

February 10, 2017

CD#: 92896-CORR-00531-01063

**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 – Pickering Waste Management Facility Licence Renewal Application – April 2017**

References: 1. OPG Letter, L. Swami to M. Leblanc, "Application for Renewal of Pickering Waste Management Facility Operating Licence," October 28, 2016, CD# 92896-CORR-00531-01031.

The purpose of this letter is to notify the CNSC of OPG's intent to participate at the April 2017 Public Hearing for the PWMF Waste Operating Facility Operating Licence, pursuant to Rule 18 of the Canadian Nuclear Safety Commission Rules of Procedure.

OPG has requested a renewed term to August 31, 2028 for the Pickering Waste Management Facility operating licence that includes the construction and operation a new DSC Processing Building and additional DSC Storage Buildings (Reference 1). In support of the Hearing, OPG has attached a written submission regarding the Licence Renewal of the Pickering 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  
Vice President  
Nuclear Waste Management  
Ontario Power Generation Inc.

Mr. M. Leblanc

February 10, 2017  
92896-CORR-00531-01063

Attach.

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

Mr. M. Leblanc

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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 – Pickering Waste Management Facility Licence Renewal Application – April 2017,"  
CD # 92896-CORR-00531-01063

**ATTACHMENT 1**

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

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Original

**CNSC Commission Member Document (CMD)**

**CMD: 17-H5.1**

**Date Submitted: 10 February 2017**

Reference CMDs: N/A

## **Ontario Power Generation**

One-Day Public Hearing

Scheduled for:

11<sup>th</sup> or 12<sup>th</sup> April 2017

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**Request for a Licensing Decision:**

Regarding:

The application of Pickering Waste Management Facility Waste Facility Operating Licence Renewal

Submitted by:

Ontario Power Generation

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## Executive Summary

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Ontario Power Generation Inc. (OPG) is requesting approval from the Canadian Nuclear Safety Commission (CNSC) to renew the Pickering Waste Management Facility (PWMF) Waste Facility Operating Licence until August 31, 2028. The current ten year operating licence, WFOL-W4-350.02/2018, for the PWMF expires on March 31, 2018.

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

- Dry Storage Container (DSC) Storage Building #4 (carried over from current licence);
- DSC Storage Buildings #5 and #6 (new), and
- a new DSC Processing Building (new).

These new buildings would not alter the basic purpose and activities associated with the PWMF. The additional DSC Storage Buildings will allow OPG to store all of the used fuel generated by Pickering Nuclear Generating Station (NGS) to the end of its commercial operational life. The new DSC Processing Building would increase processing capabilities from 50 DSCs to approximately 100 DSCs per year. OPG is requesting that the licensed area be expanded to accommodate Storage Buildings #4, #5, #6 and the new DSC Processing Building which will be within the current environmentally assessed area.

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

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.

PWMF demonstrated its commitment to safety by operating for the past 22 years without a lost time accident.

This submission presents information on the performance of PWMF in the CNSC's 14 Safety and Control Areas to meet the requirements for renewal of the PWMF 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 PWMF, 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, PWMF has operated safely and reliably to protect the public, 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 the PWMF.



## 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 its 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 Pickering Waste Management Facility (PWMF) operating licence. The current operating licence for the PNGS expires on August 31, 2018. OPG is requesting a renewal of the operating licence with an expiry date of August 31, 2028. The renewal would allow OPG to continue with the safe interim storage of used fuel and intermediate-level radioactive waste.

This submission is in support of the licence renewal application for the PWMF, located on the Pickering Nuclear site within the Regional Municipality of Durham, in the City of Pickering in southern Ontario, and demonstrates that:

- (1) OPG is qualified to operate the PWMF, 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 PWMF 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 I Nuclear Facilities Regulations* to provide for the safe handling, management, and the interim storage of radioactive wastes, including intermediate level radioactive waste and used fuel produced by Pickering NGS. The PWMF has been developed to accommodate used fuel produced by Pickering NGS reactor operation, and the intermediate level waste from the past re-tubing of Pickering NGS units 1 to 4.

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

- Dry Storage Container (DSC) Storage Building #4 (carried over from current licence);
- DSC Storage Buildings #5 and #6 (new), and
- a new DSC Processing Building (new).

OPG is requesting that the licensed area be expanded to accommodate Storage Buildings #4, #5, #6 and the new DSC Processing Building which will be within the current environmentally assessed area. These new buildings would not alter the basic purpose and activities associated with the PWMF, and are described in more detail in the following sections of this submission. Project specific design requirements will be submitted to the CNSC in accordance with the PWMF 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.

This document is presented in support of the public hearing scheduled in April 2017 for the renewal of the PWMF Operating Licence (WFOL-W4-350.02/2018). It provides the Canadian Nuclear Safety Commission (CNSC) members, and members of the public with a summary of information on the performance of PWMF in areas related to the 14 Safety and Control Areas as defined in the CNSC "*Guide for Applicants and Intervenor 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. The very small quantity of low level waste that is generated at PWMF is sent to Pickering NGS to be transported to the Western Waste Management Facility for processing and storage. These items comprise about 95% of the total non-fuel waste volume.
- **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 system 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 nuclear station. There is no intermediate level waste generated at PWMF.

PWMF does provide interim storage for retube components received from the Pickering NGS Units 1-4 refurbishment operations from 1984 to 1992. The irradiated reactor components are stored in Dry Storage Modules at the PWMF Phase I site.

- **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, and then transferred into DSCs. Currently, there are three DSC Storage Buildings at PWMF, with plans to construct three additional DSC Storage Buildings.

### 1.1.2 Existing Pickering Waste Management Facility

The PWMF (Used Fuel Dry Storage Facility) became operational in 1996 in an area on the Pickering Nuclear site within the Regional Municipality of Durham, Ontario. The PWMF is dedicated to the processing and interim storage of used fuel discharged from the Pickering NGS units. In addition, PWMF provides safe interim storage for components received from the Pickering NGS Units 1-4 retubing operations from 1984 to 1992.

The PWMF is composed of two sites, as shown in Figures 1, 2 and 3. The PWMF Phase I site is located within the Pickering NGS protected area, southeast of Pickering NGS Unit 8, adjacent to the east side of the station security fence. The PWMF Phase II site is located approximately 500 m northeast of PWMF Phase I site, east of the Pickering NGS powerhouse, within its own security-protected area on the Pickering Nuclear site.

The Retube Components Storage area, which is now part of the Phase I site, has been operational since 1984.

The PWMF Phase I site consists of a DSC Processing Building, DSC Storage Buildings #1 and #2, and the Retube Components Storage area. This phase was constructed in two stages as follows:

- Stage 1 became operational in 1996, and contains the DSC Processing Building and DSC Storage Building #1. DSC Storage Building #1 has a nominal design capacity of up to 185 DSCs.
- Stage 2 became operational in 2001, and consists of DSC Storage Building #2, which has a nominal design capacity of up to 469 DSCs.

PWMF Phase II site consists of DSC Storage Building #3 with a nominal design capacity of 500 DSCs, which was placed into service in 2009.

The DSC Transporter is used to transfer clamped DSCs between the Pickering NGS irradiated fuel bays and the PWMF DSC Processing Building. The Transporter also transfers seal-welded DSCs between the Phase I and Phase II sites, and for placement and retrieval of the seal-welded DSCs inside the DSC Storage Buildings.

Table 1 provides a summary of the developments at PWMF.

**Table 1: Chronology of Development for Used Fuel at PWMF**

Building	Number	Design Capacity	In-Service Dates
DSC Processing Building			1996
DSC Storage Building	#1	185 DSCs (nominal)	1996
	#2	469 DSCs (nominal)	2001
	#3	500 DSCs (nominal)	2009

Figure 1 shows the current layout of PWMF.

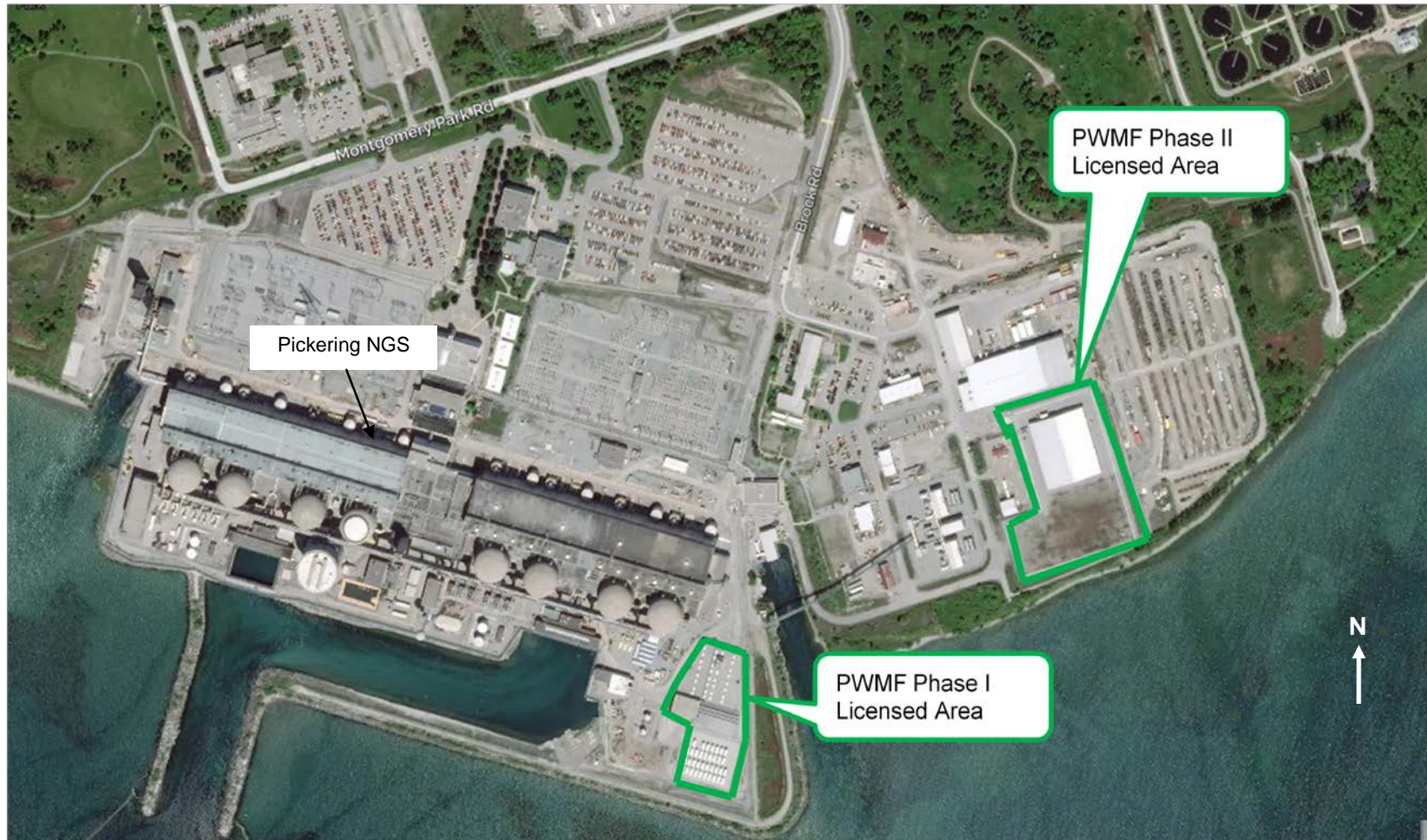


Figure 1: Layout of PWMF in 2016





- 1. Retube Components Storage Area
- 2. DSC Processing Building
- 3. DSC Storage Building #1
- 4. DSC Storage Building #2
- 5. Pickering NGS

Figure 2: PWMF Phase I site

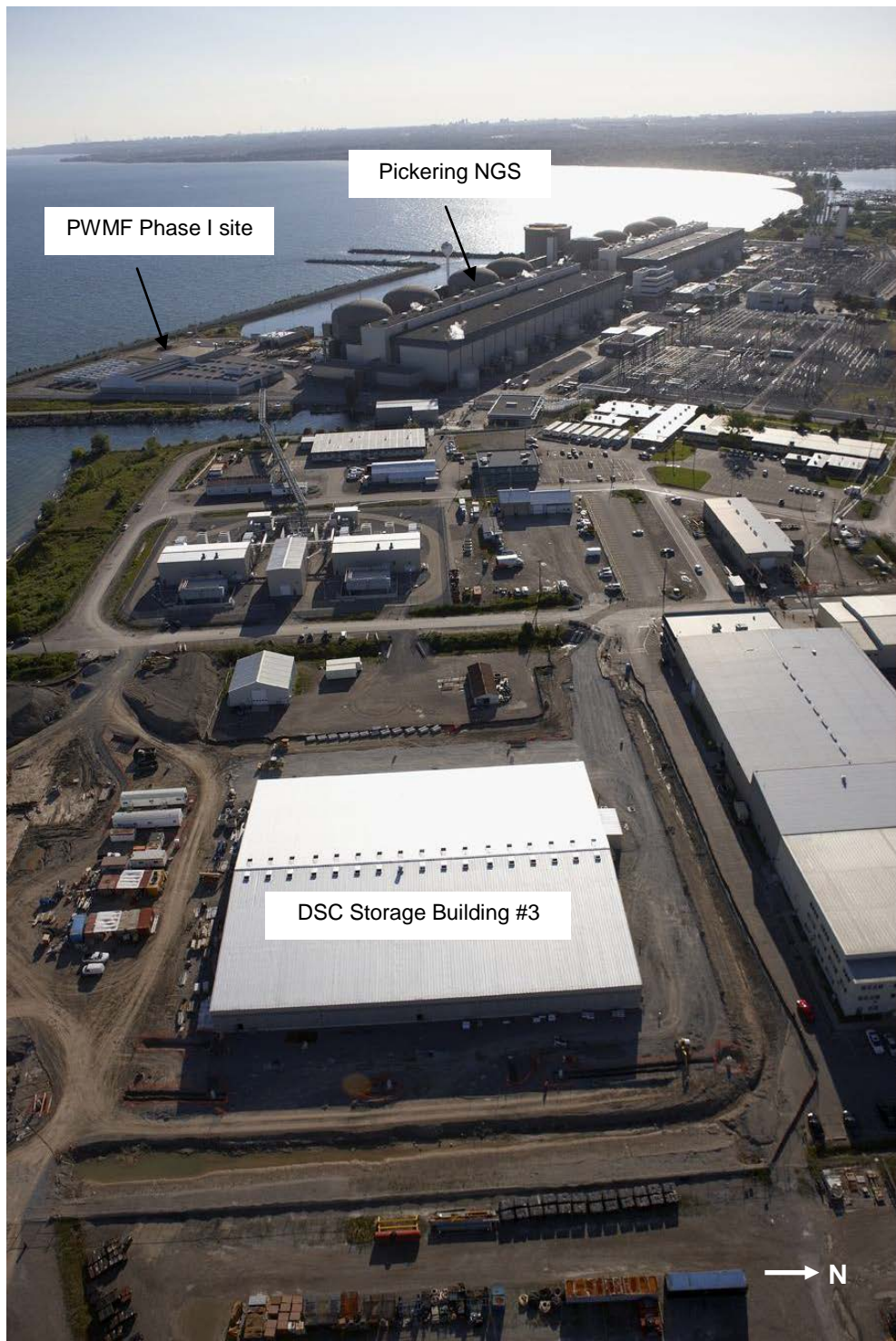


Figure 3: PWMF Phase II site

### 1.1.3 Management of Intermediate Level Waste (Retube Components)

The Retube Components Storage area in the PWMF provides interim storage of irradiated reactor components in Dry Storage Modules. The Dry Storage Modules are stored outdoors in a fenced and access controlled area, situated south of the PWMF Phase I DSC Storage Buildings, as shown in Figure 2.

The irradiated reactor components, consisting of pressure tubes, end fittings, shield plugs, and miscellaneous identified components, were removed during the retube of the Pickering NGS Units 1-4 reactors in the period of 1984 to 1992 and were loaded into 34 specifically designed and shielded Dry Storage Modules for interim storage at the PWMF. Two empty Dry Storage Modules are stored in the Retube Component Storage area for contingency and Dry Storage Module aging management and monitoring purposes.

There have been no operational activities for Retube Component Storage since 1993. The Dry Storage Modules currently stored in the Retube Component Storage area on the PWMF Phase I site will continue to be periodically inspected, monitored and maintained for the requested licence period. There are no future plans to store any more intermediate level waste at the PWMF.

### 1.1.4 Management of High Level (Used Fuel) Waste

The PWMF provides safe interim storage for the used fuel discharged from the Pickering NGS units and cooled for a period of time in the irradiated fuel bays. As of the end of Q2 2016, 835 DSCs were safely stored in the DSC Storage Buildings at the PWMF. Based on annual processing rates of approximately 50 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 (Figure 4), 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 PWMF. 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<sup>3</sup> 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 4. These tubes are used for attaching two different types of International Atomic Energy Agency seals.

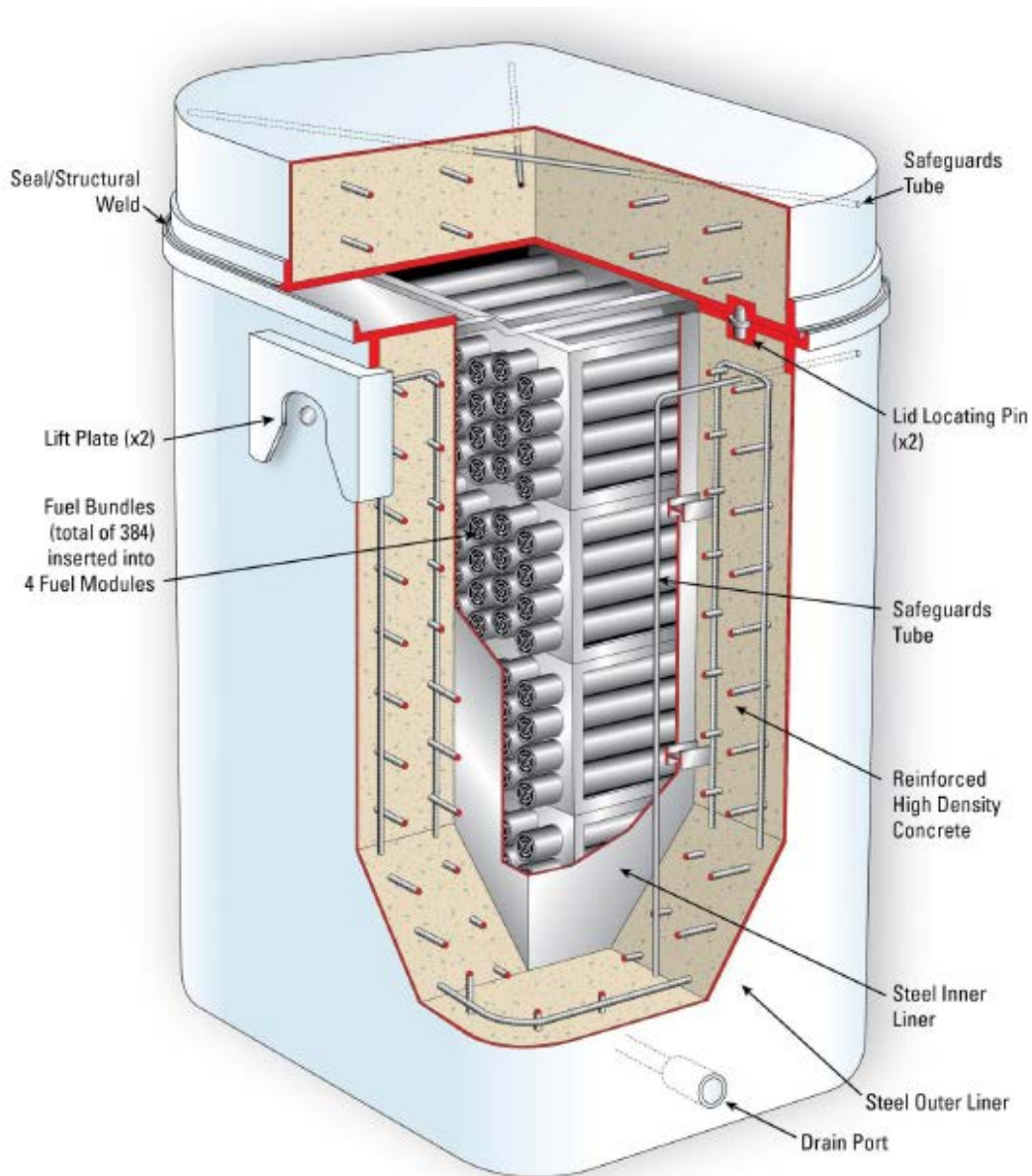


Figure 4: Dry Storage Container

### Used Fuel Dry Storage Processing

The processing of a DSC begins with the preparation of new empty DSCs at the DSC Processing Building and ends with the storage of loaded, hermetically sealed DSCs in the DSC Storage Buildings. The steps are summarized in Figure 5 and described below.



# The Used Fuel Dry Storage Process

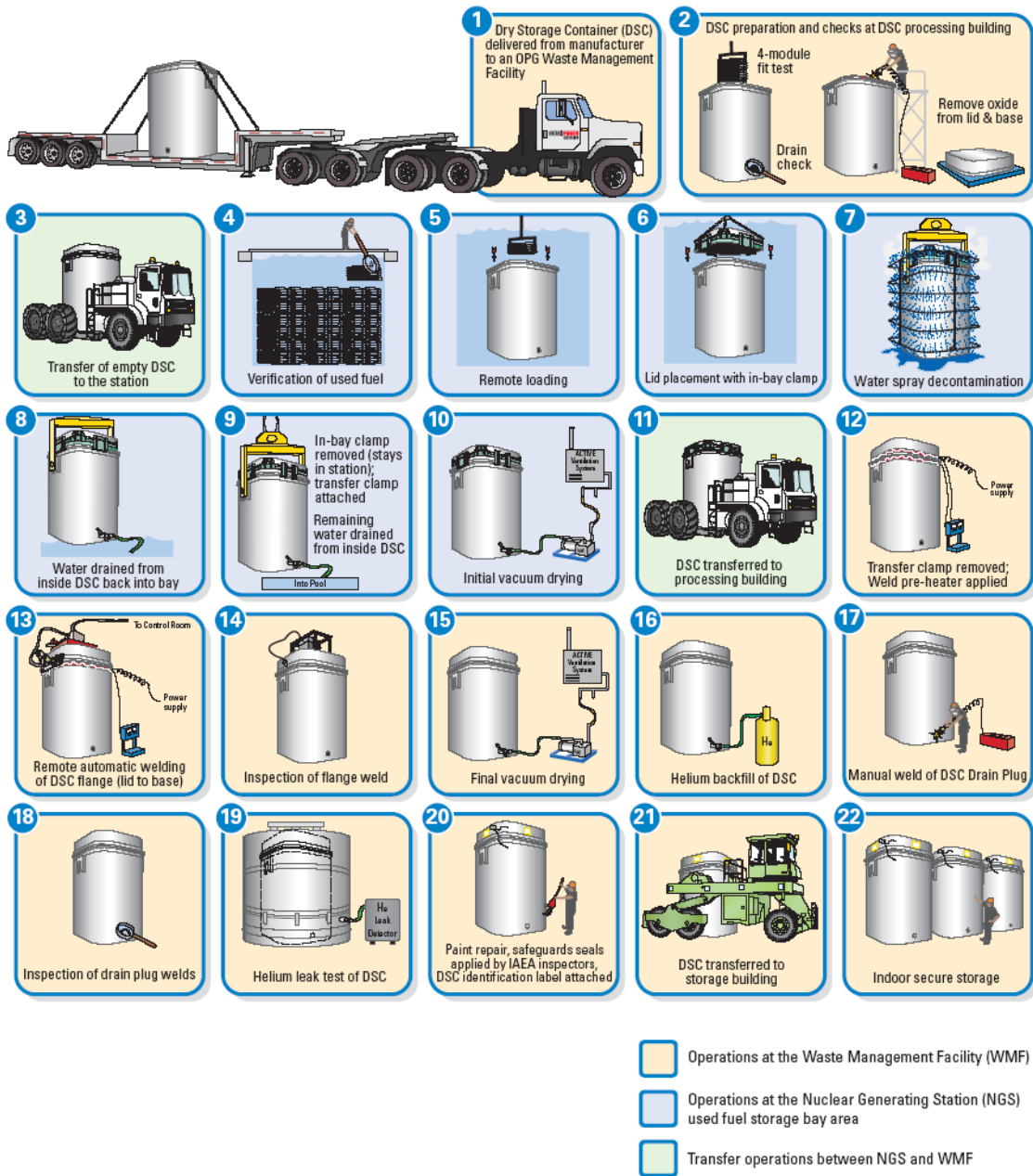


Figure 5: Used Fuel Dry Storage Process

**Steps 1-3: Preparing and Transferring Empty DSCs**

New, empty DSCs are received at the PWMF Phase I site from the manufacturers. The DSCs are then prepared and transferred to the Pickering NGS for subsequent loading of used fuel.

The DSC Transporter is used to transfer both new (empty) and loaded DSCs between PWMF and Pickering NGS.

**Steps 4 – 10: Loading a DSC at Pickering NGS**

The processes of loading, decontaminating, draining and initial drying are completed at Pickering NGS under the Power Reactor Operating Licence. At the Pickering NGS, fuel bundles are loaded under water into storage modules. After a storage module has been loaded, it is transferred under water to a DSC. Each DSC is designed to hold four storage modules, 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, drained and then 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 PWMF.

Prior to leaving the Pickering NGS, the DSC is surveyed and the entire exterior surface of the loaded DSC and its components are decontaminated including lid flange, drain housings, and the transfer clamp, to ensure there is no detectable loose contamination as per OPG's Waste Acceptance Criteria.

**Step 11: DSC transfer between Pickering NGS and the DSC Processing Building at the PWMF**

The DSC Transporter picks up a loaded DSC from the Pickering 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 transporter with a loaded DSC then leaves the station and travels along the Pickering NGS site roads to the PWMF Phase I site for further processing, in accordance with security and safeguards requirements for on-site transportation. The maximum lift height required during loading or unloading of 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 Transporter operates at low speed and has a short stopping distance where stopping is essentially instantaneous. The vehicle is always operated by a trained vehicle operator.

**Steps 12 - 20: Processing a DSC at PWMF**

At the PWMF Phase I site, the loaded DSC is off-loaded at the DSC Processing Building for further processing, as follows:

- **Receiving a Loaded Dry Storage Container (Step 12)** - After the loaded DSC is received at the DSC Processing Building, movement of the DSC within the DSC Processing Building is performed using the workshop overhead crane and lifting beam.
- **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. The weld between the

lid and base of the DSC is performed with 10 consecutive passes of the semi-automatic welder. 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.
- **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. Following helium backfill, the drain port is welded and inspected via visual and dye penetrant techniques.
- **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. After completion of the lid weld inspection, partially processed DSCs may be transferred inside the DSC Processing Building and temporarily stored for up to one year from the time of loading.
- **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 typically carried out in the paint bays. Documentation and identification labelling are completed and permanent safeguards seals are installed in a designated International Atomic Energy Agency (IAEA) surveillance area.

#### **Steps 21 - 22: Storage of DSC at PWMF**

- **Dry Storage Container Placement and Storage (Steps 21 and 22)** - The DSC is moved, using the Transporter, to a designated location in a storage building (Figure 6). In the storage building, the Transporter unloads the DSC in the designated storage location.



Figure 6: 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 Pickering NGS's irradiated fuel bays to the DSC Processing Building, and for transporting processed DSCs from the DSC Processing Building to storage (Figure 7). 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 transporting 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.

PWMF may use either of two types of Transporter / Transfer vehicles. Each type has a different manufacturer – Liftking or MacLeans.

Neither the Liftking nor MacLeans vehicles 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.

The vehicle control systems limit the maximum speed of each type of vehicle (4 km/hr for the Liftking and 12 km/hr for the MacLeans).



**Figure 7: 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 Pickering NGS irradiated fuel bays and the PWMF. 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.

## **DSC Storage Buildings for Used Fuel**

Each DSC Storage Building is designed and constructed to provide for the safe storage of DSCs. Each storage building is a single story, pre-engineered or precast concrete structure with a concrete slab-on-grade floor. 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. Building walls consist of precast concrete panels to provide effective radiation shielding. The walls above the concrete panels consist of metal panels. A combination of wall louvers and roof turbines are installed to assist passive ventilation. The building provides weather protection for DSCs in storage. The 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.

### **1.2. Highlights**

OPG is planning to extend the operation of the Pickering NGS before permanent shutdown and safe storage. This will result in an increase in the number of used fuel bundles produced that require interim storage in Dry Storage Containers (DSC) at PWMF.

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

- Dry Storage Container (DSC) Storage Building #4 (carried over from current licence);
- DSC Storage Buildings #5 and #6 (new), and
- a new DSC Processing Building (new).

No significant changes are anticipated in the designs previously approved for similar buildings on-site, or that have been approved and implemented at the Western Waste Management Facility or Darlington Waste Management Facility. Project specific design requirements will be submitted to the CNSC in accordance with the PWMF operating licence prior to the start of construction. Consistent with OPG's practice, OPG will construct new facilities on an as-needed basis. In addition, the operation of any building would only begin following OPG's submission of a commissioning report and its acceptance by the Commission or a person authorized by the Commission.

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 PWMF Operating Licence for another term to August 31, 2028. OPG is requesting that the PWMF Operating Licence renewal includes provisions for the site preparation, construction or construction modification of:

- Dry Storage Container (DSC) Storage Building #4 (carried over from current licence);
- DSC Storage Buildings #5 and #6 (new), and
- a new DSC Processing Building (new).

These facilities would not alter the basic purpose and activities associated with the PWMF. The additional DSC Storage Buildings will allow OPG to store all of the used fuel generated by Pickering Nuclear Generating Station (NGS) to the end of its commercial operational life. The new DSC Processing Building would increase processing capabilities from 50 DSCs to approximately 100 DSCs per year. PWMF will continue to provide safe, interim dry storage of used fuel generated by Pickering 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. The new DSC Processing Building design will be similar to those in operation at OPG's Western Waste Management Facility and the Darlington Waste Management Facility.

OPG is requesting a renewal of the operating licence for PWMF until August 31, 2018 on the basis that it has been safely 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.

### 1.2.2 Expansion of Pickering Waste Management Facility

#### Additional DSC Storage Buildings

OPG is currently licensed to construct and operate DSC Storage Building #4 at the Phase II site. In order to support the continued operation of Pickering NGS, and to utilize and optimize the vacant land most of which resides within the current PWMF licensed area, OPG plans to construct a storage building which will allow storage of up to 648 DSCs (Figure 8). Storage Building #4 is expected to be in-service in 2019.

OPG also intends to construct two additional storage buildings in the next licensing period to accommodate DSCs from Pickering NGS until the end of commercial operation. The design of the proposed DSC Storage Building #5 and #6 will be similar to the design of the existing storage buildings which are approved and in use at all three of OPG's waste management facilities for the storage of DSCs. Based on the site optimization and conceptual design studies, an amalgamated storage building with a nominal storage capacity of up to 1,200 DSCs is currently planned.

The proposed location for DSC Storage Building #5 and #6 is east of the existing DSC Storage Building #3 on the PWMF Phase II site (Figure 8). The currently licensed area will be expanded to accommodate Storage Buildings #5 and #6. The amalgamated building will be within a designated secured area as required by the *Nuclear Security Regulations* under the *Nuclear Safety and Control Act*.

### **New DSC Processing Building**

A new DSC Processing Building would be designed to increase the processing capability from 50 DSCs per year at the existing DSC Processing Building to approximately 100 DSCs per year, to support the Pickering NGS end of commercial operation and safe storage. The new DSC Processing Building would receive and process DSCs in the same manner, as the existing DSC Processing Building.

The existing DSC Processing Building at the Phase I site is small and congested, and many of the support functions, offices and workshop areas are located elsewhere on the Pickering Nuclear site. Since there is no room available for the expansion of the Phase I site, moving DSC processing activities to the Phase II site will increase the space for work activities and improve PWMF performance. At the time of writing, the OPG business approval process is in progress for the new DSC Processing Building.

The design of the new DSC Processing Building to be located in PWMF Phase II would be similar to the DSC Processing Buildings in operation at the Darlington and Western Waste Management Facilities. The building will be within a designated secured area as required by the *Nuclear Security Regulations* under the *Nuclear Safety and Control Act*. The proposed location for the new DSC Processing Building is the area west of the existing DSC Storage Building #3 on the PWMF Phase II site (Figure 8). The currently licensed area will be expanded to accommodate the new DSC Processing Building.

The building will be rectangular shaped, approximately 100 m long and 40 m wide. The amenities area will include utility rooms, office areas and other supporting facilities including washrooms, change rooms, a lunch room and a security guard station.

The processing area will include a truck bay area for receiving the DSC delivery truck from the manufacturer, and also the DSC transporter. This area will provide space for storage of new empty DSCs and for the preparation of empty DSCs prior to transfer to a Pickering irradiated fuel bay for used fuel loading. The length of the truck bay will be designed to enclose the DSC delivery vehicle. The location and configuration of the truck bay are designed to enable receipt or transfer of a DSC out of the facility without interrupting the processing of loaded DSCs.

The DSC processing area includes an area for storage of loaded (unwelded) DSCs received from the irradiated fuel bay plus areas for welding, painting, testing and other DSC processing activities.

The second-floor area of the building will include the welding control center, a Phased Array Ultrasonic Testing analysis room and storage for the DSC painting bay platform.

The preparation of empty DSCs and the processing activities will continue in the existing DSC Processing Building located within the PWMF Phase I site until the new DSC Processing Building on the PWMF Phase II site is in-service. At that time, DSC processing would no longer be conducted at the original DSC Processing Building.



### **Dry Storage Container Transporter Route**

The Transporter route from the irradiated fuel bays to a new DSC Processing Building in Phase II for a clamped DSC would be approximately 500 m longer than the current route. The route is entirely within the overall Pickering Nuclear site. There is no safety impact from this new route. A security escort will continue to be used for each transfer.

### **1.2.3 Move to a 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 8: Indicative PWMF Expansion Areas

## **2.0 Business Plan**

### **2.1 Nuclear Waste Management**

PWMF is integral to the ongoing operations of the PNGS 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 PWMF. The Director, Eastern Waste Operations leads all operations at the PWMF. The day-to-day operations and management of PWMF is the responsibility of the Operations Manager for Pickering Used Fuel Operations. Only those persons who are authorized by the facility operations manager can supervise the operations at PWMF.

The Nuclear Waste Management program at PWMF 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 nuclear waste from PNGS.

### **2.2 Planning for the Future at PWMF**

Nuclear Waste Management maintains a system plan document which is based on a set of the 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.

PWMF 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.

The information is used to:

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

PWMF 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 PWMF is an input into the PWMF Campus Plan, that was created to institute a framework for future land use changes and growth for buildings outside the protected area of PWMF and for ensuring that spatial planning accommodated OPG's vision for the site over the next 30 to 40 years.

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. PWMF 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 approved 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 the 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;
- 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;

- Conservative Decision-Making;
- Respectful Work Environment;
- Continuous Learning;
- Problem Identification and Resolution;
- Environment for Raising Concerns, and
- Work Processes.

These traits are continuously reinforced, promoted, and applied by staff in all work performed. Many of the daily meetings that occur at PWMF 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 PWMF. 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 PWMF 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:

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

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 PWMF 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. Some examples of procedural documents specific for PWMF are the work management and emergency response procedures. 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 PWMF, such as the handling and storage of the used fuel DSCs.

As with all other parts of the OPG Nuclear Management System, implementation of the management system for PWMF is assessed on an on-going basis.

### **Organization**

During the current 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 PWMF. The day-to-day operations and management of the PWMF is the responsibility of the Operations Manager, who reports to the Director of Eastern Waste Operations and Deep Geologic Repository. Only those persons authorized by the Operations Manager supervise operations at the PWMF. 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 PWMF and supporting center-led organizations is shown in Figure 9.

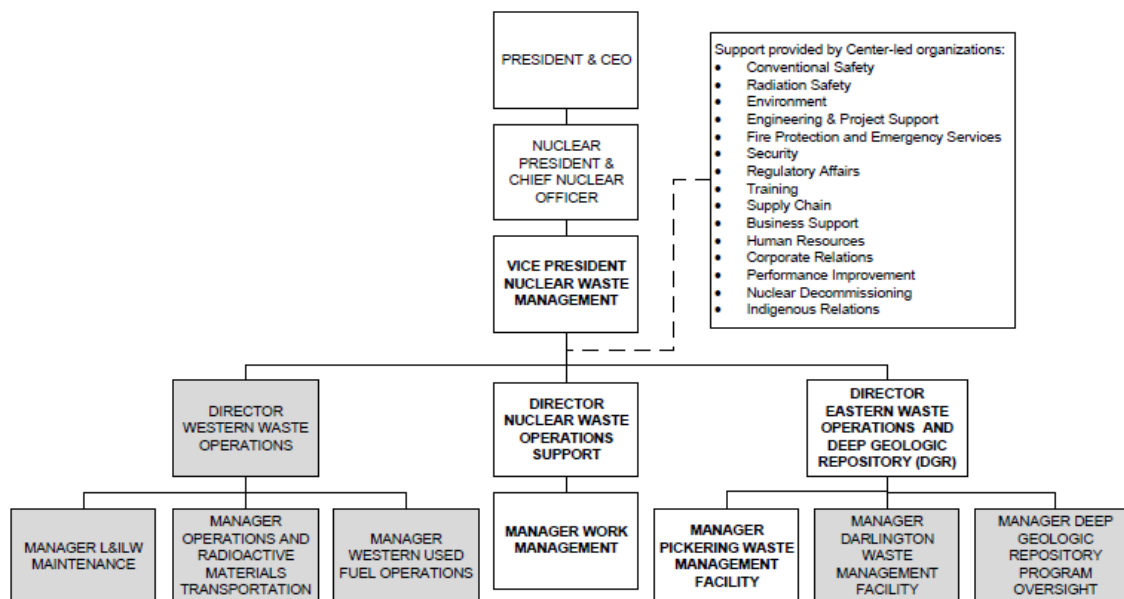


Figure 9: PWMF Organization Chart

### 3.1.2 Past performance

During the current licensing period, PWMF achieved several improvement objectives targeted at making the management system more effective and efficient. The results from the Governance Simplification and Fleetview Program Health and Performance Reporting are described in detail below.

#### Governance Simplification

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 current licensing period, all programs applicable to Nuclear Waste Management transitioned to CSA N286-12. This helped build on the strengths of the Nuclear Management System, including implementation of industry best practices. Although this initiative is now 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 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.

Oversight of the Fleetview initiative is performed collectively by the Nuclear Executive Committee.

## **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 the 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 (up to several weeks or months) without resulting in significant consequences to the generating stations. As the impact of delays to these activities was 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 is composed of all of the managers and senior leadership within Nuclear Waste Management. The panel evaluates the information and approves any initiatives or reinforces 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 Nuclear Waste Management 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 operating experience, 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 OPG's 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.

### **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 OPG's 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 CSA 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 work under the contractor's quality program to ensure there is an assurance that the agreed upon 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 that 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, all contractor work will be carried out in accordance with 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 PWMF 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 PWMF has taken or proposes to take with respect to the event 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, [www.opg.com](http://www.opg.com).

### **3.1.3 Future plans**

PWMF 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 licensing period, any substantive changes to the management system. The main focus for the next licensing period at the PWMF will be the safe handling and interim storage of used fuel in support of Pickering NGS continued operations, shutdown and safe storage. This will result in new facilities being required. These are not expected to result in substantive changes to the management system.

### **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 PWMF, 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, PWMF is positioned to continually improve organizational effectiveness through the use of best practices, enhanced behaviours and learning.

An OPG fleetwide 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 PWMF. The human performance expectations are built into the training courses; for example, the nuclear general employee training that is taken 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.

During the current licensing period, there were no Site Event Free Day Resets as a result of operations at the PWMF. However, there were three Human Performance related events reportable to the CNSC. Two events occurred in 2011. The first event involved two snow removal vehicles exiting the PWMF Phase II site without radiological monitoring, which was caused by operators failing to comply with Radiation Protection procedures. The second event was due to a missed quarterly retube component storage area surface drainage sample, resulting from a temporary suspension of the groundwater program. A third event related to security occurred in 2013. Detailed investigations were performed following these events and corrective actions to prevent recurrence were implemented.

#### **Procedure Use and Adherence**

OPG staff is expected to follow procedures as written. Employees are required 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 during pre-job briefings 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-job 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 employees perform a two-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, PWMF 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**

In order to ensure adequate irradiated fuel bay space for operation of the Pickering NGS, the PWMF is operated to safely and reliably transfer, process, and store DSCs from the Pickering NGS until a long-term waste management facility for used fuel becomes available.

OPG operates and manages the Nuclear Waste Management Facilities in accordance with the facility licensing basis and applicable regulations and standards. Procedures are used for all aspects of PWMF's operation, including safety related activities, regulatory requirements, plant and equipment operation and maintenance, work authorizations, equipment labelling, facility access, and plant status.

### **3.3.2 Past performance**

During the current licensing period, the safety performance of the PWMF used fuel processing and storage facilities has been excellent while meeting all production targets to the end of 2015. PWMF has operated safely without a Lost Time Accident for all 22 years the facility has been in operation.

#### **DSC Transfer**

Empty DSCs, and those loaded with used fuel, are transferred on-site between the Pickering NGS and the PWMF. Since the inception of the PWMF to the end of Q2 2016, there have been more than 800 on-site transfers of loaded DSCs without incident. Table 2 shows 374 DSCs were processed and stored between 2008 and Q2 2016.

To improve operational flexibility, a second entrance to the existing DSC Processing Building in the Phase I area was assessed and implemented during the current licensing period.

### **DSC Reverse Loading**

In the current licence period, OPG has demonstrated that all of the required DSC reverse loading steps to safely return fuel to an irradiated fuel bay can be performed 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 used fuel from a DSC was performed where a partially loaded DSC was submerged in the irradiated fuel bay and one of the used 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 transfer of the DSC which are routine operations performed regularly at PWMF.

### **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 2010. 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 2009, and accepted by the CNSC. The Phased Array Ultrasonic Testing method also improves inspection sensitivity.

### **DSC Weld Wire Quality**

In 2013, 6 DSCs at PWMF (12% 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 contaminants in the weld wire that directly influenced the quality. As a result, defects were detected in some welds. 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 2013, the weld quality defects from 2008 through 2016 have been less than the internal rework target of 10%.

All of the 6 DSCs that demonstrated porosity in the welds during Phased Array Ultrasonic Testing in 2013 were repaired, processed and placed in storage.

### **Surveillance Area**

In 2013 a surveillance area was implemented to facilitate scheduling of IAEA safeguards seal application to the DSCs and improve space utilization in the processing shop. This area was created in the Stage I storage area and is under IAEA camera surveillance and has operated without incident.

### **Production History**

The number of DSCs loaded at PWMF between 2008 and Q2 2016 is shown in Table 2. PWMF has met its target for number of DSCs loaded per year every year during this reporting period. Lower targets were set for 2009 to 2011 due to reduced station equipment availability and the campaign to move DSCs from Phase I to Phase II.



**Table 2: DSCs Loaded at PWMF per Year**

<b>Year</b>	<b>Number of DSCs Loaded at PWMF between 2008-2016</b>
2008	51
2009	40
2010	20
2011	35
2012	50
2013	51
2014	51
2015	50
Q1 & Q2 2016	26
<b>TOTAL</b>	<b>374</b>

### **Spare Weld Head**

A Divisional spare weld head for the DSC welding system was procured and commissioned at the PWMF in October 2016. The spare weld head increases the reliability of the DSC welding system across the fleet.

### **Retube Component Storage Area**

The Retube Component Storage area at the PWMF provides interim storage for components removed during retubing of the Pickering NGS Units 1-4 reactors from 1984 to 1992. The retube waste is stored and treated as nuclear waste using Dry Storage Modules.

During this current licensing period, radioisotope inventories inside the Dry Storage Modules have been steadily decreasing due to radioactive decay. Operational activities at the Retube Component Storage area have been limited to periodic inspection, monitoring, maintenance, and refurbishment of the Dry Storage Modules and the Retube Component Storage area since 1993.

There are 36 Dry Storage Modules located in the Retube Component Storage area; two of these are empty and are stored for contingency and Dry Storage Module aging management and monitoring purposes. The remaining 34 Dry Storage Modules contain irradiated reactor components for interim storage.

In the fall of 2009, the Dry Storage Modules and Retube Component Storage area were refurbished. The Dry Storage Modules and saddle supports both received a fresh coat of paint. The asphalt surface of the Retube Component Storage area was repaired, as necessary, and a rubber membrane was applied to the surface of the asphalt. The Retube Component Storage area fence was also replaced.

### Reportable Events

One CNSC reportable event under Operating Performance occurred during the current licensing period. In 2011, Operations noticed that the frequency of sampling of the Active Liquid Waste tanks was different in the work order than in the operating procedure and safety report. The work order had a frequency of 26 weeks, whereas the safety report and operating procedure stated a frequency of four weeks. The work order was corrected and monthly sampling has continued without any further events. All corrective actions were completed.

### 3.3.3 Future Plans

Previously implemented improvements to the Retube Components Storage area will continue to be monitored to maintain Dry Storage Module integrity. Radiological monitoring and access control to the area remains in effect.

At PWMF, the following future improvements are planned:

- Construction of the proposed new DSC Processing Building to replace the existing, and increase the annual rate of DSCs being placed into storage at the PWMF from the current rate of 50 DSCs per year to a rate of approximately 100 DSCs per year;
- Construction of DSC Storage Buildings #4, #5 and #6 to support Pickering NGS;
- Refurbishment of Liftking vehicles by 2018 to ensure continued reliability, and;
- Implementation of a Work Management process that closely aligns with the Nuclear Generating Stations, commencing in 2017. 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.

### 3.3.4 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, PWMF 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 PWMF 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. It defines organizational responsibilities and key program elements for the management of issues related to Nuclear Safety Analysis. Specifically the Reactor Safety Program defines the processes associated with maintaining the following areas: Safety Analysis Basis, Beyond Design Basis Accident Management and Nuclear Waste Management Facilities Safety Reports and Safety Analysis.

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 documentations 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 PWMF Safety Report 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 PWMF Safety Report was submitted to the CNSC in 2013, and accepted by staff in 2014. The Safety Report demonstrates that dose rates and emissions from the PWMF under normal and abnormal operating conditions as well as postulated accident conditions are well within allowable limits, and operation of the facility continues to pose a negligible risk to the public, the workers, and the environment. The next PWMF safety report update will be in 2018.

#### **Safety Assessment Results for PWMF Structures**

##### 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 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 are estimated to result in doses 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 determine 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 30% fuel sheath failures. The total doses to the public at the Pickering Nuclear site boundary 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 Pickering Nuclear site boundary and the occupational doses due to this event were assessed to be below the regulatory dose limits.

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

### *Criticality*

Criticality assessments have been completed for the used fuel stored in DSCs for the PWMF. 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 PWMF.

### Retube Component Storage Area

#### *Normal Operating Conditions*

Waste structures are designed and constructed such that dose rate targets at exterior surfaces of the structures, at the facility fence and at site boundaries are achieved. Dose rates in the Retube Component Storage area are routinely monitored and shown to be within facility targets, well below regulatory limits.

#### *Abnormal Operating Conditions*

Potential exposures from the Retube Component Storage area under abnormal operating conditions have been reviewed and no credible events that would lead to a

failure of the Dry Storage Modules have been identified. Conservative estimates of worst case doses from extreme conditions, such as a lightning strike or impact of a small aircraft, are well below the regulatory limits.

### **OPG's Response to Fukushima**

Following the 2011 event at Fukushima, OPG assessed the impact of consequential event sequences on the existing PWMF safety envelope. The initiating and consequential events considered a seismic event, fire, explosion, loss of power, tornado and thunderstorm. In all scenarios assessed for the PWMF, 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 conservatism exist. These improvements are expected to be used for the 2018 PWMF Safety Report update.

### **Support for Additional Facilities**

In the current PWMF operating licence, there is provision and authorization for DSC Storage Building #4 to be built at the PWMF Phase II site.

As discussed in Section 1.2.2, three additional buildings are being requested, namely a new DSC Processing Building (similar in design and function to the existing processing buildings currently in use at the Darlington Waste Management Facility and the Western Waste Management Facility) and two additional DSC storage buildings. Detailed safety assessments will be performed for these new buildings once additional design and specific 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 PWMF Licence are met.

### **Safety Analysis Update**

Safety Analyses will be reviewed as necessary prior to construction and/or 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 PWMF complies with the current safety basis and that all changes are authorized and performed in a controlled manner, and in accordance with the PWMF Operating Licence.

### 3.5.1 Relevance and management

#### Design Programs

Management of the design basis at the PWMF 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 PWMF 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 reliably 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 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:

- All modifications to systems, structures, and components are designed correctly;
- Modification designs are reviewed by all stakeholders and authorized by the Nuclear Waste Management Design Authority before being implemented;
- Modifications are installed in accordance with approved procedures;
- Modifications are commissioned and tested to demonstrate that design requirements have been met, and

- 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 PWMF pressure boundary systems meets the requirements of CSA N285.0-08 (including Update 1 & Update 2) and additional requirements per Appendix D of the PWMF operating licence. OPG also maintains a pressure boundary program document 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 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 applicable to PWMF design:

- National Research Council of Canada NBCC (2005), *National Building Code of Canada*;
- National Research Council of Canada 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 2012 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 PWMF's ability to operate within its safety envelope. These modifications have been undertaken to improve the overall performance of the PWMF and to improve safety in design and operations. Significant design modifications in the current licensing period are listed below:

- (1) A modified design of the DSC (referred to as Mark II or MKII) was introduced at the PWMF. 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 of the DSC. Commissioning of the DSC MK II was completed at the PWMF in 2009.

- (2) Phased Array Ultrasonic Testing was introduced for inspecting the DSC lid-to-base containment weld to replaced radiographic inspection, thereby eliminating the health and safety hazards of radiographic inspection method's radiation exposure, and improved inspection sensitivity.
- (3) In April 2013, a modification was undertaken to install visual fire alarm devices (strobe lights) in the welding area ventilation rooms. This was to address the concerns that the audible fire alarms might not be heard by personnel due to the high levels of noise generated from the ventilation equipment. The modification was designed to comply with requirements of the *National Building Code of Canada* (2005), and was completed in 2014.
- (4) To facilitate interim storage of used fuel on site, DSC Storage Building #3 was constructed and placed in-service in 2009. Further proposed expansion of the Phase II PWMF site is described within Section 1.2.2.

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 within Nuclear Waste Management. Quality of design products is monitored using recorded verification results and cold-body design review boards within Nuclear Waste Management. 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

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

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

PWMF 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 PWMF as well. Once the Darlington NGS Refurbishment project is completed, the new code effective dates for applicable pressure boundary codes are to be accepted by CNSC staff and will be incorporated into OPG Nuclear governance. The anticipated PWMF 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 PWMF.

### 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 the activities that impact the physical condition of systems, components and structures to ensure that they remain effective over time. This includes programs that ensure the equipment is available to perform its intended design functions 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 PWMF 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 PWMF systems 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 Records, 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 11 systems at PWMF 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 storage structures to protect the health and safety of persons and the environment.

## **3.6.2 Past performance**

### **Aging Management Programs**

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.

#### 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, and
- Monitoring of chloride levels which have the potential to accelerate corrosion.

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 (CNSC is provided with annual summary reports of the inspections), and

- 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.

#### Dry Storage Modules Aging Management Program

During the current licensing period, annual visual inspections of the Dry Storage Modules were performed. Recommendations were identified for future improvements based on the 2008 inspection and implemented in 2009. In the fall of 2009, the Dry Storage Module storage area underwent refurbishment. The modules were repainted, with new nameplates and covers installed. The surrounding asphalt area was resealed with a membrane, and new fencing was replaced around the site. Fluorescent magnetic particle inspection on the bottom half of circular weld and all of the support saddle welds were also performed on two of the oldest Dry Storage Modules, and inspection results were acceptable.

Twice annually, dose rates at the Dry Storage Modules are recorded, and surfaces checked for contamination, to confirm Dry Storage Module integrity. No loose contamination has been recorded to date. Dose rate measurements taken at the east and south fences of the Retube Component Storage area show no significant change over the current licensing period.

As part of the on-going aging management plan, the Dry Storage Modules with the higher contact dose rates are monitored to confirm Dry Storage Module integrity has not changed and contents remain in design configuration. With the ongoing implementation of this Aging Management Program, OPG is confident of Dry Storage Module integrity throughout and beyond the next licence period.

### **Periodic Inspection Programs**

#### PWMF Floor Slabs Periodic Inspection Program

The PWMF underwent an assessment in 2014 to determine the structural condition of the Stage 1 and Stage 2 floor slabs, with the conclusion that the floor condition was acceptable for continued operation.

With implementation of recommendations from the assessment, OPG will ensure that the slabs are available for continued operations for the projected end of facility service.

In 2014 and 2015, no condition inspections were expected to be completed under the assessment plan. Floor deflection inspections were completed in 2016. Operations reviewed the 2016 deflection results with historic data and concluded there were no notable changes in the control point deflections. Hence, no further analysis was deemed necessary.

#### Phase I Processing Building Periodic Inspection Program

In 2014, System Health Reporting was initiated for the Building Envelope system. Preventative Maintenance tasks are in place for yearly inspection and maintenance (roof anchor points, drains, floor crack, overall building health, etc).

### 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:

- Lifting transporter upgrades are planned to address reliability and obsolescence issues. There are no safety issues with the Lifting transporter.
- Continued implementation of PWMF Phase 1 floor slab recommendations to ensure the continued operations for the projected end of facility service. Deflection measurements and visual inspections are ongoing to confirm that the floor slab integrity is maintained. Repairs to Storage Building #1 & #2 floor slabs will be completed in 2017. A floor slab re-assessment is scheduled for 2019 as per the floor slab analysis recommendation.
- OPG is updating the list of safety-related system, structures and components for PWMF. This plan will then be used to assist in determining which systems, structures and components shall be subjected to aging management evaluations and actions.
- OPG is updating the aging management plan for the Dry Storage Modules to reflect the information from recent condition assessment report as well as current aging management practices.

### 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

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

#### **Radiation Protection Program Monitoring and Oversight at PWMF**

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, and
  - 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, and
- Reviews of industry operating experience.

### **Management Control over Worker Practices for Dose and Contamination Control**

Performing radioactive work within PWMF 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, and
- 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 are 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 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 PWMF, or any loss of contamination control events in excess of PWMF's contamination control action levels.

The current action levels for dose to workers and for contamination control are shown in Table 3.

Table 3: Radiological Action Levels for PWMF

<b>Application</b>	<b>Action Level</b>	<b>Observations</b>
<u>Dose To Workers</u>  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.
<u>Contamination Control</u>  Surface contamination levels greater than a predetermined activity in the DSC Storage Area.	$3.7 \times 10^4$ Bq/m <sup>2</sup> (1 $\mu$ Ci/m <sup>2</sup> )	The Action Level is exceeded if two or more surface contamination events exceeding $3.7 \times 10^4$ Bq/m <sup>2</sup> (1 $\mu$ Ci/m <sup>2</sup> ) occur per quarter.

OPG is currently reviewing the above action levels.

### **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) in a 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.

Figure 10 and Table 4 outline the key dose statistics for PWMF. 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.

As noted previously, the number of DSCs loaded at PWMF increased in 2012 as compared to previous years, resulting in an expected corresponding increase in collective dose. However, with the dedicated application of As Low As Reasonably Achievable principles, the collective dose decreased back to pre-2012 levels, demonstrating the commitment to As Low As Reasonably Achievable at PWMF.

OPG's exposure control program continues to be in full compliance with regulatory requirements. As Low As Reasonably Achievable targets are set yearly for PWMF.

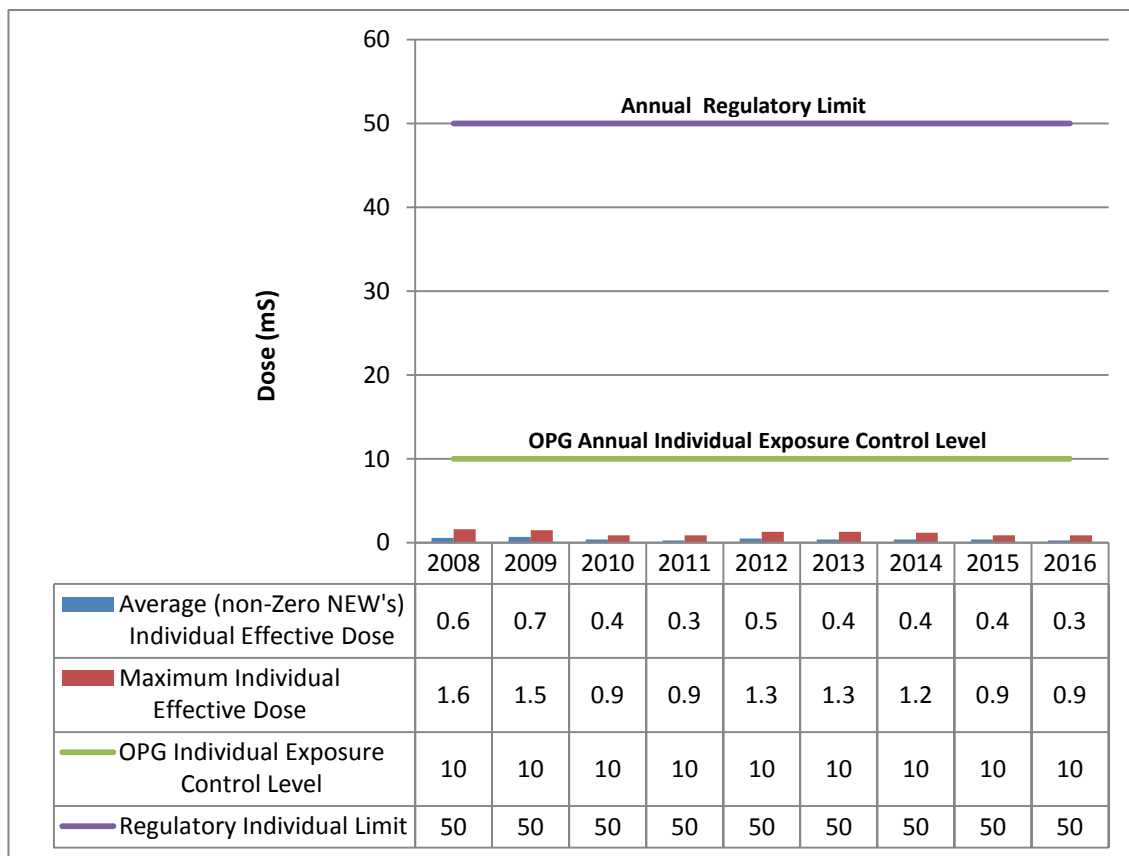


Figure 10: Average and Maximum Dose at PWMF

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

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	DSCs Loaded per Year
	#	#	Person-mSv	mSv	mSv	mSv	#
2008	37	37	9.7	0.3	0.6	1.6	51
2009	39	39	11.2	0.3	0.7	1.5	40
2010	47	45	7.3	0.1	0.4	0.9	20
2011	51	49	6.0	0.1	0.3	0.9	35
2012	45	42	10.6	0.2	0.5	1.3	50
2013	38	37	9.4	0.2	0.4	1.3	51
2014	40	38	8.8	0.2	0.4	1.2	51
2015	40	38	6.7	0.2	0.4	0.9	50
Q1 & Q2 2016	30	29	4.7	0.2	0.3	0.9	26

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



### **PWMF Perimeter Dose Monitoring**

Environmental Thermoluminescent Dosimeters are mounted on the perimeter fence of both PWMF Phase I and Phase II sites as shown on Figure 11 and Figure 12, and are changed and analyzed quarterly. The Thermoluminescent Dosimeters are located on the inner fence of the Retube Components Storage area, DSC Storage Building #3 and the eastern perimeter wall of the PWMF Phase I. The Thermoluminescent Dosimeters measure the dose rate to the air. Data is reported to the CNSC in the PWMF quarterly operations report. Target Dose Rates for the Retube Component Storage area and DSC Storage Building #3 have been set to less than 0.5  $\mu\text{Gy/h}$ , and less than 1.75  $\mu\text{Gy/h}$  at the eastern perimeter wall of the PWMF Phase I.

A dose rate to the air of 1  $\mu\text{Gy/h}$  results in a dose rate to a person that is approximately 1  $\mu\text{Sv/h}$ , but the exact value depends on a number of factors, one of which is irradiation geometry (e.g., for the same dose rate to air, the dose rate to a person facing a Dry Storage Container 5 meters away is different than to a person standing in an open field and receiving dose from all around them).

A dose rate of 0.5  $\mu\text{Sv/h}$  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 annual limit. The average actual perimeter dose rate at the PWMF has consistently been less than the 0.5  $\mu\text{Sv/h}$ , with an overall average less than 0.1  $\mu\text{Sv/h}$ . 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 2008, all measured dose rates have been better than target. Annual performance is reported as the average of all dose rates. Any contributions from PWMF to offsite public dose are captured as part of the Pickering Environmental Monitoring Program.

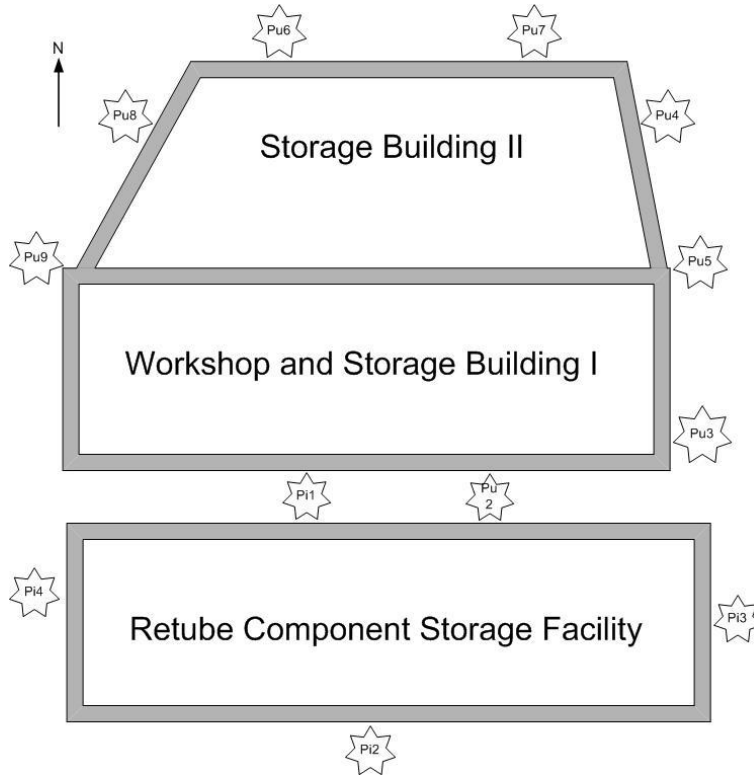


Figure 11: Thermoluminescent Dosimeters Locations around the PWMF Phase I Site (not to scale)

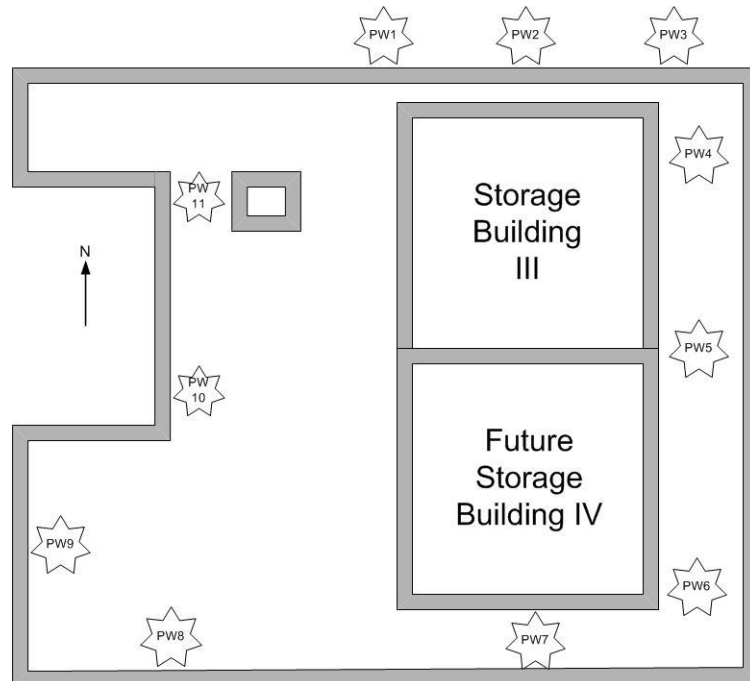


Figure 12: Thermoluminescent Dosimeters Locations around the PWMF Phase II Site

### **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 PWMF; however, improvements in the application of Radiation Protection fundamentals (use of personal protective equipment) were cited and that operating experience has been shared with all OPG Nuclear Waste sites.

### **Other CNSC Licences**

Current revisions of OPG's Nuclear Substances and Radiation Devices Licences at the time of writing this application include:

- 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**

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.

### **3.7.4 Challenges**

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

### **3.7.5 Requests**

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

## **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 a core value and by managing conventional risks in the workplace associated with PWMF'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 applied consistently throughout OPG Nuclear, 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 performance indicators:

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

### 3.8.2 Past performance

PWMF has demonstrated its commitment to safety by working without a lost time accident for its entire operational period. This period has lasted 22 years.

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 Rates and Accident Severity Rates) identified in Figure 13 and Figure 14 are inclusive for the entirety of Nuclear Waste Management. Specific safety events at PWMF that impact the All Injury Rate and Accident Severity Rate are discussed below.

#### All Injury Rate

The All Injury Rate is defined as is the number of fatalities, lost-time injuries and medical treatment injuries multiplied by 200,000 person-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 13. Although there was no All Injury Rate target for 2008, PWMF did have one medically treated injury due to an allergic reaction to dust in the eye. In 2009, there were two medically treated injuries at PWMF that contributed to the All Injury Rate target not being met for that year. Both of them were related to musculoskeletal injuries due to over-exertion. Since 2009, the PWMF site has shown an improved safety performance where there have not been any injuries at the PWMF impacting the All Injury Rate. The target was reduced throughout the licence period to drive continuous improvement.

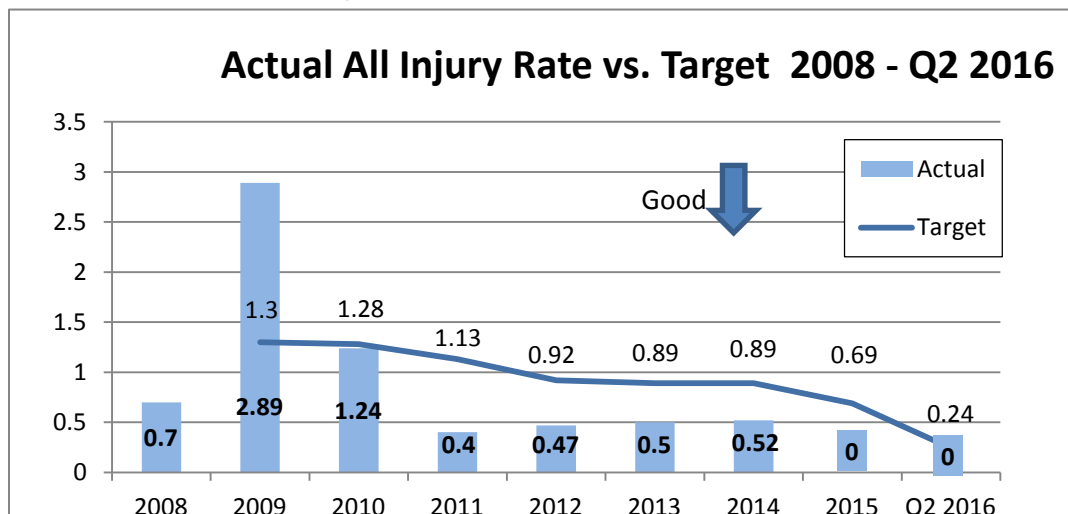


Figure 13: Nuclear Waste Management All Injury Rate vs. Target

#### Accident Severity Rate

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

Nuclear Waste Management’s Accident Severity Rate was better than target from 2010 through 2015 as shown in Figure 14. There was no Accident Severity Rate target for 2008. In 2009, one long-duration Musculoskeletal Disorder overexertion lost time event was recorded which exceeded the Accident Severity Rate target for that year. Although

there was no target for Accident Severity Rate in 2016, the Accident Severity Rate continues to maintain its performance with no lost time injuries.

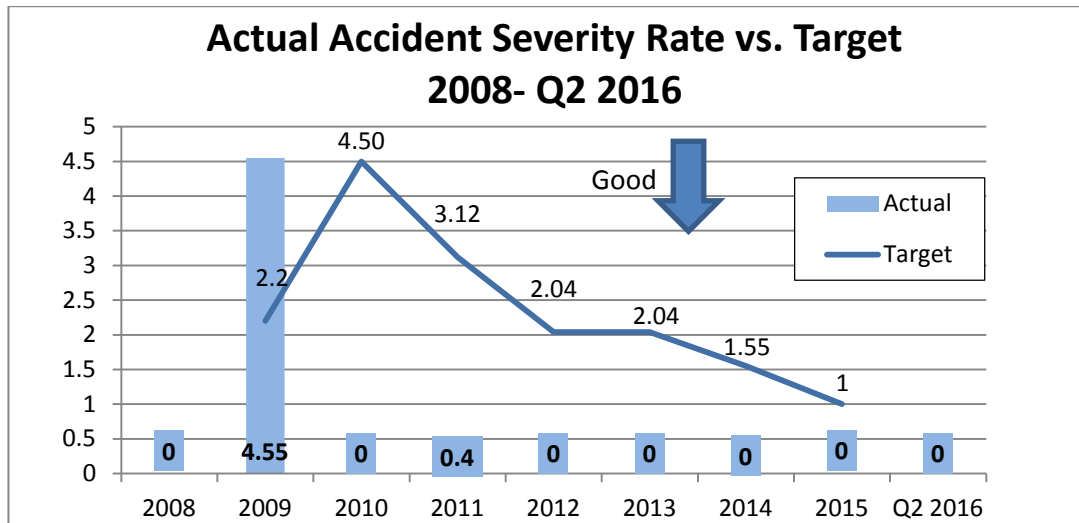


Figure 14: Nuclear Waste Management Accident Severity Rate vs. Target

### High Maximum Reasonable Potential for Harm Events

The Maximum Reasonable Potential for Harm is an OPG 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 was one High Maximum Reasonable Potential for Harm event that occurred at PWMF. In April 2015, the inner section of the southwest roof ventilation turbine fell to the floor. There was no one in the area when the roof ventilation fell to the floor. Access to the area was restricted, but staff were authorized to work nearby. To prevent recurrence of such an event, PWMF maintenance staff installed enclosures and fall prevention equipment (i.e. tethers) to all ventilators. Also, an annual inspection of roof turbines was added to the inspection program.

### Safety Enhancements

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

- Strobe lights were added as a visual enhancement to the fire emergency notification system in the fan room;
- The DSC welding preheater was strategically moved to the catwalk to create a clear pathway below the catwalk;
- An ergonomic enhancement was made to the welding height of the DSC drain plug which provides additional working space, and
- A DSC turning tool and turbine stand hook was procured for ease of turning DSCs without direct contact with the load while positioning the DSC turbine stands.

### 3.8.3 Future plans

A number of health and safety improvement initiatives have been identified for the PWMF as part of the continuous improvement cycle of the health and safety management system, which include:

- Implementation of the OPG Nuclear Human Performance Program tools and processes;
- An increased focus on Situational Awareness, particularly around routine activities such as walking and continued focus on improvements to the Internal Responsibility System, and
- Implementation of a “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’);

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 “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 (PWMF) 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*, PWMF 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

PWMF 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. OPG has established effluent monitoring programs in support of its nuclear facility operations to assure compliance with the *Nuclear Safety and Control Regulations*, applicable Provincial Legislation and



OPG requirements. The program is administered on a site-wide basis and encompasses all nuclear facilities at the Pickering Nuclear site, including the PWMF.

The applicable effluent monitoring program elements at the PWMF include:

- Airborne emissions from the DSC Processing Building ventilation stack, and
- Liquid effluent from the active liquid system in the DSC Processing Building.
- Liquid effluent monitoring from the Retube Component Storage Area and DSC Storage Buildings.

The effluent monitoring program ensures releases are within 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](http://www.opg.com). A summary of the results since 2008 are 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 PWMF have been consistently orders of magnitude below the derived release limits. The derived release limits as shown in Table 5 are for the Pickering Nuclear site which includes both Pickering NGS and the PWMF. PWMF reports against the derived release limits of Pickering NGS Units 5-8.

**Table 5: Pickering Nuclear site Derived Release Limits Applicable to PWMF**

Release Category	Radionuclide	Derived Release Limit (Bq/y) Pickering NGS Units 1-4	Derived Release Limit (Bq/y) Pickering NGS Units 5-8**
<b>Air</b>	Tritium (HTO)	$1.2 \times 10^{17}$	$1.9 \times 10^{17}$
	Iodine (mixed fission products)	$9.9 \times 10^{12}$	$8.9 \times 10^{12}$
	Carbon-14 (CO <sub>2</sub> )	$2.2 \times 10^{15}$	$2.0 \times 10^{15}$
	Noble Gases*	$3.2 \times 10^{16}$	$4.7 \times 10^{16}$
	Particulate – Gross Beta-Gamma (Co-60)	$4.9 \times 10^{11}$	$7.2 \times 10^{11***}$
	Particulate – Gross Alpha (Pu-239, Pu-240)	$8.7 \times 10^{10}$	$1.2 \times 10^{11}$
<b>Water</b>	Tritium	$3.7 \times 10^{17}$	$7.0 \times 10^{17***}$
	Carbon-14 (as carbonate)	$3.2 \times 10^{13}$	$6.0 \times 10^{13}$
	Gross Alpha (Pu-239/Pu-240)	$1.4 \times 10^{13}$	$2.6 \times 10^{13}$
	Gross Beta-Gamma (P-32)	$1.7 \times 10^{12}$	$3.2 \times 10^{12***}$
<b>Sewage</b>	Tritium	$5.4 \times 10^{16}$	
	C-14	$9.9 \times 10^{13}$	
	Gross beta-gamma (limited by Co-60)	$1.2 \times 10^{11}$	

\*Unit for noble gases derived release limit is Bq-MeV

\*\*PWMF reports against the derived release limits of Pickering NGS Units 5-8.

\*\*\*Applicable to PWMF Effluent Monitoring Program.

### 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 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.

The action levels in Table 6 are for the Pickering Nuclear site which includes the Pickering NGS and PWMF. PWMF reports against the action levels of Pickering NGS Units 5-8.

**Table 6: Pickering Nuclear Environmental Action Levels**

Release Category	Radionuclide	Action Levels: Gaseous releases (Becquerel/year) Pickering NGS Units 1-4	Action Levels: Gaseous releases (Becquerel/year) Pickering NGS Units 5-8**
<b>Air</b>	Tritium (HTO)	$2.5 \times 10^{14}$	$3.7 \times 10^{14}$
	Iodine	$2.0 \times 10^{10}$	$1.8 \times 10^{10}$
	Carbon-14	$4.4 \times 10^{12}$	$4.0 \times 10^{12}$
	Noble Gases*	$6.3 \times 10^{13}$	$9.4 \times 10^{13}$
	Particulate	$9.8 \times 10^8$	$1.4 \times 10^9$ ****
<b>Water</b>	Tritium	$3.0 \times 10^{15}$	$5.6 \times 10^{15}$ ****
	Carbon-14	$2.6 \times 10^{11}$	$4.8 \times 10^{11}$
	Gross Beta-Gamma	$1.4 \times 10^{10}$	$2.5 \times 10^{10}$ ****
<b>Sewage***</b>	Tritium (HTO)	$4.3 \times 10^{14}$	
	Carbon-14	$7.9 \times 10^{11}$	
	Gross beta-gamma	$9.7 \times 10^8$	

\*Units for noble gas action level are Bq-MeV/week

\*\*PWMF reports against the action levels of Pickering NGS Units 5-8.

\*\*\*All sewage from the Pickering Nuclear site is reported as a release from Pickering NGS Units 1-4.

\*\*\*\*Applicable to PWMF Effluent Monitoring Program.

### Radiological Airborne Emissions

The active ventilation exhaust from the DSC Processing Building is monitored for radioactive particulates. A continuous emission sample is passed through a particulate filter that is replaced and analyzed on a weekly basis. The concentration of particulate matter on the samples has typically been below the Minimum Detectable Activity of  $3.3 \times 10^3$  Bq.

Although there are no significant particulate emissions expected from the exhaust at the PWMF, it is monitored for confirmation purposes. All data is reported to the CNSC in the PWMF's quarterly operations reports.

Figure 15 shows a summary of the radiological airborne emissions from the DSC Processing Building stack at the PWMF since 2008. During the current licensing period, there have been no derived release limit or action level exceedances for airborne particulates from the DSC Processing Building stack sampler. The emissions from the PWMF have been orders of magnitudes below the Pickering NGS Units 5-8 derived release limits and action levels. The overall trend has been stable.

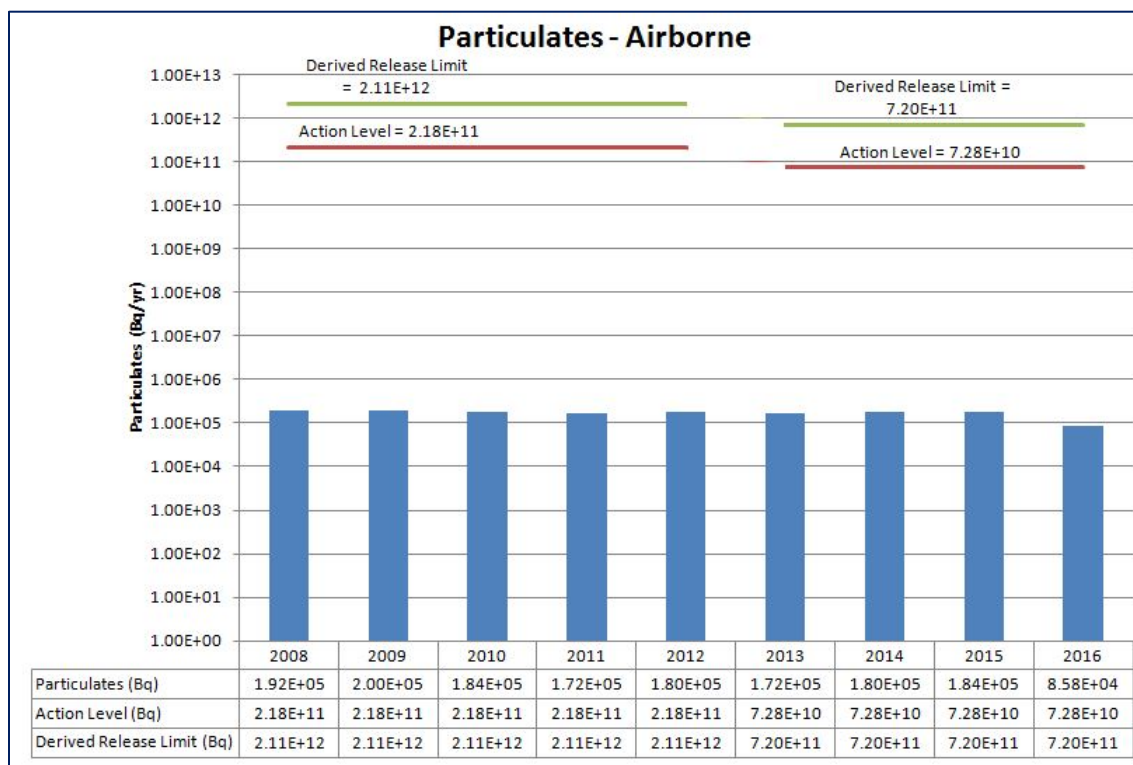


Figure 15: Airborne Particulates from DSC Processing Building Stack Sampler

### Radiological Waterborne Effluent

A small quantity of radioactive liquids from the PWMF Phase I buildings may be generated during DSC decontamination, from floor drains or HVAC condensate in the DSC Processing Building. This liquid is routed to the Pickering NGS's active liquid waste management system where it is monitored and accounted with the station's emissions. The active liquid waste tanks in the DSC Processing Building are sampled for tritium, and gross beta-gamma, prior to being pumped out and discharged into the Pickering NGS's active liquid waste management system.

Figure 16 shows a summary of the tritium in waterborne effluents from the Active Liquid Waste Tanks at the PWMF since 2008. During the current licence period, there have been no derived release limit or action level exceedances for waterborne tritium found in the Active Liquid Waste Tanks. The emissions have been several orders of magnitude below the derived release limit and action levels. The overall trend has remained stable.

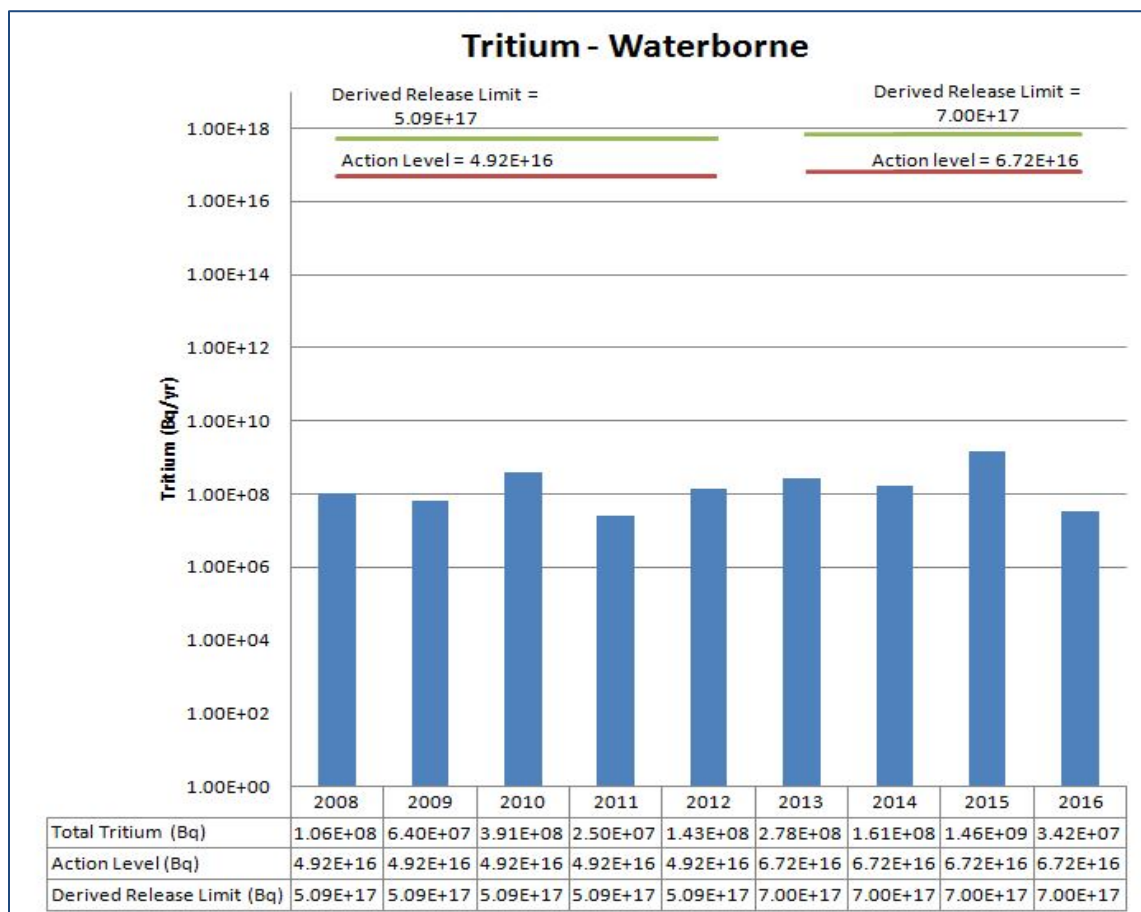


Figure 16: Tritium Waterborne Effluent found in the PWMF Active Liquid Waste Tanks

Figure 17 shows a summary of the gross beta-gamma waterborne effluents from the Active Liquid Waste Tanks at the PWMF since 2008. Any gross beta-gamma data below the Minimum Detectable Activity was assumed to be at the Minimum Detectable Activity of  $1.15 \times 10^{-2}$  Bq/mL for data analysis. The total emissions (Bq) were calculated by multiplying the concentration by the amount of liquid pumped out of the tank.

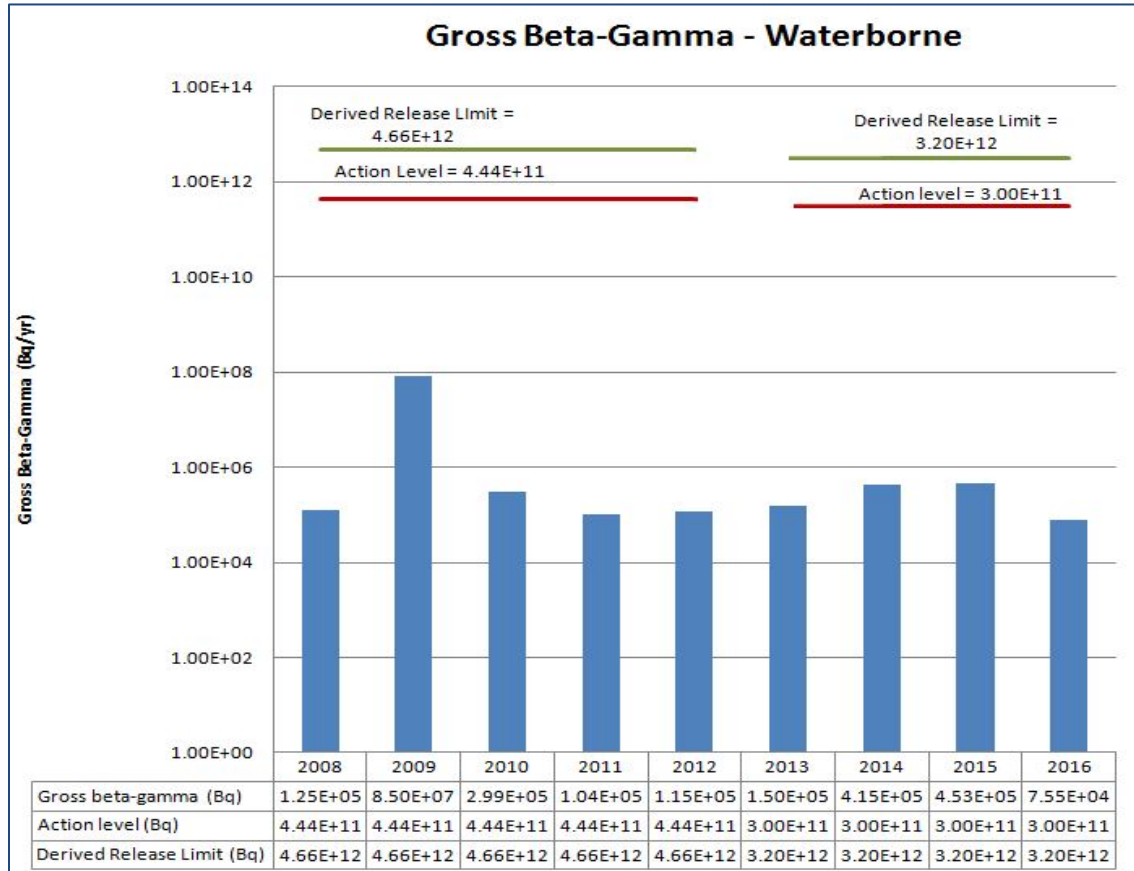


Figure 17: Gross Beta-Gamma Waterborne Effluent found in the PWMF Active Liquid Waste Tanks

Water is sampled from the Retube Component Storage area surface drainage system and catch basins for gross beta-gamma activity on a quarterly basis. This provides assurance that any radioactive contamination in the surface water originating from the Retube Component Storage area is detected. The gross beta-gamma levels have been typically below the Minimum Detectable Activity of  $1.51 \times 10^{-2}$  Bq/mL and generally no detectable levels of activity are found in the surface water runoff.

Since 2008, only two quarters (Q2 2009 and Q3 2010) were reported to be slightly above the Minimum Detectable Activity limit while all other quarters were equal to or less than the Minimum Detectable Activity. During the current licensing period, there have been no derived release limit or action level exceedances for waterborne gross beta-gamma associated with the Retube Component Storage area drainage system.

Beginning in 2009, two water sample stations from DSC Storage Building #3, located on the PWMF Phase II site, have been sampled for gross beta-gamma on a quarterly basis. The gross beta gamma results have been typically below the Minimum Detectable Activity of  $1.51 \times 10^{-2}$  Bq/mL. Since 2009, only three quarters (Q3 2009, Q2 2010 and Q1

2013) were reported to be above the Minimum Detectable Activity limit while all other quarters were equal to or less than the Minimum Detectable Activity. During the current licensing period, there have been no derived release limit or action level exceedances for waterborne gross beta-gamma associated with the DSC Storage Building #3 sampling stations.

All data is reported to the CNSC in the PWMF's quarterly operations reports, and posted on OPG's website at [www.opg.com](http://www.opg.com).

### **Groundwater Monitoring Program**

The Pickering NGS site groundwater monitoring study in 1999/2000 used extensive background research to determine potential locations of contamination in order to accurately represent at-risk areas. The groundwater monitoring network at the Pickering NGS site is shown on Figure 18. The PWMF groundwater monitoring around the facility is integrated into the Pickering NGS site groundwater monitoring program. The direction of groundwater flow beneath the Pickering NGS site and PWMF has been established based on groundwater elevation contours.

The assessment conducted in the previous Environmental Assessment concluded that the project works and activities (including site preparation, construction and operation of DSC Storage Buildings #3, #4, #5 and #6) would not result in any likely effects to the environment. In addition, no Environmental Assessment follow-up activities pertaining to groundwater monitoring at PWMF Phase II were required.

### **Non-Radiological Emissions**

Non-radiological emissions at the PWMF are negligible. DSC paint touch-up operations involve minimal paint quantities. Residual paint aerosols from the paint bays are removed through filters before exhausting to the active ventilation system. Due to small quantities, painting methods, and the use of appropriate filtration, no significant emissions of paint materials are expected. Welding fumes from DSC seal-welding operations are additionally exhausted through the High Efficiency Particulate Air filtered active ventilation system. The emissions from the welding operations are also negligible. Consequently, there is no monitoring program required for non-radiological emissions at the PWMF.

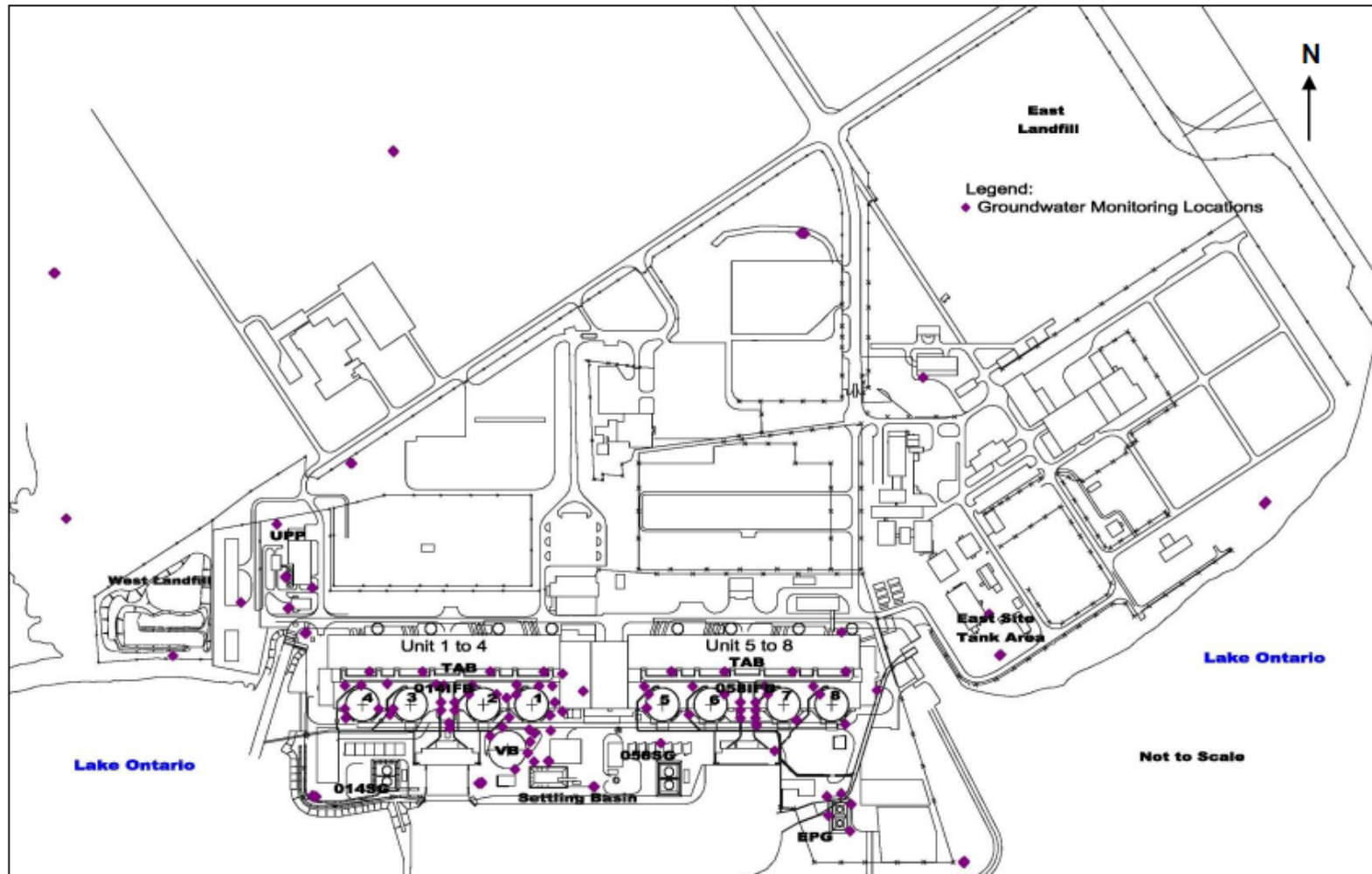


Figure 18: 2016 Groundwater Monitoring Locations



### **Estimated Dose to the Public from the Overall Pickering Nuclear Site**

Radiological emissions from the PWMF are an extremely small fraction of the overall emissions from the Pickering Nuclear site. The off-site radiological impacts from the operation of the PWMF, in addition to the other facilities on the Pickering Nuclear site, are monitored under Pickering Nuclear Environmental Monitoring Program. The Pickering Nuclear Environmental Monitoring Program monitors off-site air, water (municipal, well, lake/stream), aquatic samples (fish, sediment, sand), and terrestrial samples (animal feed, and vegetation). 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 Pickering Nuclear site.

Results of monitoring and public dose assessment are published in the Pickering NGS annual Environmental Monitoring Program report which is submitted to the CNSC and made available to the public on [www.opg.com](http://www.opg.com). Dose to the public from the operation of facilities on the Pickering Nuclear site (including the PWMF) is a very small fraction of the public dose limit. The Pickering Nuclear Environmental Monitoring Program is in compliance with CSA N288.4, *Environmental Monitoring Program at Class I Nuclear Facilities and Uranium Mines and Mills*.

### **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 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 PWMF which is aligned with OPG'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 for 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 and environmental compliance are reviewed annually to ensure that opportunities for continuous improvement are identified and implemented.

Identification of the OPG Significant Environmental Aspects which apply to PWMF 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 PWMF include the following:



- Habitat and Wildlife Biodiversity Conservation, and
- Spills prevention and mitigation.

Risks associated with these Significant Environmental Aspects are managed through operational controls and quality control/assurance. Performance measures are established to ensure the controls perform as designed and are corrected and/or 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 surpassed these targets. Since 2008, there have been no reportable spills and no environmental infractions at the PWMF.

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 Pickering Nuclear site for many years. The site's conservation vision follows the four R's:

- Retain what is significant;
- Restore habitats that have been degraded;
- Replace habitats that have been lost, and
- Recover species that are at risk.

The PWMF biodiversity plan has been integrated into the Pickering NGS biodiversity plan. Multiple site biodiversity and Natural Area Management plans have been made throughout the years in order to maintain a diverse site and achieve the Wildlife Habitat Council Certification. The Wildlife Habitat Certification adds value to programs by providing third party credibility and an objective evaluation of projects.

The major initiatives implemented since 2008 at the Pickering Nuclear site under the Biodiversity Program are as follows:

Accomplishments between 2008 and 2011:

- Terrestrial Long-term Monitoring Project - initiated in 2009 for a five year plan based on the monitoring methodology used by the Toronto and Region Conservation Authority's regional terrestrial long-term monitoring initiative. Forests, wetlands and meadow habitat types were included in order to assess the response of the terrestrial system to various landscape changes, effects of reforestation efforts or urbanization, and then using the natural system changes to better guide management actions on site to improve biodiversity. The monitoring program is ongoing;
- Monitoring - amphibian, habitat structures (wood duck boxes, bat boxes, etc), butterfly and dragonfly inventory, and participation in electrofishing monitoring;
- On-Site Habitat Enhancements - beaver controls to reduce damage to mature trees, Naturalization areas created, planting of native pollinator garden, etc;
- Off-Site Habitat Enhancements - funding to Duffins Creek Marsh Rehabilitation Project and installation of a boardwalk in Altona Forest to reduce soil compaction;

- Wildlife Habitat Council Re-certification - Wildlife Habitat Council Corporate Lands for Learning Recertification obtained in 2009 and Wildlife Habitat Council Wildlife at Work Recertification obtained in 2010, and
- Partnerships - maintained with many local communities, conservation groups and government agencies.

Accomplishments between 2012 and 2016:

- G.L Cinquefoil/Barrier beach - continued naturalization along north shore, amphibian monitoring and Monarch Larva monitoring;
- Hydro Marsh/Krosno Creek - amphibian monitoring, Durham Region Coastal Wetland monitoring, on-site biodiversity, delivered Yellow Fish Road Program to facilitate improvement in water quality, repairs to common tern nesting raft and maintenance of wood duck nest boxes;
- Kinsmen Woodlot, Park Pond, Alex Robertson Park Woodlot, Alex Robertson Park and Brock Road Woodlot - on-site biodiversity monitoring;
- Pickering NGS Lake Ontario Aquatic Nearshore - Durham Region Coastal Wetland monitoring, on-site biodiversity monitoring, and installation of Fish Diversion System, and
- Other programs supported by Pickering Nuclear site - Bring Back the Salmon yearlings release and hatchery, Great Canadian Shoreline Clean-up, Sustainable Pickering Day, and more.

OPG's ongoing Beyond Compliance Biodiversity Management Plan continues to incorporate the restoration, retention, replacement and recovery of multiple Priority Natural Areas. Specifically, future plans have been made for Duffin's Creek Marsh, Frenchman's Bay, the Krosno Creek Hydro Marsh, and the Great Lakes Cinquefoil/Barrier Beach. Pickering Nuclear, including the PWMF, submitted their Wildlife Habitat Council Conservation recertification application in 2016 and has received recertification that is valid until the end of 2019. The Wildlife Habitat Council Conservation Wildlife Certification adds value to programs by providing third-party credibility and an objective evaluation of projects.

### **Environmental Risk Assessment**

An Environmental Risk Assessment has been prepared for the Pickering Nuclear site in accordance with the requirements of CSA N288.6-12, *Environmental Risk Assessment at Class I Nuclear Facilities and Uranium Mines and Mills*. The Environmental Risk Assessment characterized the baseline environment and assessed the human health and ecological risks from operations of the facilities located on the Pickering Nuclear site. The Environmental Risk Assessment had the specific objectives to:

- evaluate the risk to relevant human and ecological receptors resulting from exposure to contaminants and stressors related to the Pickering Nuclear site and its activities, and
- recommend potential further monitoring or assessment as needed based on the results of the Environmental Risk Assessment.

This Environmental Risk Assessment identified a number of areas where supplementary monitoring studies were recommended in order to clarify risk and reduce uncertainty in future human health and ecological risk assessments.

To support the licensing process for the continued operations and eventual Safe Storage of the Pickering NGS, OPG is in the process of updating the Pickering Nuclear site Environmental Risk Assessment. The Environmental Risk Assessment will be updated in advance of the five year cycle to ensure that it reflects the most up to date information. As such, the Environmental Risk Assessment is being revised with the last five years of available data (2011 to 2015) from ongoing environmental programs (i.e. groundwater, fish impingement, environmental monitoring, thermal discharges and species inventory). In addition, a baseline environmental monitoring program was conducted in 2015 for media and parameters that are not routinely analyzed (on-site soil, storm water, lake water, sediment and noise), in order to reduce uncertainty in the Environmental Risk Assessment and address the recommendations identified in the previous Environmental Risk Assessment.

Specific to the operations of the PWMF facilities, emissions from the PWMF are accounted for in the overall emissions reported for the site and the environmental measurements. This revised Environmental Risk Assessment will include a description of the PWMF facilities and capture the human health and ecological risk associated with the operations of the PWMF.

### **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, a review of environmental performance and re-evaluation of objectives and targets in key areas which may impact on the environment is performed.

OPG will continue to implement best practices at the PWMF, aimed at reducing the environmental and radiological risk associated with the handling, processing, and storage of used fuel. PWMF will continue to be included in the Pickering NGS Biodiversity initiatives, which are continuously developing.

The derived release limits for the Pickering Nuclear site will be updated to reflect the 2014 version of CSA N288.1 during the next five year cycle.

### **3.9.4 Challenges**

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

### **3.9.5 Requests**

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

- By December 31, 2017, PWMF will meet the requirements of CSA Standard N288.3.4, *Performing Testing of Nuclear Air-Cleaning Systems at Nuclear Facilities*.
- By December 31, 2017, PWMF 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 Management at PWMF 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 Management encompasses emergencies arising from both nuclear and conventional hazards.

The Nuclear Waste Management program references OPG's Consolidated Nuclear Emergency Plan which documents the emergency response capability to a nuclear emergency at OPG's nuclear stations. Staff on-site at the PWMF participate in site wide emergency drills that involve assembly and accounting or site evacuation.

### Fire Protection

Nuclear Waste Management's goals for Fire Protection at PWMF 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

OPG's Consolidated Nuclear Emergency Plan deals with nuclear emergency situations that endanger the safety of on-site staff, the environment and the public. Although event scenarios at PWMF would not result in a radiological danger to the public or any required protective actions as defined in the Provincial Nuclear Emergency Plan, the procedures developed under the Consolidated Nuclear Emergency Plan would be implemented to support a PWMF event if it resulted in a Station Emergency being declared, or at the nuclear station Shift Manager's discretion.

#### Fire Protection

The fire protection provisions for PWMF are currently required to conform to the:

- 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. Nuclear Waste Management fire protection procedures and other elements 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 specific governance is being reviewed to ensure effective alignment with OPG Nuclear Fire Protection Program. The Fire protection Program ownership has also been reviewed to ensure clarity in roles and responsibilities. The new impairment standard, new revision of Nuclear Waste Management's Impairment Manual and associated documentation is updated to ensure alignment with the OPG Nuclear impairment process.

### **Key Program Elements for PWMF**

The Fire Safety Plan at PWMF meets the requirements of the *National Fire Code of Canada*. The 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.

Fire Drills are performed annually, and inspection and testing of the fire detection and protection system is performed at the required frequency as stipulated in the *National Fire Code of Canada*. A tri-annual independent third party review of PWMF's *National Fire Code of Canada* compliance to the Inspection, Testing and Maintenance report is performed.

A *Memorandum of Understanding* between the City of Pickering and OPG applies to the provision of fire protection services, including coordinated emergency response.

### **3.10.2 Past performance**

#### **Emergency Management**

The Pickering NGS Emergency Response Team is the primary responder for PWMF Phase I, since it is within the nuclear generating station security-protected area. For Phase II, emergency, medical, and fire response is provided by the city of Pickering, with the Pickering NGS Emergency Response Team as the secondary responder.

The Pickering NGS Emergency Response Team conducts two fire response drills per crew per year and one medical response drill per year. PWMF staff participate in all emergency response drills (fire and radiological) conducted by Pickering NGS which affect the PWMF facility.

Hazardous Material spill drills are conducted annually at the Pickering site that include consideration of Pickering NGS and PWMF during the reporting period. Upon completion of each drill, a report is issued which captures lessons learned, corrective actions and valuable operating experience. Spill Drills are one component of spill response improvement and organizational learning as described in the OPG Nuclear Spill Management Standard.

#### **Response to Fukushima Event**

OPG reviewed the initial lessons learned from the Fukushima event in Japan, and re-examined the safety case for the PWMF. 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 summary of PWMF's response to the Fukushima event, refer to Section 4.8.1. No significant gaps and no compensatory actions related to emergency management were identified during these reviews; however, some additional technical studies were performed such as beyond design basis seismic event analysis and flood hazard assessment for the PWMF. 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, and
- For beyond design basis events, internal programs and procedures were revised to improve the post-event response. OPG also purchased additional emergency equipment such as emergency provisions and satellite phones for the PWMF.

A mutual aid agreement that formalizes support among Canadian nuclear operators in the event of a major emergency at any of the nuclear stations 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 PWMF 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 N285.0-08, Update 1, *General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants*;
- CSA B51-03, *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.

In accordance with the PWMF operating licence, inspection, testing and maintenance of the fire detection and protection system is performed at the required frequency as stipulated in the *National Fire Code of Canada*. These inspections and testing are performed by OPG with review by a third party at PWMF. During the reporting period, independent third party reviews were completed tri-annually to confirm the PWMF 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 received indicate that PWMF is in general compliance with the *National Fire Code of Canada* requirements. Corrective actions resulting from the reviews that have been completed include:

- revising the Preventative Maintenance programs to complete visual inspection for self contained emergency lighting units;
- ensuring hydrants are flow tested for a minimum of one minute;
- revising the operating instructions of the Fire Protection system to include a drain test, and
- incorporating maintenance requirements of screw and yoke valves.

The results of the compliance reviews have been submitted to the CNSC as required by the licence.

Fire Drills were also performed in accordance with the *National Fire Code of Canada*. Findings from drills have been satisfactory with no major findings. Recommended minor improvements to procedures and facilities have been assessed and are being implemented as appropriate.

Additionally, in March 2012, OPG provided a review to CNSC staff of the Fire Protection Program at PWMF undertaken by independent third party organizations. This review concluded that the Fire Protection Program at the PWMF substantially fulfills operating licence requirements, and OPG operates, maintains, tests and inspects the fire protection systems in general compliance with the applicable requirements of the *National Fire Code of Canada*. Corrective actions have been completed on all items resulting from the reviews.

Internal audits of the Nuclear Fire Protection Program were also conducted to evaluate effectiveness of the program. An audit conducted in 2013 identified unclear Nuclear Waste Management Fire Protection program ownership, and deficiencies in Nuclear Waste Management Fire Protection governance. 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 also resulted in OPG Nuclear's Fire Protection program becoming the governing program for the PWMF. 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 deficiencies in Nuclear Waste Management Fire Protection governance.

During the current licensing period, there was one CNSC reportable event related to fire protection at PWMF. In February 2015, two air relief valves of the fire protection system were discovered to have a maximum operating pressure lower than the system design. A corrective action to replace them was undertaken and code-compliant valves were installed in December 2015.

#### Fire Protection Response

A *Memorandum of Understanding* between the City of Pickering and OPG applies to the provision of fire protection services, including coordinated emergency response. In the event of an on-site incident, City of Pickering's Fire Services will be called for assistance.

The initial response for the PWMF Phase II portion within its own protected area rests with Pickering Fire Service with support from the Pickering NGS Emergency Response Team. The initial response for the PWMF portion inside the Pickering NGS protected area (Phase I) rests with Pickering NGS Emergency Response Team with support from Pickering Fire Service. Pickering Fire Service is familiar with PWMF.

#### Nuclear Waste Management Division 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 PWMF. 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 Division. 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

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

- REGDOC 2.10.1 (2016), *Nuclear Emergency Preparedness and Response*

#### 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 PWMF Phase II licensed area is expanded as proposed, the new buildings within that area will comply with CSA N393-13 and applicable fire codes and standards.

### 3.10.4 Challenges

Fire Protection governance will be reviewed to further align PWMF with OPG Nuclear.

### 3.10.5 Requests

#### Emergency Management

Consistent with OPG fleet plans and as part of continuous improvement, the PWMF 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

PWMF has completed a gap analysis and is developing 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
- Fire Hazard Assessment.

OPG will provide CNSC staff with a compliance date for transition to CSA N393-13 by December 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 PWMF.

Waste management also covers decommissioning planning. The objective of decommissioning planning is to demonstrate the technical and financial feasibility of decommissioning PWMF 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'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.

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 PWMF use waste management procedures to ensure that waste generated at the facility is separated properly. Waste receptacles are located throughout the PWMF for likely clean and active waste. Minimal radioactive waste is generated from activities conducted at the PWMF. Low level waste generated by PWMF typically is restricted to floor sweepings that have a potential to contain contamination from preparing and welding DSCs. Annual volumes amount to less than one drum and are sent to Pickering NGS for segregation as necessary and eventual transportation to the Western Waste Management Facility. PWMF does not generate intermediate level waste.

#### **Decommissioning**

Planning for the eventual decommissioning of the PWMF is an ongoing process, taking place throughout each stage of the licensed facility lifecycle. A Preliminary Decommissioning Plan 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*. 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 PWMF, 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 PWMF 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 Low and Intermediate Level Waste generated during decommissioning in the Low and Intermediate Level Waste 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 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 PWMF to the Adaptive Phased Management facility.

The PWMF Preliminary Decommissioning Plan describes the activities that will be required to decommission and restore the site for other 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**

The volume of low level radioactive waste produced at PWMF is expected to remain minimal during the next licensing period with an expected slight increase proportional to the number of DSCs processed.

#### **Decommissioning**

OPG is updating the PWMF Preliminary Decommissioning Plan in support of the 2018 to 2022 Financial Guarantee submission. This revision of the Preliminary Decommissioning Plan includes the proposed expansion of PWMF Phase II. The requirements of CSA N294-09 as well as any relevant domestic and international experience obtained in the previous five years are 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.

### **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, PWMF 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*.

## 3.12 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.

PWMF Phase I is contained within the Pickering NGS protected area and as such the security program with respect to that site is described in documentation relating to the Pickering NGS. These meet all regulatory requirements and are consistent with the measures described below. PWMF Phase II is contained within a separate protected area located on the Pickering NGS controlled area site. The security provisions described in this section relate to both phases of the PWMF unless stated otherwise.

The security program for PWMF currently meets the requirements of the *Nuclear Security Regulations* and:

- 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*.

OPG's Cyber Security policy outlines OPG's commitment to operate Information Technology and Industrial Control Systems in a secure, vigilant, and resilient manner that minimizes cyber risks to our information assets and generation facilities. In conjunction with that policy, 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 security program ensures the security of the PWMF'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 PWMF 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 OPG's 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 has evaluated force on force exercises, conducted at the nuclear generation sites, which provide performance testing of the nuclear security program. Lessons learned through OPG security drills and exercises are applied to enhance the program at PWMF;
- 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 PWMF.

Details of the Security Program for PWMF, including the measures to prevent loss or illegal use, possession or removal of nuclear substances, prescribed equipment or prescribed information, are contained in the security protected PWMF Security Report.

OPG has conducted an assessment with respect to REGDOC-2.12.3 *Security of Nuclear Substances – Sealed Sources* in relation to Category 1, 2 and 3 sealed sources and has determined that OPG is in compliance with the requirements of this Regulatory Document. Sealed sources are not included in the PWMF 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). OPG does not have any category 1, 2 or 3 sealed sources at the PWMF. OPG does have lower activity category 4 and 5 sealed sources at the PWMF.

Improvements made to the OPG Security Program during the current licensing period include:

- Major enhancements to the OPG nuclear security training program, incorporating systematic approach to training principles, and the addition of dedicated Security training positions;

- Completion of the transition from the Durham Regional Police Service to an armed Nuclear Security Response Team enhancing overall site security, and
- Enhancements to the security clearance program including additional OPG staff receiving an enhanced security clearance level.

Additionally, the following security improvements were made at Pickering NGS which also enhances security to the PWMF Phase I area:

- The addition of the physical barrier system at Pickering NGS, which is a comprehensive detection system and delay barrier surrounding the Pickering NGS security-protected area, and
- The replacement of aging weapons detection, explosive detection and baggage x-ray devices, used for search of persons entering the Pickering NGS, with devices utilizing industry leading technology.

### 3.12.3 Future plans

#### **Expansion of the PWMF Phase II Protected Area**

OPG is planning on building three additional DSC storage buildings for used fuel in the PWMF Phase II site as shown in Figure 8 and described in section 1.2.2. In addition, OPG is planning on building a new DSC processing building at the Phase II site (also shown in Figure 1 and described in section 1.2.2) to replace the existing DSC Processing Building at the Phase I site. Until completion of the new DSC Processing Building at the Phase II site, the Phase I DSC Processing Building will continue to be used.

The design will incorporate additional security measures, and include enhancements to existing facilities and structures designed to meet the requirements of subsection 9(3)(b) of the *Nuclear Security Regulations*.

Changes to the Phase II area include:

- Expansion of the current Phase II protected area boundary to enclose the footprint of the new DSC Processing Building;
- Construction of temporary protected area barriers which will be placed into service at PWMF to separate the operating facility from the area where construction is occurring. These temporary protected area barriers will be placed into service during construction and remain in place until the conclusion of the construction;
- Replacement of the existing entrance to the PWMF Phase II area with a new security entrance to the Protected Area. The entrance will be constructed to facilitate the search of persons and packages for weapons and explosives through the use of explosives detection and baggage x-ray devices upon access; and for nuclear materials upon egress, utilizing industry leading technology carried out by nuclear security officers, and,
- Further expansion of the protected area boundary at a future date to enclose the footprint of DSC Storage Building #5 and #6.

Both permanent and temporary protected area barriers will be constructed to meet the requirements of the *Nuclear Security Regulations* and CNSC Regulatory Documents RD-321 and RD-361. OPG submitted a security-protected Security Report Annex on November 4, 2016 in support of this application to detail the measures that will be put in place for these new structures at PWMF.

### 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 requirements of REGDOC-2.12.3 and will be compliant with the Regulatory Document's requirements prior to the compliance date of May 31, 2018 as required by 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

The objective of OPG's Safeguards Program is to support OPG's 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 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 PWMF for the current licensing period.

In 2014, the ownership for Safeguards programs in OPG Nuclear moved from the Director, Regulatory Affairs, to the Director, Nuclear Waste Engineering.

PWMF 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 PWMF staff have 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 2008, there have been two CNSC reportable events at PWMF under the Safeguards Regulations. In 2008, there were two reportable events related to the loss of electrical power to the IAEA modem because it was connected to Class IV power which is interruptible. The modem is now connected to Class II power which is uninterruptible. In recent years, there have been no subsequent events demonstrating programmatic improvement.

The IAEA Fuel Verification Program includes material accounting, IAEA monthly remote monitoring reports and the use of surveillance equipment such as cameras, portable verification equipment and containment equipment.

PWMF'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*.

PWMF 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 may perform limited confirmation activities following the annual Physical Inventory Taking process. The IAEA completed a Physical Inventory Verification at PWMF in November 2016.

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.

PWMF also performs annual self-assessments to ensure adherence to the OPG Nuclear Safeguards program.

As of June 2012, PWMF 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 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 19 shows DSCs in storage with their IAEA wire seals in place.



Figure 19: DSCs in Storage with IAEA Wire Seals

### 3.13.3 Future plans

OPG plans to continue to perform annual self-assessments at PWMF 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.

#### **Laser Mapping Container Verification System**

The Western Waste Management Facility's Used Fuel Dry Storage Facility has finished 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 20), 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 DSCs at the Western Waste Management Facility.

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



**Figure 20: Laser Mapping Container Verification System**

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

#### **3.13.4 Challenges**

PWMF 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**

At the Pickering Nuclear site, the transportation of low and intermediate level waste off-site is conducted under the Pickering NGS Power Reactor Operating Licence. There are no off-site shipments of radioactive waste directly from PWMF.

Under the PWMF operating licence, used fuel in DSCs is transferred on-site from the Pickering NGS irradiated fuel bays to the PWMF. CNSC's *Packaging and Transport of Nuclear Substances Regulations* does not apply to the on-site transfer of used fuel in DSCs between the Pickering NGS and the PWMF. Nonetheless, in the absence of any specific regulations for on-site packaging and transport, OPG provides an equivalent degree of safety to workers, the general public and the environment as would have been achieved for off-site transportation.

### **3.14.2 Past performance**

OPG has been safely transporting radioactive materials on public roads 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.

The on-site transfer of used fuel in DSCs from the Pickering NGS to the PWMF is conducted on designated transfer routes in accordance to OPG's procedures. As of Q2 2016, OPG has safely transferred 835 loaded DSCs from the Pickering NGS to the PWMF for processing and storage since 1996.

### **3.14.3 Future plans**

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 PWMF, no off-site shipments of filled DSCs have occurred.

### **3.14.4 Challenges**

PWMF does not foresee any challenges with respect to packaging and transport during the next licensing period.

### **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 Pickering Waste Management Facility Phase II Environmental Assessment

Prior to PWMF expanding to a Phase II site (Figure 21), OPG performed a screening level Environmental Assessment in 2003 in accordance with the Canadian Environmental Assessment Act 1992 to provide additional storage capacity of used fuel in dry storage containers [R1]. The scope of the project included construction and operation of DSC Storage Buildings #3 and #4.

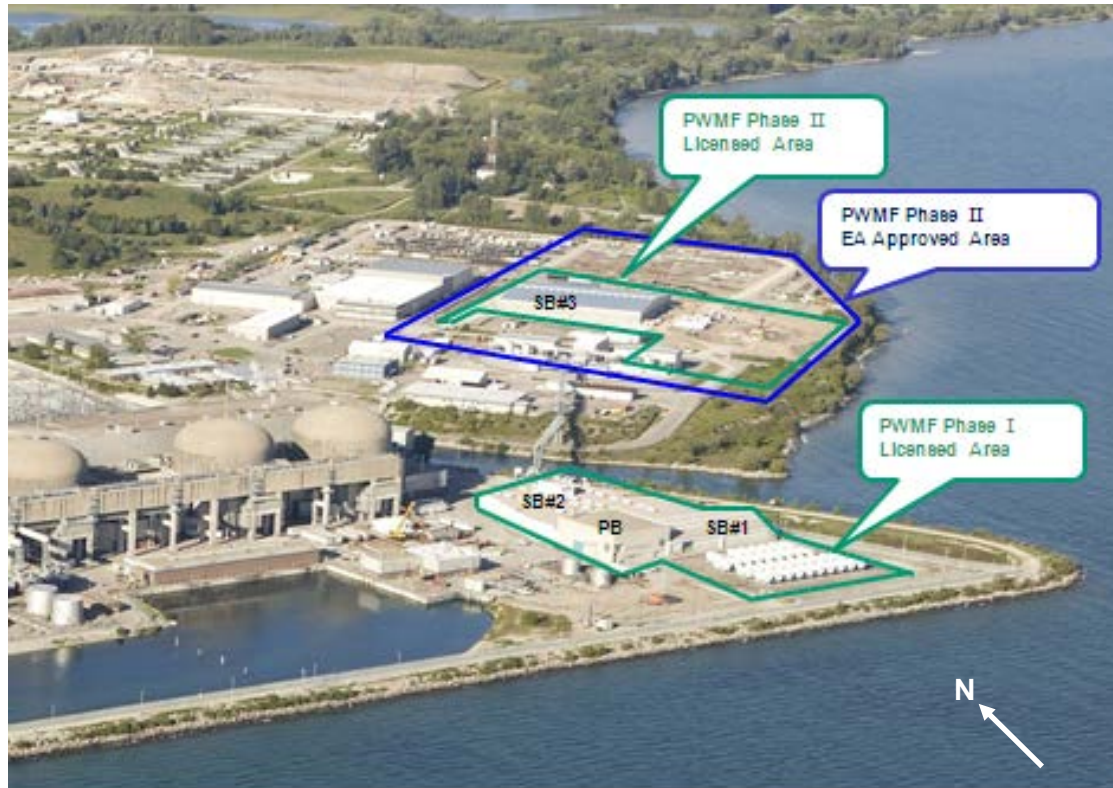


Figure 21: PWMF Phase I and Phase II Sites

The results of the assessment identified no significant residual adverse environmental effects of the PWMF Phase II project with the proposed mitigation measures in place. In 2004, the Commission concluded that the project, taking into account the appropriate mitigation measures identified in the Screening Report, was not likely to cause significant adverse environmental effects, and approved the Environmental Assessment [R2]. The PWMF operating licence was amended in 2005 to include the construction of DSC Storage Buildings #3 and #4.

As part of the PWMF Phase II project, OPG submitted an Environmental Assessment Follow-up Plan which outlined the monitoring requirements for the project. The Environmental Assessment follow-up plan included monitoring related to the following:

- **Stormwater Management:** Stormwater drainage was monitored during the construction of DSC Storage Building #3 which included daily inspection of storm water, erosion, and check dam. The constructor's records indicate that there were no significant problems with storm water drainage [R3];

- Visual Screening: Original plantings along the east perimeter fence of the Pickering Nuclear site were substituted with larger, more mature trees which enhanced the screening and have better survival rates. The trees now provide adequate visual screening of the buildings from the Waterfront Trail, and
- Public Attitude Research Survey: The results from the 2009 survey were compared to the results from the 2002 survey. The results suggest that the PWMF Phase II project did not result in a change in attitude in the local community.

The Environmental Assessment Follow-up Plan, accepted by the CNSC, assumed that DSC Storage Building #4 would be constructed by 2016, and the monitoring results submitted to the CNSC in 2016. Given that DSC Storage Building #4 is not expected to be in-service until 2019, the Environmental Assessment follow-up activities which include stormwater monitoring were rescheduled to align with the timing of the construction and operation of this building.

#### **4.1.2 Pickering NGS Units 5-8 Refurbishment and Continued Operation Project**

As part of its planning process, OPG conducted an Environmental Assessment study for the Pickering NGS Units 5-8 Project to refurbish one or more of the Pickering NGS Units 5-8 reactors. The scope of the Environmental Assessment included the construction and operation of additional waste storage structures to accommodate wastes resulting from reactor refurbishment activities, and from on-going operation of the reactors.

The Environmental Assessment study report and nine technical supporting documents were submitted to the CNSC in December 2007 [R4]. After considering the screening report, the mitigation measures, and comments filed from the public, the CNSC Commission accepted that the project would not cause significant adverse effects [R5].

No specific Environmental Assessment follow-up activities related to the construction and operation of additional storage buildings were identified in the Pickering NGS Units 5-8 Refurbishment and Continued Operation Environmental Assessment.

In 2010, OPG announced that it would not proceed with refurbishing Pickering NGS. Currently OPG is pursuing its plans to operate Pickering NGS to 2024. In consideration of operation to 2020 or potentially to 2024, and to support the need for transfer of all Pickering NGS used fuel to DSCs, OPG plans to proceed with the construction of additional waste storage structures for used fuel, namely DSC Storage Buildings #5 and #6.

## **4.2 Aboriginal consultation**

OPG is committed to engaging with Indigenous communities about PWMF's 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*. OPG also maintains an Indigenous Relations program in accordance with REGDOC-3.2.2 *Aboriginal Engagement*.

Of particular interest are the four communities that make up the Williams Treaties First Nations; Scugog Island, Curve Lake, Hiawatha, and Alderville, in whose traditional

territory the Pickering Nuclear site is located. OPG is also engaged with the local Oshawa and Durham Region Métis Council.

For example, in August 2016 OPG was invited to hold community information sessions in Curve Lake and Hiawatha First Nations to discuss a variety of subjects with community members. In addition to the Pickering licensing, decommissioning, Darlington Refurbishment, the Deep Geological Repository and waste transportation were also covered.

On October 16, 2016, representatives of the Williams Treaties First Nations were invited to the luncheon event for the Darlington breaker-open event. In November 2016, OPG staff briefed Métis Council representatives from Oshawa/Durham, York/Toronto and Peel on the same subjects as a prelude to further engagement with their membership.

Also in November 2016, OPG, as a member of the Aboriginal Apprenticeship Board of Ontario (AABO), took part in the 2<sup>nd</sup> annual day in the trades event held in Cobourg, Ontario. Suppliers, contractors, unions and post-secondary institutions also participated. The emphasis was on attracting Aboriginal youth to the trades. Seventy-six Aboriginal youth from Curve Lake, Tyendinega Mohawk Territory and Pikwakanagan First Nation attended.

In 2016, tours were undertaken by Indigenous communities that have rights and/or interests in current and planned OPG Nuclear and related operations, usually as a study for the Adapted Phase Management plan currently underway with the Nuclear Waste Management Organization. There were two Indigenous community specific tours in 2016 of the PWMF, with twenty-two participants. Planned tours are ongoing, including one that took place for Williams Treaties First Nations representatives in January 2017.

Previously, in 2013, members representing three Métis Councils from southern Ontario toured Pickering NGS including PWMF.

### **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.

OPG holds regular meetings regarding OPG's nuclear operations, including waste operations and transportation with Indigenous communities. The purpose of these meetings is to share information, to identify issues and concerns for resolution, and work collaboratively on areas of common interest.

OPG meets with those Indigenous communities who have an interest in OPG's nuclear operations including the current PWMF Waste Facility Operating Licence renewal application and the longer term PWMF operating license 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 Indigenous procurement, skills training and employment.

On a local basis over the reporting period, OPG met regularly on these topics with:

- Members of the Williams Treaties First Nations:
  - Scugog First Nation;
  - Hiawatha First Nation;
  - Curve Lake First Nation, and

- Alderville First Nation.
- Durham Region Métis Council.

In support of Indigenous community relations and the licensing processes for both PWMF and the Pickering NGS Power Reactor Operating Licence, OPG continues to:

- Inform local Indigenous communities about future site operations proposed in the licences;
- 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 specific Indigenous communities continue to have a primary interest with respect to OPG's waste operations at the PWMF:

- Williams Treaties First Nations;
- Mississaugas of the New Credit First Nation;
- Saugeen Ojibway Nation;
- Historic Saugeen Métis;
- Métis Nation of Ontario;
- Oshawa and Durham Region Métis Council, and
- Toronto and York Region Métis Council.

Further information sharing on current operations, events of significance and the PWMF operating licensing process will continue to be shared with the above communities and any others that identify an interest.

OPG continued its engagement with Indigenous communities through 2016 to raise awareness about its nuclear operations and its nature and scope. Discussion of potential timing of the PWMF operating licence renewal process, how to access the Participant Funding Program from the CNSC, and determination of a community's level of desired engagement were also included.

Engagement with Indigenous communities during the re-licensing process includes timely communication by e-mail, phone, in-person meetings, community information sessions and presentations. To facilitate this level of contact, quarterly meetings are held with the Williams Treaties First Nations and the Métis Nation of Ontario, as well as broader engagement meetings with the Mississaugas of New Credit and the Oshawa Durham and Toronto and York Region Métis Councils. As noted previously, two site tours to the PWMF have been conducted with twenty-two members of interested Indigenous communities and this will continue to be accommodated and encouraged.

### **Future Plans for Improvement**

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

In 2015 OPG participated in the Progressive Aboriginal Relations program offered by the Canadian Council for Aboriginal Business. The summary report from the Canadian Council for Aboriginal Business identified opportunities to enhance the Indigenous procurement process and Indigenous recruitment. These recommendations will be implemented during 2017 and assist OPG in enterprise-wide alignment on these issues.

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 current licensing period, to the CNSC on a quarterly basis 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**

PWMF 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 PWMF 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, 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 proposed 2013-2017 CNSC Consolidated Financial Guarantee requirement submission which was accepted by the CNSC Commission 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 in 2017.

#### **Financial Guarantee**

As noted, in December 2012, 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 Province of Ontario, and the *Provincial Guarantee Agreement* between the CNSC and the Province of Ontario. The PWMF 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 Guidance 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

### Other Relevant Regulations, Obligations and Permits

At the time of writing, Table 7 provides the list of other regulations, obligations that PWMF must abide by, and permits, certificates and licences issued by authorities other than the CNSC.

Table 7: Other Legislation (Non-CNSC) that PWMF Abides By

Regulatory Agencies	Legislation	Legislative Instrument	Reporting Requirements
<b>FEDERAL</b>			
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
<b>PROVINCIAL</b>			
Ministry of Environment and Climate Change	Environmental Protection Act	Not Applicable	Annual Written Summary report for Air and Noise under Environmental Compliance Approval 9090-6SBGEH



<b>Regulatory Agencies</b>	<b>Legislation</b>	<b>Legislative Instrument</b>	<b>Reporting Requirements</b>
Ministry of Environment and Climate Change	Environmental Protection Act	Not Applicable	Annual Update of the Emission Summary and Dispersion modelling for Environmental Compliance Approval 9090-6SBGEH
Ministry of Environment and Climate Change	Environmental Protection Act	Not Applicable	Source Test Report associated with Environmental Compliance Approval 9090-6SBGEH
Ministry of Environment and Climate Change	Environmental Protection Act	Not Applicable	Annual Industrial Sewage Works Performance Report under Environmental Compliance Approval 4881-5MHQ9F
<b>MUNICIPAL</b>			
Toronto and Region Conservation Authority	Not Applicable	Not Applicable	Toronto and Region Conservation Authority Permit #C-110875 expired in October 2013, as all construction was completed.
<b>OTHER</b>			
Technical Standards and Safety Authority	Ontario Technical Standards and Safety Act	Boilers and Pressure Vessels Regulation	Certificate of Authorization P-CERT-01913-0497064 (expires April 15, 2017)
Technical Standards and Safety Authority	Ontario Technical Standards and Safety Act	Elevating Devices Regulation (O. Reg. 209/01)	Licence Number EDLIC-069578 (expires April 15, 2017)

## 4.6 Licensee's public information program

PWMF 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 operations and potential impacts, both positive and negative, which may occur.

### 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. 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, OPG publicly posts performance reports on nuclear waste operations at [www.opg.com](http://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](http://www.opg.com) for both Pickering and Darlington sites.

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'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 PWMF 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.

Two-way dialogue with the public was facilitated through personal contact, community newsletters, speaking engagements, educational outreach, and 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 PWMF, a total of 51 tours were conducted from 2008 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 generated the following:

- Six newsletters to a combined audience of 130,000 households;
- Over 17,000 visitors in 2015 to OPG's waste and Deep Geologic Repository websites;
- A presentation to the Pickering Community Advisory Council (CAC) on Nov. 15, 2016;
- Recent community updates:
  - Sept. 16, 2016 and Nov. 15 2016, CAC meetings; and
  - Nov. 4, 2016 Durham Nuclear Health Committee meeting.
- Recent Community Information Sessions:
  - Wednesday, Nov. 26, 2014 – Pickering Nuclear Information Centre
  - Thursday, Oct. 22, 2015 – Pickering Nuclear Information Centre
  - Wednesday, Oct. 19, 2016 - Toronto Pan Am Sports Centre
  - Thursday, Oct. 20, 2016 - Pickering Recreational Centre
  - Wednesday, Oct. 26, 2016- McLean Community Centre
  - Thursday, Oct. 27, 2016 - OPG Pickering Nuclear Information Centre
- The Community Information Sessions are organized in a way to provide an opportunity for the public to ask questions, obtain clarification, and identify or raise any concerns or issues they may have pertaining to current or future operations.

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 Twitter account with over 7,000 followers, an Instagram account with over 600 followers, and Tweets on relevant nuclear activities and information.

During the licence renewal process, OPG has developed and is undertaking a public community engagement program. The program will:

- Communicate and inform public and Indigenous communities of the future site operations and expansion to determine level of interest and concern;
- Document findings and address concerns;
- Take appropriate steps for public and Indigenous engagement and consultation to help inform the environmental review work as part of OPG's licence submission, and
- Address and manage concerns as appropriate.

#### **4.6.3 Future Plans for Improvement**

OPG plans to:

- Continue to develop and implement a yearly public information program;
- Continue to maintain strong community relationships;
- Continue with website improvements and migration of all relevant PWMF 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 PWMF consistent with the requirements of the new *Nuclear Liability and Compensation Act* which took effect on January 1, 2017. Insurance inspections are conducted at PWMF 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, the 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;
- Dry fuel storage systems and structures;
- Communication and Public Address systems; and
- Transportation packages.

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 prevention or mitigating measures.

### **B. Safety Cases for Beyond Design Basis Events**

For beyond design basis events, the actions applicable to PWMF 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.

No significant gaps were identified during the emergency preparedness review. However, some possible enhancements were identified (Table 8). OPG has completed the implementation.

#### **b. *Technical Studies***

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 PWMF 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 PWMF 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 PWMF.

**Table 8: 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. 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 a satellite and usage. The phone number for the PWMF satellite phones was provided to the CNSC.
2	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.
3	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.
4	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.

#### 4.8.2 Long-Term Waste Management

The long term management or permanent disposal of intermediate level waste and used fuel is outside the scope of the PWMF licence renewal application. It is included here to demonstrate OPG's commitment to managing its waste from cradle to grave.

##### **OPG's Low & Intermediate Level Waste Deep Geologic Repository**

OPG's commitment to safely managing its nuclear waste includes the long-term disposal of Low and Intermediate Level Waste. An environmental assessment for a project to prepare, construct and operate the Low and Intermediate Level Waste Deep Geologic Repository on the Bruce Nuclear Site within the Municipality of Kincardine, Ontario, has been conducted. The Low and Intermediate Level Waste Deep Geologic Repository

would be designed to manage the Low and Intermediate Level Waste produced from the continued operation of the Bruce, Pickering and Darlington NGSs.

If approved, OPG assumes that the Low and Intermediate Level Waste Deep Geologic Repository will be constructed and become operational near the end of the requested licensing period. The availability of the Low and Intermediate Level Waste Deep Geologic Repository will not result in a need to change the programs for the ongoing monitoring and maintenance of the Dry Storage Modules during 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 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 PWMF in the requested licensing period.

#### **4.8.3 Pickering NGS End of Commercial Operation**

During the next PWMF licensing period (2017 – 2028), Pickering NGS will end its commercial operation by shutting down and entering the Stabilization Phase. The Stabilization Phase refers to the period in time following the permanent shutdown of the Pickering NGS where stabilization activities will be carried out in order to transition the station from its current (operational) state, to its Safe Storage State.

During the Stabilization Phase, the reactors will be defueled and the fuel will continue to be stored in the irradiated fuel bays before transfer to the PWMF. The Stabilization Phase is expected to last approximately three years.

Following the Stabilization Phase is the Storage with Surveillance Phase where Pickering NGS will exist in its Safe Storage State until dismantling and demolition activities commence. The Storage with Surveillance period is expected to last approximately 30 years. The fuel will be transferred into dry storage at PWMF during both the Stabilization Phase and Storage with Surveillance Phase.

Throughout the phases of Pickering NGS end of commercial operation, a systematic review of the programs and services which support the Safety and Control Areas will be undertaken. Changes are documented in the Stabilization Activity Plan and other documents which are routinely submitted to the CNSC staff. The continued operation of PWMF will be taken into account to ensure its safe operation when programs are being revised for Pickering NGS.

#### **4.8.4 Open Action Items Discussed in CNSC Hearings and Meetings**

There are no open action items remaining from the 2007 CNSC Hearing on PWMF Licence renewal, the waste management facility consolidated interim status update meetings held in 2010 and 2015, and the meeting in which CNSC staff presented the *Regulatory Oversight Report for Waste Management, Storage and Processing in Canada: 2015* held in 2016.

## 5.0 Conclusions

Through this Commission Member document and the Application for the Renewal of the PWMF Operating Licence, OPG has demonstrated that it is qualified to operate the PWMF 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 PWMF. PWMF has further demonstrated its commitment to safety by operating for the past 22 years without a lost time accident. PWMF has a history of strong operating performance coupled with reliable operation. Over its operating lifetime, PWMF 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. PWMF has met its obligations arising from the Canada/IAEA Nuclear Safeguards Agreement.

OPG continues to enhance the safety, reliability and performance of PWMF 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 PWMF 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 PWMF 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 PWMF safely and reliably, and requests the renewal of the PWMF Operating Licence to August 31, 2028.



## References

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- [R1] OPG Letter, K.E. Nash to M. Ben Belfadhel, "Pickering Waste Management Facility Phase II Project - Submission of Final Environmental Assessment Study Report," December 19, 2003, CD# 92896-CORR-00531-00205.
- [R2] CNSC Letter, S. Locatelli to K. Nash, "Record of Proceedings – Ontario Power Generation," May 28, 2004, CD# 92896-CORR-00531-00233.
- [R3] OPG Letter, N. Mihalic to P. Jones, "Pickering Waste Management Facility Phase II – Environmental Assessment Follow-up Report 2010 – Submission of Enclosures," July 30, 2010, E-Doc 3589043, CD# 92896-CORR-00531-00532.
- [R4] OPG Letter, D.P. McNeil to T.E. Schaubel, CNSC, "Pickering B Environmental Assessment (EA) for Proposed Refurbishment and Continued Operation – Submission of Final EA Study Report," December 17, 2007, CD# NK30-CORR-00531-04644.
- [R5] CNSC Letter, L. Levert to D.P. McNeil, OPG, "Record of Proceedings – Ontario Power Generation Inc.," January 26, 2009, e-Doc 3330500, CD# NK30-CORR-00531-05083.

## List of Acronyms

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CANDU	CANada Deuterium Uranium
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DSC	Dry Storage Container
IAEA	International Atomic Energy Agency
ISO	International Organization for Standardization
NBCC	National Building Code of Canada
NFCC	National Fire Code of Canada
NGS	Nuclear Generating Station
OPG	Ontario Power Generation
PWMF	Pickering Waste Management Facility

## Addendum A: Supporting Details

### Business Plan

Current forecasted in service dates for buildings and structures requested in this licence

<b>Storage Buildings / Structures at PWMF</b>	<b>Next Licence Renewal (2017 – 2028)</b>	
	<b>Approved in Previous Licence, not yet built and carried into Renewed Licence</b>	<b>New Projects to be included in the 2017 – 2028 Licence Period</b>
Dry Storage Modules for Retube Waste Components	Not Applicable	Not Applicable
DSC Storage Buildings	Storage Building #4 (2019)	Storage Buildings #5 and #6 (2024)
DSC Processing Buildings	Not Applicable	New DSC Processing Building (2024)