the amount of the liabilities and the financial resources available to discharge the obligations. The guarantee remains valid and in effect, and is sufficient. The 2016 Annual Report for the 2013-2017 CNSC Financial Guarantee was submitted to the CNSC in February 2016.

Financial Guarantee Hearing

The next financial guarantee public hearing before the CNSC Commission is expected to occur towards the end of 2017 where OPG will request that the Commission accept a revision to OPG's consolidated financial guarantee for the 2018-2022 review period.

4.5 Other regulatory approvals

At the time of writing, Table 9 provides the list of other regulations, obligations that WWMF must abide by, and permits, certificates and licences issued by authorities other than the CNSC.

Table 9: Other Legislation (Non-CNSC) That WWMF Abides By

Regulatory Agencies	Legislation	Legislative Instrument	Reporting Requirements
FEDERAL			
Environment and Climate Change Canada	Canadian Environmental Protection Act	Federal Halocarbon Regulations SOR/2003-289	Semi-annual report on halocarbon releases in excess of 10 kg but less than 100 kg.
Environment and Climate Change Canada	Canadian Environmental Protection Act	Canadian Environmental Protection Act	Annual National Pollutant Release Inventory Report
Environment and Climate Change Canada	Environmental Emergency Regulation	Canadian Environmental Protection Act	Emergency Plan for propane system associated with the incinerator
PROVINCIAL			
Ministry of Environment and Climate Change	Environmental Protection Act	Landfilling Sites, Reg. 232/98	Annual Landfill Report under Environmental Compliance Approval A272006
Ministry of Environment and Climate Change	Environmental Protection Act	Environmental Compliance Approval	Annual Written Summary report for Air and Noise under Environmental Compliance Approval 8047-8GLPAM
Ministry of Environment and Climate Change	Environmental Protection Act	Air Pollution, O. Reg. 419/05	Annual Update of the Emission Summary and Dispersion modelling for Environmental Compliance Approval 8047-8GLPAM

Regulatory Agencies	Legislation	Legislative Instrument	Reporting Requirements
Ministry of Environment and Climate Change	Environmental Protection Act	Environmental Compliance Approval	Source Testing Report associated with Environmental Compliance Approval 8047-8GLPAM
Ministry of Environment and Climate Change	Environmental Protection Act	Environmental Compliance Approval	Waste Processing and Transfer Site (Spent Solvent Treatment Facility) Annual Industrial Sewage Works Performance Report under Environmental Compliance Approval 5167-4TYKED
Ministry of Environment and Climate Change	Environmental Protection Act	Environmental Compliance Approval	Annual Storm water Report under Industrial Sewage Works Environmental Compliance Approval 5381-8ZCP75
MUNICIPAL			
Saugeen Valley Conservation Authorization	Not Applicable	Not Applicable	SVCA Permit No. 13-015 expired in Apr 2014, as all construction was undertaken prior to expiry.
OTHER			
Technical Standards and Safety Authority	Ontario Technical Standards and Safety Act	Boilers and Pressure Vessels Regulation	Certificate of Authorization (expires April 15, 2017).
Technical Standards and Safety Authority	Ontario Technical Standards and Safety Act	Private Fuel Outlet	Registration # 76600774
Technical Standards and Safety Authority	Ontario Technical Standards and Safety Act	Elevating Devices Regulation (O. Reg. 209/01)	Licence Number EDLIC-2002-078905 (expires August 27, 2017)

4.6 Licensee's public information program

WWMF is required to have in place a public information and disclosure program in accordance with CNSC RD-99.3, *Public Information and Disclosure* and to comply with the *Nuclear Safety and Control Act* and associated Regulations.

4.6.1 Community Consultation Program

OPG ensures timely, open and transparent communication to maintain positive and supportive relationships and confidence of key stakeholders. OPG develops, maintains and implements an annual public information and disclosure program that takes into consideration:

- The type of facility and activities being regulated;
- The risks to public health, safety, security, and the environment posed by the facility or activity; and,
- The level of public interest or concern.

Annual engagement activities are directed towards community stakeholders, including government, media, business leaders, educational institutions, interest groups, and community organizations. OPG ensures transparent disclosure of our operations and potential impacts, both positive and negative.

4.6.2 Current Operations

During the reporting period, OPG regularly and proactively provided information to the public on its facility activities. For operational status changes or unscheduled operations that may cause public concern or media interest, OPG follows a protocol to notify key community stakeholders in a timely manner. To support this protocol, OPG maintains a duty on-call position 24 hours a day, seven days a week, to manage this requirement.

Increased efforts over the past four years have resulted in expanded outreach with key stakeholders, government officials and the broader public. This is in response to growing interest by the public and community in OPG's waste operations and OPG's proposed Deep Geologic Repository.

On a quarterly basis since 2011, OPG publicly posts performance reports on nuclear waste operations at www.opg.com and shares this document electronically with key stakeholders. Additionally, starting in 2014 OPG developed and began issuing a quarterly Environment report in an easy to read and understandable format. Annually, OPG posts the Environmental Monitoring Program report on www.opg.com for both Pickering and Darlington. Aspects of our nuclear waste operations at WWMF are included in Bruce Power's Environmental Monitoring Program report which is posted on Bruce Power's website.

In 2015, OPG initiated the quarterly posting of Waste Facilities Reportable Events, aligned with OPG's nuclear station disclosure activities.

Disclosure Protocol

In 2013, OPG implemented a managed system to carry out the requirements of CNSC RD-99.3, *Public Information and Disclosure.* This included the development and issuance of OPG Nuclear's Nuclear Public Information and Disclosure Standard and the development and public posting of an OPG *Nuclear Information Disclosure and Transparency Protocol*. While the guidance is directed at Class IA facilities, all of OPG's nuclear waste operations at the nuclear stations and operations at the WWMF adhere to

OPG Nuclear's Nuclear Public Information and Disclosure Standard and the *Nuclear Information Disclosure and Transparency Protocol*.

Community Outreach and Programming

Through community outreach, OPG has established strong working relations within the community. Regular briefings are provided to elected officials and council, key community organizations, interested groups and the general public on waste operations and the Deep Geologic Repository. OPG continues to respond to and support requests for information or briefings. In the past three years briefings and information sharing efforts have substantially increased as a result of interest in the Deep Geologic Repository project. OPG has worked to respond to all of these requests and proactively reached out to communities to share information in both Canada and the United States.

Two-way dialogue with the public was facilitated through personal contact, community newsletters, speaking engagements, educational outreach, robust websites, with email response options, and many other products and programs.

To increase the understanding of nuclear waste operations, tours are provided to key stakeholder groups, media and interested groups. At the WWMF, a total of 216 tours were conducted from 2007 to the end of 2016.

OPG received, documented, and responded to concerns, complaints and inquiries raised by the public. A managed process is in place to track actions through to closure.

During the current licence period, communications in support of waste operations and the Deep Geologic Repository generated the following:

- 24 newsletters to a combined audience of 260,000 households; and
- Over 17,000 visitors in 2015 to OPG's waste and Deep Geologic Repository websites.
- A stakeholder Deep Geologic Repository project information session
- Spring and Fall updates on the Deep Geologic Repository and WWMF 2017 licence renewals to six Bruce County Councils.

OPG relies heavily on websites to provide up-to-date information that is easily accessible by the public and offers opportunities for further contact. In this period, a number of newsletters, reports, media releases, updated stories and links to other agencies and regulatory proceedings were kept current on a number of nuclear-related websites.

Social media continues to increase in popularity and use. OPG actively monitors and responds to activity through Tweets, Facebook, and other social media platforms. OPG maintains a Facebook account, a Twitter account with over 7000 followers, and Tweets on relevant nuclear activities and information.

Through OPG's Corporate Citizenship Program and the Deep Geologic Repository Community Partnership Program, financial support is provided for community-based programs with a focus on education, environment and community-building events. Each year, support is provided for a number of charitable and non-profit initiatives in our host communities. Employee leadership on local committees and volunteerism helped strengthen the social infrastructure of our host communities.

The WWMF hosted a variety of environmental education and recreational programs geared to students to demonstrate that OPG shares the values of family, safety and environmental stewardship. The WWMF site supports Science Career Paths sessions, tree planting in three Watersheds, The Bluewater Regional Science & Technology Fair,

Water Works, McGregor Provincial Park Nature Program, Peregrine Foundation School Program, Grey Bruce Children's' Water Festival, Bruce Museum Eco Explorers and the Girls Science Club reaching over 6,000 students.

4.6.3 Future Plans for Improvement

OPG plans to:

- Continue to develop and implement a public information program;
- Continue to maintain strong community relationships;
- Track and execute Community (non-regulatory) commitments as described in the Deep Geologic Repository project commitment report;
- Establish a Community Advisory Council in Bruce County once a Deep Geologic Repository construction licence is issued;
- Continue with website improvements and migration of all relevant Deep Geologic Repository information to OPG websites; and,
- Continue to expand public environmental reporting and engagement including environmental follow up programs.

4.7 Nuclear liability insurance

OPG continues to maintain Nuclear Liability Insurance for WWMF consistent with the requirements of the new *Nuclear Liability and Compensation Act* which took effect on January 1, 2017. Insurance inspections are conducted at WWMF at the request of the nuclear property or conventional insurers.

4.8 Additional/Other matters

4.8.1 OPG'S RESPONSE TO THE FUKUSHIMA INCIDENT IN 2011

In response to the Fukushima Daiichi nuclear power plant incident, the CNSC established the Fukushima Task Force to evaluate operational, technical and regulatory implications for Canadian nuclear power plants and requested actions to be completed by major nuclear facilities in Canada.

CNSC requested that OPG review initial lessons learned from the earthquake in Japan and re-examine the safety cases in particular the underlying defence-in-depth concept, with the focus on external hazards such as seismic, flooding, fire and extreme weather events; measures for prevention and mitigation of severe accidents; and emergency preparedness. The CNSC also requested that OPG re-examine the assessments from a consequential event sequences perspective and report on implementation plans for short-term, medium-term and long-term measures to address any potential gaps.

Due to the broad scope of the reviews performed by OPG, Nuclear Waste Management nominated an executive team lead and a supporting work force to manage the extensive work load and tight time lines.

In the review of the safety cases, OPG took on a number of actions with the objective of improving defences and mitigating the consequences for both design basis and beyond design basis events, should they occur at its waste management facilities.

A. Safety Cases for Design Basis Events

OPG performed a systematic review of the impact of the events described above on the following systems:

- Fire detection, protection and water supply;
- L&ILW storage structures;
- Dry fuel storage systems and structures;
- Communication and Public Address systems;
- Fixed radiological monitors;
- Transportation packages; and,
- Site drainage and storm water.

The potential consequential failure modes of the above systems, structures, and equipment following the external initiating event were determined and the potential impact to the workers, the public, and the environment from these extreme events was assessed, as well as the need for any preventing or mitigating measures.

OPG did not find any significant gaps during the review of the safety cases for OPG's WWMF. However, some possible improvements and enhancements were identified during this assessment (Table 10). Following the schedule proposed by the CNSC Management Response guidance for implementing recommendations, OPG has completed the implementation.

B. Safety Cases for Beyond Design Basis Events

For beyond design basis events, the actions fell into two broad categories as discussed below:

a. Emergency Response Capability

This category of actions includes the revision of internal programs and procedures to improve the post-event response, a review of the need for additional contracts for external emergency services, and the purchase of additional emergency equipment. The following were reviewed:

- The fire safety plans for the WWMF;
- The Employee Emergency Response and Fire Protection procedures;
- The Legal Agreement between Bruce Power and the WWMF for emergency preparedness;
- The Emergency Propane Plan at the WWMF;
- Fire detection and protection systems and equipment;
- The Transportation Emergency Response Plan, and,
- Training qualifications associated with emergency preparedness.

No significant gaps were identified during the emergency preparedness review. However, some possible enhancements were identified (Table 10). Again, OPG has completed the implementation by following the schedule proposed by the CNSC Management Response guidance for implementing recommendations.

b. Technical Studies

The undertakings in this category which required further evaluation include the assessment of various waste management systems and structures under post-event conditions.

A flood hazard assessment completed for the WWMF site concluded that:

- A 1-hour probable maximum precipitation event could result in flood levels generally between 0.15 and 0.5 metres, but up to 2 metres in localized areas; and,
- A flooding potential from the lake is insignificant compared to the probable maximum precipitation flood levels.

A public dose assessment as a result of the probable maximum precipitation flood indicated that potential doses to the public would be significantly below the regulatory dose limit.

Flood water modelling was performed to evaluate whether the waste storage structures at WWMF would be “fit for service” following a beyond design basis probable maximum precipitation flood event at WWMF. It was found that all storage structures and buildings would retain their structural integrity during and after a beyond design basis flood event, and would therefore be fit for service.

Flood hazard mitigation for the carbon dioxide fire suppression rooms supporting the Low Level Storage Buildings was analyzed, and concluded that radiological dose to the public as a result of using water to fight a Low Level Storage Building fire is below regulatory dose limits. Furthermore, fighting fire with water would not pose an unreasonable risk to the environment.

A seismic assessment of the DSC Processing Building was completed to determine the impact of the building collapsing while an unclamped and non-welded DSC is located inside a weld bay. The analysis assumed the DSC Processing Building collapses and the heaviest roof truss falls on an unclamped and non-welded DSC. It was determined that the lid would be displaced, but not fully removed and the used fuel in the DSC would not be exposed. The assessment concluded that the DSC is sufficiently robust to withstand design basis, and beyond design basis events without a loss of shielding and/or containment integrity.

In the event of an emergency, the OPG emergency preparedness and response procedure includes radiological surveys after the event to confirm that the shielding integrity of the DSCs has not been compromised.

A dose rate assessment was conducted in order to determine the magnitude of the potential public dose at the site boundaries, if all the waste storage buildings at the WWMF were to collapse as a result of a beyond design basis seismic event. Conservatively, rubble was not credited with providing any radiation shielding.

The dose over the course of a year to a member of the public located at the site boundaries of the WWMF was found to be well below the CNSC annual dose limit of 1 mSv for a member of the public. This value is also used by OPG as the acceptance criterion for abnormal operating events at the WWMF.

Table 10: Possible Improvements and Enhancements with OPG's Actions Taken

Item	Possible Improvements and Enhancements	Actions Taken
1	Purchase satellite phones and associated contracts for all facilities, to ensure Nuclear Waste Management has a means of communication if regular phone lines are down, and cell phones cannot be charged due to loss of power. This could be required as a result of a severe weather emergency that results in Nuclear Waste Management employees being stranded at work for up to seven days.	Three satellite phones were purchased and these phones can be charged by a computer, an electrical outlet, or a car, which provides flexibility in keeping the phones charged in the event that some of these power sources are impacted by a severe weather event. Also, a contract has been established for access to the satellite and usage. The satellite phone number for the WWMF was provided to the CNSC.
2	Update the OPG document "Environmental Emergency Plan – Propane" to identify the evacuation area of employees in the event of a potential propane tank explosion caused by severe weather event.	A copy of "Environmental Emergency Plan – Propane" was provided to the CNSC. OPG provided the CNSC with information to clarify the roles and expectations of the Propane Emergency Response and the evacuation plan to expediently evacuate all personnel and members of the general public within a 1600 m radius.
3	The Nuclear Waste Management operating procedure for the Low Level Storage Building did not instruct OPG operations staff to manually activate the Low Level Storage Building fire suppression system.	The Nuclear Waste Management operating procedure for Low Level Storage Buildings was updated to include instructions for the manual activation of the Low Level Storage Building fire suppression system. In addition, a procedure for a fire watch following a post-event fire system impairment was created.
4	Assess the carbon dioxide fire suppression system's availability in the event of a loss of Class IV electrical power.	A manual transfer switch that would allow back-up power to be provided to the carbon dioxide fire suppression system supporting Low Level Storage Buildings 11 to 14 was installed. The same change was previously installed for the fire suppression system supporting Low Level Storage Buildings 1 to 10.

Item	Possible Improvements and Enhancements	Actions Taken
5	Investigate if a procedure to lower a suspended DSC in the event of a crane failure, as a result of a beyond design basis event is required.	An OPG review of the postulated suspended DSC event determined that no procedure was required, as the DSC lift height would be lower than the maximum height for a drop within the existing safety envelope, as analysed in the Safety Report.
6	Develop a procedure for the safe shutdown of the nuclear waste management facilities in the event of a beyond design basis event.	A "Nuclear Waste Management Emergency Preparedness and Response" procedure was developed and issued. It includes actions to be taken by staff during and after a beyond design basis event. The procedure includes facility specific checklists for all sites, which comprises the list of components that need to be checked, to ensure the facility is in a safe state.
7	It was identified that the WWMF did not have defined radiation emergency response support in the Bruce Site Services Agreement.	A mutual Aid Agreement for nuclear emergency support was developed, agreed to by Bruce Power, Ontario Power Generation, Hydro Quebec, New Brunswick Power, and Atomic Energy of Canada Limited, and was placed into effect November 30, 2012. In addition, Bruce Power updated their seismic event procedure to include notifications to the WWMF.
8	Review the adequacy of the OPG Transportation Emergency Response Plan to ensure that no significant gaps exist for a response in the event of a significant event at the nuclear stations, coincident with a Radioactive Materials Transportation event. The Transportation Emergency Response Plan response may be slow, or assigned lower priority compared to station responses.	The Radioactive Materials Transportation Emergency Response Plan has been included in OPG's prioritization guide for OPG Nuclear station coincident events.

Item	Possible Improvements and Enhancements	Actions Taken
9	There is no designated portable standby generator dedicated to fixed radiation monitoring at the WWMF Waste Volume Reduction Building, in the event of a seven day power outage.	WWMF maintains several small diesel generators. An assessment performed by the OPG Nuclear Waste Engineering Department concluded it is acceptable to power a radiation monitor using a small diesel generator.
10	Assess whether undertaking additional measures to provide food, water etc. is required in the event of a severe weather emergency.	Results of the assessment concluded that additional food, water, and other provisions would be required for this event. OPG procured the required additional items.
11	Investigate the adequacy of the existing Mutual Aid Agreements, and whether additional mutual aid contracts would be required in the event of a severe weather emergency.	Results of the assessment concluded that no additional mutual aid agreements would be needed.
12	Assess whether additional fire response capability would be required in the event of a severe weather emergency at the WWMF.	Results of the assessment concluded that no additional fire response capability would be needed.
13	Investigate whether an alternate fire water supply is required in the event of a severe weather emergency at the WWMF.	Results of the assessment concluded that no additional fire water supply would be needed.

4.8.2 Long-Term Waste Management

As shown in Figure 4, the long term management or permanent disposal of L&ILW and used fuel is outside the scope of the WWMF licence renewal application. It is included here to demonstrate OPG's commitment to managing its waste from cradle to grave.

OPG's L&ILW Deep Geologic Repository

OPG's commitment to safely managing its nuclear waste includes the long-term disposal of L&ILW. An environmental assessment for a project to prepare, construct and operate the L&ILW Deep Geologic Repository on the Bruce Nuclear Site within the municipality of Kincardine, Ontario, was conducted. The L&ILW Deep Geologic Repository would be designed to manage the L&ILW produced from the continued operation of OPG-owned nuclear generations at Bruce, Pickering and Darlington.

If approved, OPG assumes that the L&ILW Deep Geologic Repository which is currently undergoing an environmental assessment and licensing, will be constructed and become operational near the end of the requested licensing period.

Adaptive Phase Management for Used Fuel Deep Geological Repository

In November 2002, the Canadian Parliament passed the *Nuclear Fuel Waste Act* which provides the legal framework for the Government of Canada to make a decision on the long-term management of Canada's used nuclear fuel. The *Nuclear Fuel Waste Act* required the majority owners of nuclear fuel waste to form a Nuclear Waste Management Organization to study approaches for managing Canada's used nuclear fuel. Nuclear Waste Management Organization is therefore responsible for the long-term management of Canada's used nuclear fuel waste that currently exists and that which will be produced in the future. The Nuclear Waste Management Organization is now implementing the Adaptive Phase Management which involves the siting and development of a deep geological repository for used nuclear fuel. OPG assumes that the Adaptive Phase Management process will not result in a need to change operations at the WWMF in the requested licensing period.

4.8.3 Open Action Items Discussed in CNSC Hearings and Meetings

There are no open action items remaining from the 2007 CNSC Hearing on WWMF Licence renewal, the waste management facility consolidated interim status update meetings held in 2010 and 2015, and the meeting in which CNSC staff present the *Regulatory Oversight Report for Waste Management, Storage and Processing in Canada: 2015* held in 2016.

5.0 Conclusions

Through this CMD and the Application for the Renewal of the WWMF Operating Licence, OPG has demonstrated that it is qualified to operate the WWMF and has made adequate provisions for the protection of the environment, the health and safety of persons, and the maintenance of national security and measures required to implement international obligations to which Canada has agreed.

Nuclear Waste Management's management system has fostered a strong and healthy safety culture at WWMF. WWMF has a history of strong safety performance coupled with reliable operation. The transportation of radioactive materials has an exceptional safety record and has not resulted in a serious injury and/or radioactive release in the 40-year history of OPG/Ontario Hydro. Over its operating lifetime, WWMF has met all of its environmental targets, and radiation exposures to workers and the public have been far below Regulatory Limits and OPG Control Levels. WWMF also continues to focus on waste minimization and seek opportunities to further reprocess waste in order to reduce waste volumes and minimize the environmental footprint. WWMF has met its obligations arising from the Canada/IAEA Nuclear Safeguards Agreement.

OPG continues to enhance the safety, reliability and performance of WWMF through design modifications and other facility improvements. During the previous licensing period, facility modifications included enhancements to the Fire Detection system, various upgrades to the DSC transporters and the introduction of Phase Array Ultrasonics for inspecting DSC lid-to-base welds which reduces the radiation safety hazard during processing.OPG reviewed the initial lessons learned from the earthquake in Japan, and re-examined the WWMF safety case with a focus on external events, severe accidents and emergency preparedness. The review identified no significant gaps and no compensatory actions as being required. Notwithstanding, OPG is proactively identifying opportunities for improvement and has already prepared an emergency preparedness procedure for WWMF to improve post-event worker response. OPG can also reconfirm that the stations are safe and pose a very small risk to the health and safety of the public and environment.

In conclusion, OPG is committed to its continued operation of WWMF safely and reliably, and requests the renewal of the WWMF Operating Licence for a period of ten years.

References

[R1] OPG Letter, K.E. Nash to G. Riverin, “Environmental Study Report - Western Waste Management Facility Refurbishment Waste Storage Project” (Report #01098-REP-07701-00002 R01)”, October 21, 2005, CD# W-CORR-00531-00210.

[R2] OPG Letter, K.E. Nash to Ben Belfadhel, “Draft Environmental Assessment Study Report for OPG’s Proposed Additional Low Level Storage Buildings at the Western Waste Management Facility”, November 28, 2008, CD# 01098-CORR-00531-00253.

[R3] OPG Letter, K.E. Nash to K. Klassen, “Bruce Radioactive Waste Operating Site 2 (RWOS 2) – Submission of Environmental Assessment for Additional Storage of Low and Intermediate Level Wastes”, September 14, 2000, CD# 0125-CORR-00531-00081.

[R4] OPG Letter, L. Swami to S. Oue, “Environmental Risk Assessment for the Western Waste Management Facility (WWMF),” April 18, 2016, CD# W-CORR-00531-01121.

List of Acronyms

ALARA	As Low As Reasonably Achievable
CANDU	CANada Deuterium Uranium
CNSC	Canadian Nuclear Safety Commission
DSC	Dry Storage Container
HX	Heat Exchanger
IAEA	International Atomic Energy Agency
IC	In-Ground Storage Container
ISO	International Organization for Standardization
L&ILW	Low and Intermediate Level Radioactive Waste
NBCC	National Building Code of Canada
NFCC	National Fire Code of Canada
NGS	Nuclear Generating Station
OPG	Ontario Power Generation
WWMF	Western Waste Management Facility

Addendum A: Supporting Details

Business Plan

Current forecasted in service dates for buildings and structures requested in this licence

Next Licence Renewal (2017 – 2027)	
Approved in Previous Licence, not yet built and carried into next licence (approved in WFOL-WF-314.03/2017)	**New Projects to be included in the 2017 – 2027 Licence Period**
	4 storage buildings for used fuel • Used Fuel Dry Storage Building 5 (2019) • Used Fuel Dry Storage Building 6 (2019) • Used Fuel Dry Storage Building 7 (2027) • Used Fuel Dry Storage Building 8 (2031)
5 storage buildings for low & intermediate level waste Low Level Storage Building 15 (2019) Low Level Storage Building 16 (2019) Retube Component Storage Building 2 (2020) Low Level Storage Building 17 (2023) Steam Generator Storage Building 2 (2023)	2 storage Buildings for low & intermediate level waste • Low Level Storage Building 18 (2025) • Retube Component Storage Building 3 (2025) 4 storage Buildings for low & intermediate level waste • Low Level Storage Building 19 (2028) • Steam Generator Storage Building 3 (2028) • Retube Component Storage Building 4 (2028) • Low Level Storage Building 20 (2031)
Batch 6 (54 IC-18)	• Batches 7 - 10 (216 IC-18)
20 IC-HX (TBD)	• 10 IC-HX
	• Large Object Processing Building (2024) • Sorting Facility (2020)