ONTARIO POWER GENERATION

Laurie Swami
Senior Vice President
Decommissioning and Nuclear Waste Management

1340 Pickering Parkway P84-4 Pickering, Ontario L1V 0C4 **Tel : 905-421-9494 Ext: 3400**
laurie.swami@opg.com

May 16, 2016

CD# W-CORR-00531-01118

Mr. Marc Leblanc
Commission Secretary
Canadian Nuclear Safety Commission
280 Slater Street
Ottawa, Ontario
K1P 5S9

Dear Mr. Leblanc:

Application for Renewal of Western Waste Management Facility Operating Licence

Reference: 1. CNSC letter, S. Oue to L. Mitchell, "Application for Renewal of the Western Waste Management Facility Waste Facility Operating Licence", April 7, 2016, CD# W-CORR-00531-01140.

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

OPG Waste Inc., a corporation owned by Ontario Power Generation (OPG) Inc. is located at 700 University Avenue, Toronto, Ontario, M5G 1X6. The WWMF is located on the Bruce nuclear site within the Municipality of Kincardine in south-western Ontario. The WWMF is licensed by the Canadian Nuclear Safety Commission (CNSC) under section 24(2) of the *Nuclear Safety and Control Act* (NSCA) to provide for the safe handling, management and interim storage of radioactive wastes.

Upon renewal, OPG requests a change to the facilities listed in Appendix C associated with Part IV e) of the current licence for the site preparation, construction or construction modification to include, in total, authorization for:

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

Because of land constraints within the WWMF licensed area, OPG is requesting that the licensed area be expanded to include areas identified as the woodlot and construction laydown area. The expanded area will include the appropriate security measures required for each additional building. A Predictive Effects Assessment was conducted to determine the impact on human health and on non-human biota from the activities to be located in these areas, and it concluded that with mitigation measures, there are no adverse effects.

These facilities would not alter the basic purpose and activities associated with the WWMF. The additional storage and increased processing capability at WWMF will continue to provide safe, interim storage for radioactive waste generated by the operation of Ontario's nuclear power plants under their current respective operating licences.

Except for the Large Object Processing Building and Waste Sorting Facility, no significant changes are anticipated in the designs that have previously been accepted by the CNSC for similar buildings and structures at WWMF. Prior to construction, specific project design requirements are submitted to the CNSC in accordance with the WWMF WFOL Licence Condition 3 – Construction.

This licence renewal application demonstrates that OPG is qualified to operate the WWMF, and has made 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 applicable Regulations under the *Nuclear Safety and Control Act* require specific information to be contained in an application for licence renewal. In response to Reference 1, the following attachments are included with this application:

- Attachment 1 provides a copy of the Land Ownership;
- Attachment 2 provides a matrix that identifies the specific location of the information requested in Reference 1 to support the WWMF WFOL Licence Renewal Application; and,
- Attachment 3 provides the application and describes the objective of each Safety and Control Area and the programs in place to ensure compliance with the objectives. Also described is WWMF's performance since the last licence renewal in 2007 and our planned improvements.

Table 1 provides a list of commitments made in this correspondence and their target completion dates.

Consistent with OPG's approach towards open and transparent public communications, OPG will post this application on our external website www.opg.com.

Should you have any questions, or requests for further information, please contact Ms. Leslie Mitchell, Manager, Regulatory Programs Strategy and Support, at leslie.j.mitchell@opg.com, or (905) 839-6746 ext. 5198, or cell at 905-767-1530.

Sincerely,

Laurie Swami
Senior Vice President
Decommissioning & Nuclear Waste Management

Attach.

cc:	Haidy Tadros	CNSC (Ottawa)
	Karine Glenn	CNSC (Ottawa)
	Shirley Oue	CNSC (Ottawa)
	Shona Thompson	CNSC (Ottawa)

Table 1

Summary of Regulatory Management Actions made in this Letter

Submission Title: "Application for Renewal of Western Waste Management Facility Operating Licence"

Regulatory Management Actions (REGM):

No.	Description	Target Completion Date
1.	WWMF will complete a gap analysis and implementation plan for meeting the requirements of CSA Standard N393-12, *Fire Protection for Facilities that Process, Handle, or Store Nuclear Substances.*	August 31, 2016
2.	WWMF will complete a gap analysis and implementation plan for meeting the requirements of CSA Standards N292.0-14, *General Principles for the Management of Radioactive Waste and Irradiated Fuel,* N292.2-13, *Interim Dry Storage of Irradiate Fuel,* and N292.3-14, *Management of low-and-intermediate-Level Radioactive Waste.*	August 31, 2016
3.	WWMF will complete a gap analysis and implementation plan for meeting the requirements of CSA Standard N288.3.4, *Performing Testing of Nuclear Air-Cleaning Systems at Nuclear Facilities*.	December 31, 2016
4.	WWMF will meet the requirements of REGDOC-2.6.3, *Aging Management.*	July 15, 2017
5.	WWMF will complete a gap analysis and implementation plan for meeting the requirements of CSA Standard N288.4, *Environmental Monitoring Program at Class I Nuclear Facilities and Uranium Mines and Mills*.	December 31, 2017
6.	WWMF will complete a gap analysis and implementation plan for meeting the requirements of CSA Standard N288.7, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills*.	December 31, 2017
7.	WWMF meet the requirements of REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources* for the storage and transportation of category 4 and 5 sealed sources.	May 31, 2018

ATTACHMENT 1

Land Ownership and Control

Province of Ontario

Transfer/Deed of Land

Form 1 — Land Registration Reform Act

SoftDocs® 4.1 Wordprocessor Interface

OPG-Bruce Waste Inc.

A

FOR OFFICE USE ONLY

(1) Registry [X] Land Titles [ ]

(2) Page 1 of 3A pages 1 office schedule

(3) Property Identifier(s) Block Property P900499 Additional: See Schedule [ ]

(4) Consideration
NIL ---------- 00/100 Dollars $NIL

(5) Description This is a: Property Division [ ] Property Consolidation [ ]

New Property Identifiers see Certificate attached Additional: See Schedule [ ]

1. Part of Lots 18, 19, 20, 21, 22, 23 and 24, Concession A or Lake Range and Part of the Original Road Allowance between Lots 20 and 21 (closed by By-Law 811), Concession A or Lake Range, all designated as PARTS 12, 21, 22, 23, 24, 25, 26, 29, 30, 32, 33, 34, 35, 36, 64, 65, 68 and 69 on Plan 3R-7352, Township of Bruce, now in the Municipality of Kincardine, in the County of Bruce
- as described on Schedule annexed

Executions Additional: See Schedule [ ]

(6) This Document Contains (a) Redescription New Easement Plan/Sketch [ ] (b) Schedule for: Description [X] Additional Parties [ ] Other [X]

(7) Interest/Estate Transferred
Fee Simple
Confirming Deed.

(8) Transferor(s) The transferor hereby transfers the land to the transferee and certifies that the transferor is the owner of the land for a valid consideration and that

see attached Schedule A entitled "*Electricity Act, 1998* Registration Statement".

Name(s)	Signature(s)	Date of Signature Y M D
OPG WASTE INC.	By: [signature] Name: David W. Drinkwater Title: Executive Vice President Law and Corporate Department	2001 04 24
We have the authority to bind the corporation.	By: [signature] Name: Richard Dicerni Title: Executive Vice President and Corporate Secretary	2001 04 24

(9) Spouse(s) of Transferor(s) I hereby consent to this transaction.

Name(s)	Signature(s)	Date of Signature Y M D

(10) Transferor(s) Address for Service C/o 700 University Avenue, Toronto, Ontario M5G 1X6

(11) Transferee(s) Date of Birth Y M D

OPG WASTE INC.

(12) Transferee(s) Address for Service C/o 700 University Avenue, Toronto, Ontario M5G 1X6

Planning Act — OPTIONAL

(13) Transferor(s) The transferor verifies that to the best of the transferor's knowledge and belief, this transfer does not contravene section 50 of the Planning Act.

Date of Signature Y M D — Signature

Date of Signature Y M D — Signature

Solicitor for Transferor(s) I have explained the effect of section 50 of the Planning Act to the transferor and I have made inquiries of the transferor to determine that this transfer does not contravene that section and based on the information supplied by the transferor, to the best of my knowledge and belief, this transfer does not contravene that section. I am an Ontario solicitor in good standing.

Name and Address of Solicitor

Date of Signature Y M D — Signature

Affix Statement by Solicitor for Transferee(s) here if necessary

(14) **Solicitor for Transferee(s)** I have investigated the title to this land and to abutting land where relevant and I am satisfied that the title records reveal no contravention as set out in subclause 50(22)(c)(ii) of the Planning Act and that to the best of my knowledge and belief this transfer does not contravene section 50 of the Planning Act. I act independently of the solicitor for the transferor(s) and I am an Ontario solicitor in good standing.

Name and Address of Solicitor

Date of Signature Y M D — Signature

(15) Assessment Roll Number of Property Cty. Mun. Map Sub. Par. MULTIPLE

(16) Municipal Address of Property
Bruce Generating Station (Part)

11208441

(17) Document Prepared by:
BLAKE, CASSELS & GRAYDON LLP
Barristers and Solicitors
Box 25, Commerce Court West
Toronto, Ontario M5L 1A9
(416) 863-2400
ATTENTION: Edward M. Perlmutter

FOR OFFICE USE ONLY

Fees and Tax	
Registration Fee	60 -
Land Transfer Tax	( )
Total	60 -

 LRRA Form 1 11/1992

SCHEDULE A P90499

TO TRANSFER/DEED OF LAND

***ELECTRICITY ACT, 1998* REGISTRATION STATEMENT**

1. OPG-Bruce Waste Inc. is a person referred to in section 124 of the *Electricity Act, 1998* and is a person from which no consent was required in respect of the transfer in the transfer order, as amended, pursuant to subsection 116(5) of the *Electricity Act*, 1998.

2. OPG-Bruce Waste Inc. changed its name by Articles of Amendment effective April 12, 2001 to OPG Waste Inc. as registered in the Land Registry Office for the Registry Division of Bruce on , 2001 as No. .

3. The interests described in Box (7) in the lands (the "Lands") described in Box (5) in the Form 1 under the *Land Registration Reform Act* to which this schedule is attached were transferred unconditionally to OPG-Bruce Waste Inc. from Ontario Hydro by or pursuant to a Transfer Order, as amended, made under the *Electricity Act*, 1998, which transfer has taken effect.

4. There were no conditions or other provisions in the Transfer Order, as amended, that restrict the power or right of the Transferor to transfer the interest described in Box (7) in the Lands.

5. The foregoing statements are statements made pursuant to section 124 of the *Electricity Act*, 1998.

6. This transfer/deed of land is being registered to record the name of Transferee on title to the Lands.

7. Pursuant to Section 135 of the *Electricity Act*, 1998 the *Land Transfer Tax Act* does not apply to any transfer of assets by or pursuant to a transfer order.

8. Where applicable, by the *Power Commission Amendment Act*, 1973 proclaimed March 4, 1974, the name of The Hydro-Electric Power Commission of Ontario was changed to Ontario Hydro.

P900499

SCHEDULE

In the Township of Bruce, now in the Municipality of Kincardine, County of Bruce:

1. Part of Lots 18, 19, 20, 21, 22, 23 and 24 Concession A or Lake Range, and Part of the Original Road Allowance between Lots 20 and 21, (Closed by By-Law 811), Concession A or Lake Range.

   All designated as PARTS 12, 21 to 25 both inclusive, 26, 29, 30, 32, 33, 34, 35, 36, 64, 65, 68 and 69, on Plan 3R-7352.

2. Part of Lots 11, 12, 13, 14 and 15, Concession A or Lake Range, and Part of McNabb Street on the Town Plot of Inverhuron (Crown Survey No. VI) (Closed by By-Law 77-11) designated as PARTS 1, 2 and 3 on Plan 3R-7351, save and except PART 1 on Plan 3R-7355.

   Together with an easement in, on, over, along and upon those parts of Lots 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 and part of original allowance for road along the shore of Lake Huron Concession A or Lake Range designated as PARTS 45, 46, 47 48, 91, 92, 93, 123, 125 and 127 on Plan 3R-7352 for the purposes of pedestrian and vehicular access and installing constructing, repairing, replacing and using services, utilities, sewers, telecommunications equipment, conduits, pipes and cables and such other uses as may reasonably be required by an owner or occupant of the said lands pursuant to this transfer order and subject to such reasonable restrictions as may be imposed by the owner of the subject lands from time to time.

   And Together with an easement in, over, along and across those parts of Lots 11, 12, 13, 14, 15 and part of McNabb Street (closed by By-Law 77-11), Lot 1 west side of Head Street, Lot 1 east side of Raglan Street, Lot 1 west side of Raglan Street, Lot 1, east side of Morin Street, Lot 1 west side of Morin Street, Lot 1 east side of Russell Street, part of Head Street (closed by By-Law 1752), part of Raglan Street (closed by By-Law 810) and part of Morin Street (closed by By-Law 810), designated as PARTS 15, 16, 18, 19, 20, 21, 25 and 26 on Plan 3R-7351 and PART 1 on Plan 3R-7355 for the purposes of pedestrian and vehicular access and installing constructing, repairing, replacing and using services, utilities, sewers, telecommunications equipment, conduits, pipes and cables and such other uses as may reasonably be required by an owner or occupant of the said lands pursuant to this transfer order and subject to such reasonable restrictions as may be imposed by the owner of the subject lands from time to time.

   And Together with an easement in, on, over along and upon those parts of Lots 15, 16, 17, 18, 19, 20, 21, 22, 23, 24 and part of the original allowance for road allowance between Lots 20 and 21, Concession A or Lake Range designated as PARTS 5, 13, 14, 15, 16, 17, 18, 27, 28, 66, 113, 116, 118 and 120 on Plan 3R-7352 for the purposes of pedestrian and vehicular access and installing constructing, repairing, replacing and using services, utilities, sewers, telecommunications equipment, conduits, pipes and cables and such other uses as may reasonably be required by an owner or occupant of the said lands pursuant to this transfer order and subject to such reasonable restrictions as may be imposed by the owner of the subject lands from time to time.

ATTACHMENT 2

Table 1: WWMF Licence Application Matrix

Table 2: Changes Between Previous and this Applications

Table 1: WWMF Licence Application Matrix

Regulatory Requirement	Description of Regulatory Requirement	Related Safety Control Area	Location in Submission
General Nuclear Safety and Control Regulations			
General Application Requirements 3. (1) An application for a licence shall contain the following information;			
(a)	The applicant's name and business address;	n/a	Ontario Power Generation Inc. 700 University Avenue Toronto, Ontario M5G 1X6 <u>Mailing Address c/o:</u> Ms. Laurie Swami Senior Vice President Decommissioning and Nuclear Waste Management 1340 Pickering Parkway, 4th Floor Pickering, Ontario L1V 0C4
(b)	The activity to be licensed and its purpose;	n/a	Cover Letter – OPG letter, Laurie Swami to Marc Leblanc, "Application for Renewal of Western Waste Management Facility (WWMF) Operating Licence, and Amendment for WWMF Expansion", May 16, 2016, CD# W-CORR-00531-01118.
(c)	The name, maximum quantity and form of any nuclear substance to be encompassed by the licence;	n/a	Attachment 3, Section 1.1
(d)	A description of any nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence;	Security	Attachment 3, Section 2.12
(e)	The proposed measures to ensure compliance with the *Radiation Protection Regulations*, the *Nuclear Security Regulations* and the *Packaging and Transport of Nuclear*	Radiation Protection Security	Attachment 3, Section 2.7 Attachment 3,

Regulatory Requirement	Description of Regulatory Requirement	Related Safety Control Area	Location in Submission
	Substances Regulations, 2015;	Packaging & Transport	Section 2.12 Attachment 3, Section 2.14
(f)	Any proposed action level for the purpose of section 6 of the *Radiation Protection Regulations*;	Radiation Protection Environment Protection	Attachment 3, Section 2.7 Attachment 3, Section 2.9
(g)	The proposed measures to control access to the site of the activity to be licensed and the nuclear substance, prescribed equipment or prescribed information;	Security Radiation Protection	Attachment 3, Section 2.12 Attachment 3, Section 2.7
(h)	The proposed measures to prevent loss or illegal use, possession or removal of the nuclear substance, prescribed equipment or prescribed information;	Security	Attachment 3, Section 2.12.2
(i)	A description and the results of any test, analysis or calculation performed to substantiate the information included in the application;	Safety Analysis	Attachment 3, Section 2.4
(j)	The name, quantity, form, origin and volume of any radioactive waste or hazardous waste that may result from the activity to be licensed, including waste that may be stored, managed, processed or disposed of at the site of the activity to be licensed, and the proposed method for managing and disposing of that waste;	Waste Management	Attachment 3, Section 2.11
(k)	The applicant's organizational management structure insofar as it may bear on the applicant's compliance with the Act and the regulations made under the Act, including the internal allocation of functions, responsibilities and authority;	Management System	Attachment 3, Section 2.1
(l)	A description of any proposed financial guarantee relating to the activity to be licensed;	Financial Guarantee	Attachment 3, Section 3.5

Regulatory Requirement	Description of Regulatory Requirement	Related Safety Control Area	Location in Submission
(m)	Any other information required by the Act or the regulations made under the Act for the activity to be licensed and the nuclear substance, nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence.	n/a	n/a
1.1	The Commission or a designated officer authorized under paragraph 37(2)(*c*) of the *Act*, may require any other information that is necessary to enable the Commission or the designated officer to determine whether the applicant: (a) is qualified to carry on the activity to be licensed, or (b) will, in carrying on that activity, 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.	n/a	Refer to "Other Information" below.
(2)	Subsection (1) does not apply in respect of an application for a licence to import or export for which the information requirements are prescribed by the *Nuclear Non-Proliferation Import and Export Control Regulations*, or in respect of an application for a licence to transport while in transit for which the information requirements are prescribed by the *Packaging and Transport of Nuclear Substances Regulations*.	n/a	n/a
Other Information Pursuant to 1.1 (as provided in Attachment 4[1])			
(1)	Summary of programs and supporting documentation needed to support the licence application organized under each SCA, including other matters of regulatory interest. The programs and supporting documentation should be	All SCA	Attachment 3, Sections 2.1 to 2.14

[1] CNSC letter, S. Oue to L. Mitchell, "Application for Renewal of the Western Waste Management Facility Waste Facility Operating Licence", April 7, 2016, CD# W-CORR-00531-01140, CNSC e-doc 4950490.

Regulatory Requirement	Description of Regulatory Requirement	Related Safety Control Area	Location in Submission
	sufficiently detailed to describe the safety and control measures that will be implemented at WWMF for each SCA.		
(2)	Description of WWMF's approach to safety, including reference to corporate and facility specific documents which enunciate the safety policies and standards to which WWMF must adhere.	Management System	Attachment 3, Section 2.1
(3)	Documents describing the organizational structure, roles and responsibilities of organizational units and management; including documents governing the day to day operation and conduct of the organization.	Management System	Attachment 3, Section 2.1
(4)	Information on WWMF's performance for each SCA during the current licence period, relative to OPG's expectations, including any trends	All SCA	Attachment 3, Sections 2.1 to 2.14
(5)	Assessment of existing and future safety challenges, along with a safety improvement plan to address these challenges during the next licence period	All SCA	Attachment 3, Sections 2.1 to 2.14
(6)	Describe opportunities for improvements and any safety improvement plans to address identified safety challenges	All SCA	Attachment 3, Sections 2.1 to 2.14
(7)	A description of the proposed operating plan for the next licensing period	General Operating Performance	Attachment 3, Section 1 Attachment 3, Section 2.3
(8)	Information on significant activities envisaged beyond the end of the next licensing period, if any	All SCAs	Attachment 3, Sections 2.1 to 2.14
(9)	Provide a list of federal, provincial, municipal or other regulations, other than the regulations pursuant to the NSCA, which WWMF must abide by	Other	Attachment 3, Section 3.7
(10)	Provide a description of any obligations for municipal, provincial or other federal authorities and any obligations for public and/or private	Other	Attachment 3, Section 3.8.1

Regulatory Requirement	Description of Regulatory Requirement	Related Safety Control Area	Location in Submission
	organizations		
(11)	Provide a list of any permits, certificates and licences issued by authorities other than the CNSC	Other	Attachment 3, Section 3.8
(12)	Provide updated Derived Release Limits and Operating Release Limit reports for the facility	Environmental Protection	Attachment 3, Section 2.9
(13)	Provide OPG's plans and schedule, including dates, with respect to complying with each of the standards, codes and CNSC regulatory documents found in Attachment 2 (unless recommended to be included under recommendations and guidance), including transition measures as appropriate.	All SCA	Attachment 3, Sections 2.1 to 2.14
(14)	Summary of the current status of all open actions items, as well as issues and requests that were discussed during the last WWMF Commission hearings or meetings, including a plan and date for resolution.	Other	Attachment 3, Section 3.8.2
(15)	Provide justification to ensure that any proposed action level for the purpose of section 6 of the *Radiation Protection Regulations* will provide timely warning of any potential or actual loss of control of part of the radiation protection program.	Radiation Protection Environmental Protection	Attachment 3, Section 2.7 Attachment 3, Section 2.9
Application for Renewal of Licence 5. An application for the renewal of a licence shall contain:			
(a)	The information required to be contained in an application for that licence by the applicable regulations made under the Act; and	n/a	Cover Letter Attachment 3, Section 1
(b)	A statement identifying the changes in the information that was previously submitted.	n/a	Attachment 2, Table 2
Obligations – Representatives of Applicants and Licencees 15. Every applicant for a licence and every licensee shall notify the Commission of			
(a)	the persons who have authority to act	n/a	Attachment 3,

Regulatory Requirement	Description of Regulatory Requirement	Related Safety Control Area	Location in Submission
	for them in their dealings with the Commission;		Section 2.1.10
(b)	the names and position titles of the persons who are responsible for the management and control of the licensed activity and the nuclear substance, nuclear facility, prescribed equipment or prescribed information encompassed by the licence; and		
(c)	any change in the information referred to in paragraphs (*a*) and (*b*), within 15 days after the change occurs.		
Class I Nuclear Facilities Regulations			
LICENCE APPLICATIONS, *General Requirements*			
3. An application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain the following information in addition to the information required by section 3 of the *General Nuclear Safety and Control Regulations*:			
(a)	A description of the site of the activity to be licensed, including the location of any exclusion zone and any structures within that zone;	n/a	Attachment 3, Section 1
(b)	Plans showing the location, perimeter, areas, structures and systems of the nuclear facility;	n/a	Attachment 3, Section 1
(c)	Evidence that the applicant is the owner of the site or has authority from the owner of the site to carry out the activity to be licensed;	n/a	Attachment 1
(d)	The proposed quality assurance program for the activity to be licensed;	Management System	Attachment 3, Section 2.1
(e)	The name, form, characteristics and quantity of any hazardous substances that may be on the site while the activity to be licensed is carried on;	Other Matters of Regulatory Interest Environmental Protection	Attachment 3, Section 3.1 Attachment 3, Section 2.9
(f)	The proposed worker health and safety policies and procedures;	Conventional Health & Safety	Attachment 3, Section 2.8
(g)	The proposed environmental protection policies and procedures;	Environmental Protection	Attachment 3, Section 2.9
(h)	The proposed effluent and environmental monitoring programs;	Environmental Protection	Attachment 3, Section 2.9

Regulatory Requirement	Description of Regulatory Requirement	Related Safety Control Area	Location in Submission
(i)	If the application is in respect of a nuclear facility referred to in paragraph 2(b) of the *Nuclear Security Regulations*, the information required by section 3 of those Regulations;	Security	Attachment 2, Section 2.12,
(j)	The proposed program to inform persons living in the vicinity of the site of the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the activity to be licensed; and	Community Relations	Attachment 3, Sections 3.2 and 3.3
(k)	The proposed plan for the decommissioning of the nuclear facility or of the site.	Waste Management	Attachment 3, Section 2.11.4
Licence to Operate 6. An application for a licence to operate a Class I nuclear facility shall contain the following information in addition to the information required by section 3:			
(a)	A description of the structures at the nuclear facility, including their design and their design operating conditions;	n/a	Attachment 2, Section 1
(b)	A description of the systems and equipment at the nuclear facility, including their design and their design operating conditions;	n/a	Attachment 2, Section 1
(c)	A final safety analysis report demonstrating the adequacy of the design of the nuclear facility;	Safety Analysis	Attachment 2, Section 2.4
(d)	The proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility;	Operating Performance	Attachment 2, Section 2.3
(e)	The proposed procedures for handling, storing, loading and transporting nuclear substances and hazardous substances;	Package & Transport	Attachment 2, Section 2.14
(f)	The proposed measures to facilitate Canada's compliance with any applicable safeguards agreement;	Safeguards	Attachment 2, Section 2.13
(g)	The proposed commissioning program for the systems and equipment that will be used at the nuclear facility;	n/a	Project specific.
(h)	The effects on the environment and	Other Matter of	Attachment 3,

Regulatory Requirement	Description of Regulatory Requirement	Related Safety Control Area	Location in Submission
	the health and safety of persons that may result from the operation and decommissioning of the nuclear facility, and the measures that will be taken to prevent or mitigate those effects;	Regulatory Interest (Environmental Assessment) Environmental Protection	Section 3.1 Attachment 3, Section 2.9
(i)	The proposed location of points of release, the proposed maximum quantities and concentrations, and the anticipated volume and flow rate of releases of nuclear substances and hazardous substances into the environment, the health and safety and hazardous substances into the environment, including their physical, chemical and radiological characteristics;	Other Matter of Regulatory Interest (Environmental Assessment) Environmental Protection	Attachment 3, Section 3.1 Attachment 3, Section 2.9
(j)	The proposed measures to control releases of nuclear substances and hazardous substances into the environment;	Environmental Protection	Attachment 3, Section 3.1
(k)	The proposed measures to prevent or mitigate the effects of accidental releases of nuclear substances and hazardous substances on the environment, the health and safety of persons and the maintenance of security, including measures to (i) assist off-site authorities in planning and preparing to limit the effects on an accidental release, (ii) notify off-site authorities of an accidental release or the imminence of an accidental release, (iii) report information to off-site authorities during and after an accidental release, (iv) assist off-site authorities in dealing with the effects of an accidental release, and (v) test the implementation of the measures to prevent or mitigate the effects of an accidental release;	Emergency Preparedness	Attachment 3, Section 2.10.1
(l)	The proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility, including measures to alert the licensee to such acts;	Security	Attachment 3, Section 2.12

Regulatory Requirement	Description of Regulatory Requirement	Related Safety Control Area	Location in Submission
(m)	The proposed responsibilities of and qualification requirements and training program for workers, including the procedures for the requalification of workers; and	Training	Attachment 3, Section 2.2
(n)	The results that have been achieved in implementing the program for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility.	Training	Attachment 3, Section 2.2
Nuclear Security Regulations			
Part 2 Security Of Nuclear Facilities Listed in Schedule 2 – Licence Applications			
41	An application for a licence in respect of a nuclear facility shall contain, in addition to the information required by sections 3 to 8 of the *Class I Nuclear Facilities Regulations*, a description of the physical protection measures to be taken to ensure compliance with sections 42 to 48.	Security	Attachment 3, Section 2.12
Nuclear Substances and Radiation Devices			
3. (1) An application for a licence in respect of a nuclear substance or a radiation device, other than a licence to service a radiation device, shall contain the following information in addition to the information required by section 3 of the *General Nuclear Safety and Control Regulations:*			
(a) to (o)		Radiation Protection Security	OPG holds several licences under the Nuclear Substances and Radiation Devices Regulations, as listed in Attachment 3, Sections 2.7 and 2.12. However, OPG is not applying for these activities under this licence application.

Table 2: Changes Between Previous and this Applications

Parts of Previous Application	Contents of Previous Application (July 2006)	Parts of Current Application	Contents of Current Application (May 2016)
Letter of Application	Letter and the Western Waste Management Facility Safety Report	Letter of Application	Letter, including attachments
		Attachment 1	Land Ownership and Control
		Attachment 2	Table 1: WWMF Licence Application matrix Table 2: Changes Between Previous and This application
		Attachment 3	WWMF Licence Renewal Application

ATTACHMENT 3

WWMF Licence Renewal Application

ONTARIO POWER GENERATION

Western Waste Management Facility

Application for Licence Renewal

May 2016

Table of Contents

List of Tables and Figures

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EXECUTIVE SUMMARY

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

Upon renewal, Ontario Power Generation Inc. (OPG) requests a change to the facilities listed in Appendix C associated with Part IV e) of the current licence for the site preparation, construction or construction modification to include, in total, authorization for:

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

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

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

OPG has been safely transporting radioactive materials for over 45 years, and has never had an accident resulting in a radioactive release or serious personal injury. OPG drivers transporting radioactive materials have an excellent safety record on the roads and have travelled over 3 million kilometers during the last 9 years (current licensing period between 2007 and 2015) without any at fault incidents.

This report presents information on the performance of WWMF in areas related to the fourteen Safety and Control Areas. During the current licensing period, WWMF has operated safely and reliably to protect the public, the workers and the environment. OPG is proud of its excellent record in conventional and radiological worker safety, and is well positioned for the continued operation of WWMF.

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

OPG has built a healthy safety culture that permeates the organization, and demonstrates a focus to improve organizational effectiveness through the use of best practices, enhanced behaviours and learning.

1.0 OVERVIEW

Ontario Power Generation (OPG) is an Ontario-based electricity generation company whose principal business is the generation and sale of electricity in Ontario. Electricity generated by nuclear power comes with the by-product of radioactive waste. OPG is committed to the responsible and comprehensive management of all its radioactive waste, and has been safely storing this waste at its waste management facilities located at the Bruce, Pickering and Darlington nuclear sites.

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

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

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

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

The current ten-year WFOL for WWMF (WFOL-W4-314.03/2017) expires on May 31, 2017. OPG is requesting a renewal of the operating licence for another ten (10) years, from June 1, 2017 to May 31, 2027. The renewal would allow OPG to continue with the safe interim storage of used fuel and L&ILW.

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

Upon renewal, OPG requests a change to the facilities listed in Appendix C associated with Part IV e) of the current licence for the site preparation, construction or construction modification to include, in total, authorization for:

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

- Waste Sorting Facility.

These buildings and structures are described in more detail in Sections 1.3 and 1.4 of this application. Except for the Large Object Processing Building and Waste Sorting Building, no significant changes are anticipated in the designs that have been previously approved for similar buildings and structures on-site. Project specific design requirements will be submitted to the CNSC in accordance with the WWMF WFOL Licence Condition 3 – *Construction* 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 by the Commission or a person authorized by the Commission, in accordance with Condition 2.2 of the current licence.

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, as described in Section 2.12.3. A predictive effects assessment was conducted to identify the effects to human and non-human biota, and is described in Section 3.1.2 of this application.

Figure 1 shows the existing licensed area in red. The woodlot and construction laydown areas are two locations currently being considered for the expansion. This expansion would not alter the basic purpose and activities associated with the WWMF. The additional storage capacity at the WWMF will enable the generating stations to continue operating as planned under their current respective operating licences.

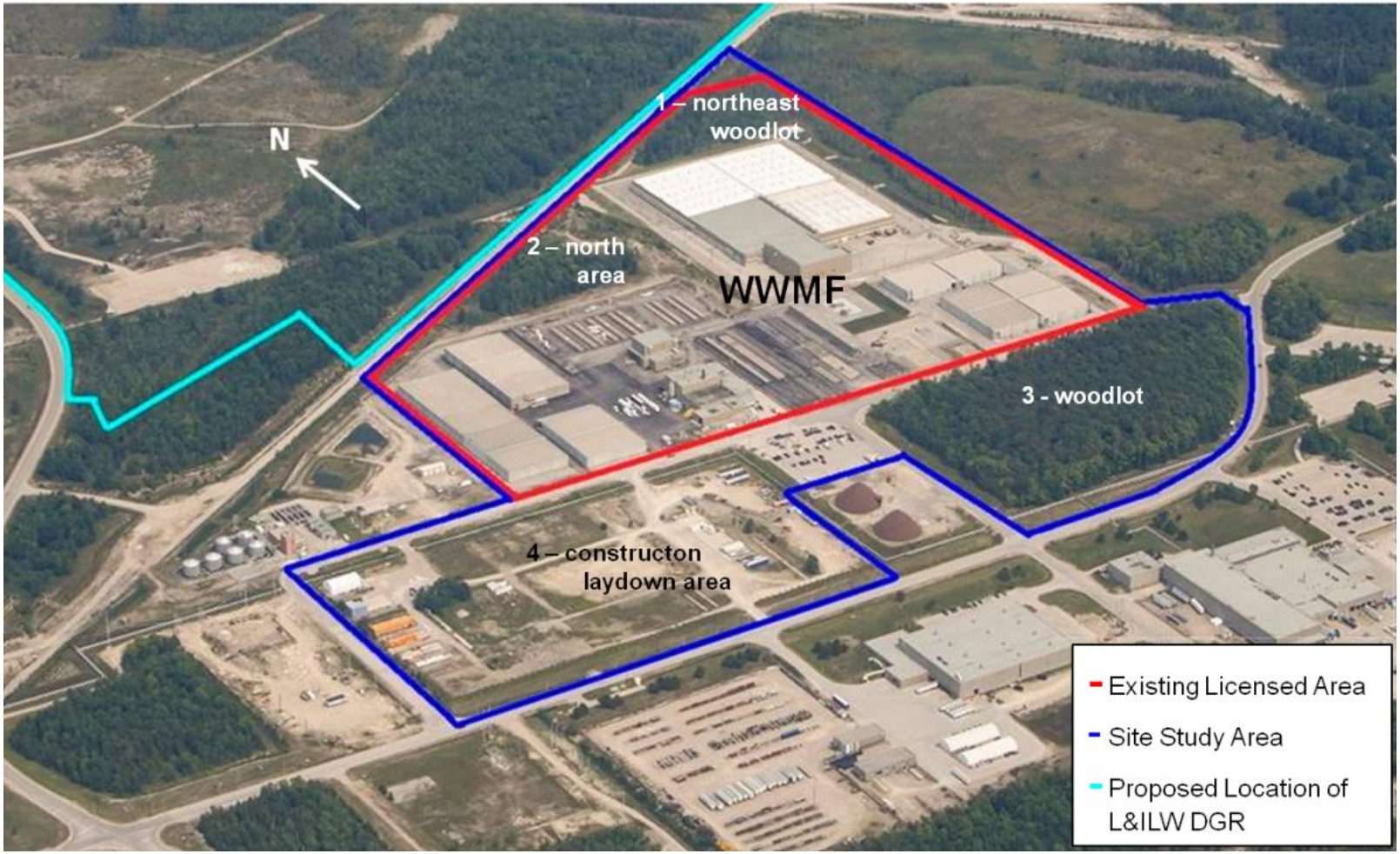


Figure 1: WWMF Site

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.

- **Low-Level Radioactive Waste (LLW)** is radioactive waste having a dose rate less than 10 mSv/h (1 rem/h) at 30 cm. LLW 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. These items make up about 95% of the total non-fuel waste volume. LLW received from the Bruce, Darlington and Pickering NGSs are received at the Waste Volume Reduction Building (WVRB) at the WWMF where it is processed through either incineration or compaction to reduce its volume, or stored as is.
- **Intermediate-Level Radioactive Waste (ILW)** is radioactive waste having a dose rate greater than or equal to 10 mSv/h (1 rem/h) at 30 cm. ILW consists primarily of used reactor core components, ion exchange columns, resins, and filters used to keep the reactor water system clean. ILW is more radioactive than LLW, and requires shielding to protect workers during handling. This waste is not processed for volume reduction, and makes up about 5% of the total volume of non-fuel waste produced by the NGSs.
- **High Level Radioactive Waste (also referred to as irradiated fuel or used fuel)** is defined as a CANDU (CANada Deuterium Uranium) fuel bundle that was irradiated in a reactor core. It is stored at the nuclear station in irradiated fuel bays for a period of typically ten years or more, and then transferred into dry storage containers (DSCs).

Maximum Quantity of Radioactive Waste (Nuclear Substances) at WWMF

The maximum quantity of high level radioactive waste (irradiated uranium) is interpreted as the maximum amount in the form of spent fuel bundles that can be stored in Used Fuel Dry Storage Buildings (UFDSBs) on site.

The maximum quantity of L&ILW is interpreted as the maximum amount of non-fuel radioactive waste that can be stored in the buildings/structures that have been designed for the purpose of storing the waste.

Table 1 shows the maximum quantities of low, intermediate and high level radioactive waste.

Table 1: Maximum Quantity of Radioactive Waste (Nuclear Substances) at WWMF

Nuclear Substance	Form/Location	Maximum Quantity
Irradiated Uranium	Solid as spent fuel bundles stored in Used Fuel Dry Storage Buildings (UFDSBs).	1,536,000 bundles (500 DSCs per UFDSB x 8 UFDSB x maximum 384 bundles per DSC)
Low Level Waste	Solids mainly stored in Low Level Storage buildings (LLSBs).	136,500 m^3 (LLSB 1-10: 7,050 m^3 each + LLSB 11-12: 7,000 m^3 each + LLSB 13 - 20: 6,500 m^3 each)
	Solid Heat Exchangers stored in in-ground containers (IC-HXs).	71 IC-HX (41 IC-HX existing + 30 IC-HX planned)
Low Level Waste	Liquid stored in one LLSB.	3500 m^3 (One half of one LLSB)
Intermediate Level Waste	Solids stored in above or below ground storage structures.	
	Steam Generator Storage Buildings (SGSBs)	72 units (24 units x 3 SGSBs)
	Retube Component Storage Buildings (RCSBs)	880 units (220 containers per RCSB x 4 RCSBs)
	Quadricells	360 m^3
	Contaminated Tool Storage Area	4700 m^3
	Trenches (Stage 1, 3 and 3E)	5870 m^3
	Tile Holes (Stage 1 and 3)	224 m^3
	In Ground Containers (ICs)	
	IC-2	40 m^3
	IC-12	240 m^3
	IC-18	9,720 m^3 (18m^3 per IC-18 x 10 batches x 54 IC-18s per batch)

1.2 Existing Western Waste Management Facility

The WWMF site was established in 1974 in an area on the Bruce Nuclear site, and shown in Figure 2 and Figure 3. The WWMF is dedicated to the processing, and the interim storage of L&ILW received from the OPG owned Nuclear Power Generating Stations (Darlington, Pickering and both Bruce Power NGSs), and the interim storage of used fuel from Bruce Power NGS. OPG's approach to the interim management of used fuel is to store all the used fuel generated at a nuclear generating station on the site where it is produced.

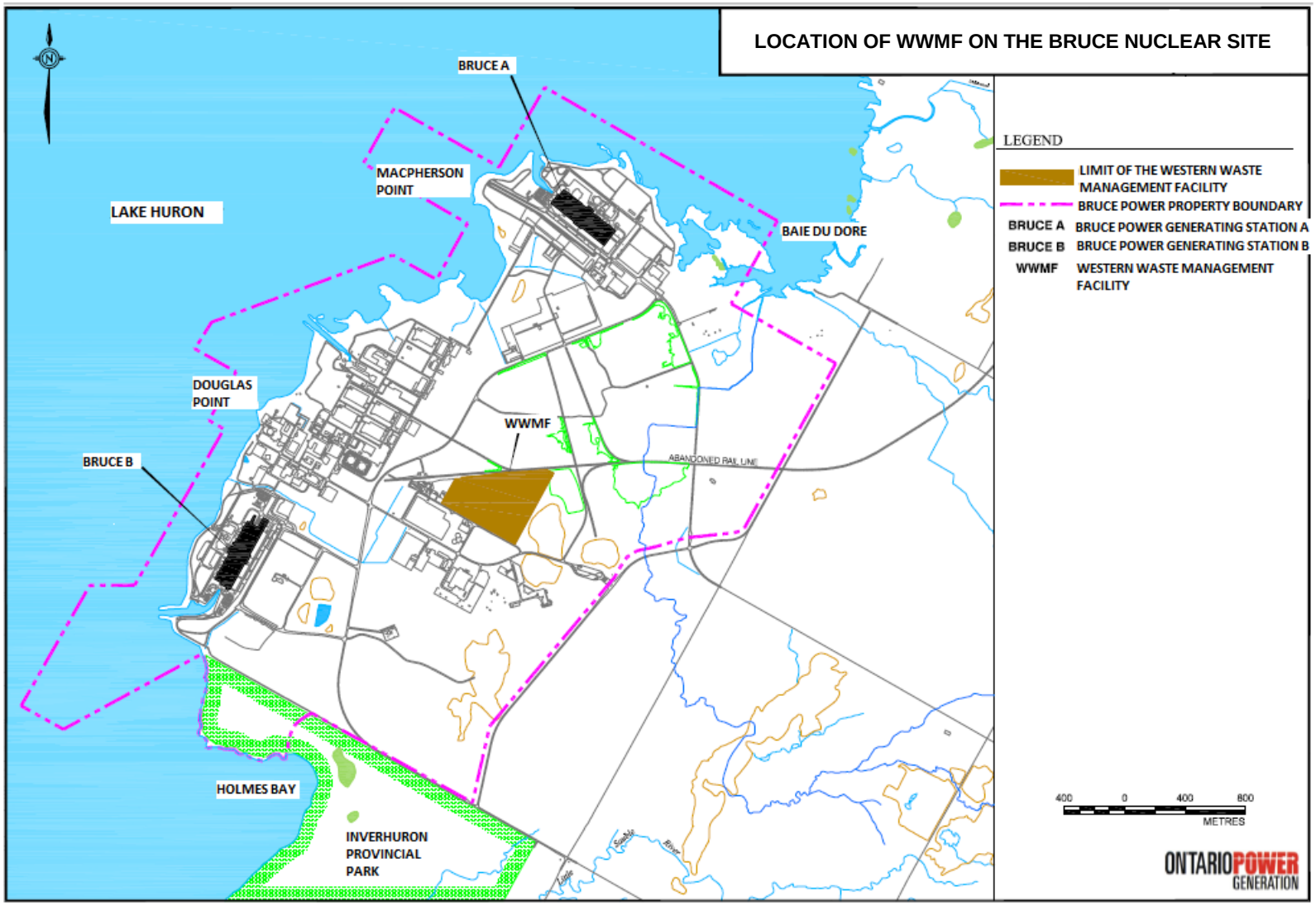


Figure 2: Bruce Nuclear Site

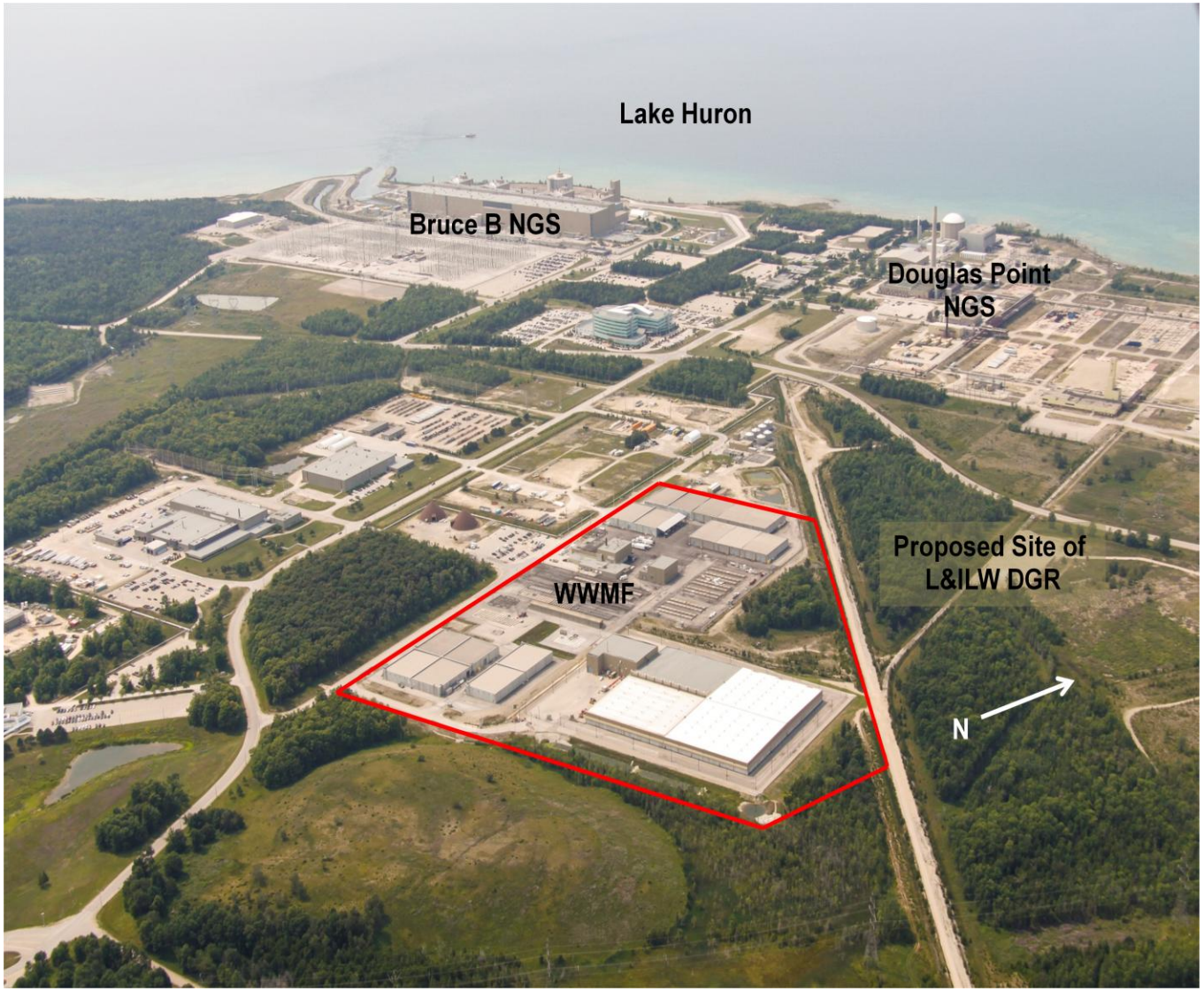


Figure 3: WWMF on the Bruce Nuclear Site

WWMF is approximately 19 hectares in size. It has undergone an orderly development in stages since 1974. Additional storage buildings and structures are constructed when required, as shown in Table 2 and Table 3.

Figure 4 shows the current layout of WWMF. Approximately 75% of the 19 hectares of the WWMF is dedicated to the management and storage of L&ILW. This area now includes 16 above-ground storage buildings for low and intermediate level wastes. Fourteen of these buildings (LLSB 1 to 14) are used to accommodate low level waste, and one for steam generators, and one for retube components. In addition, WWMF also has an amenities building, a WVRB, a transportation package maintenance building, quadricells, in-ground containers, trenches and tile holes. These buildings and structures are used for the processing and storage of L&ILW received from OPG's Pickering, Darlington and Bruce Power NGSs.

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

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

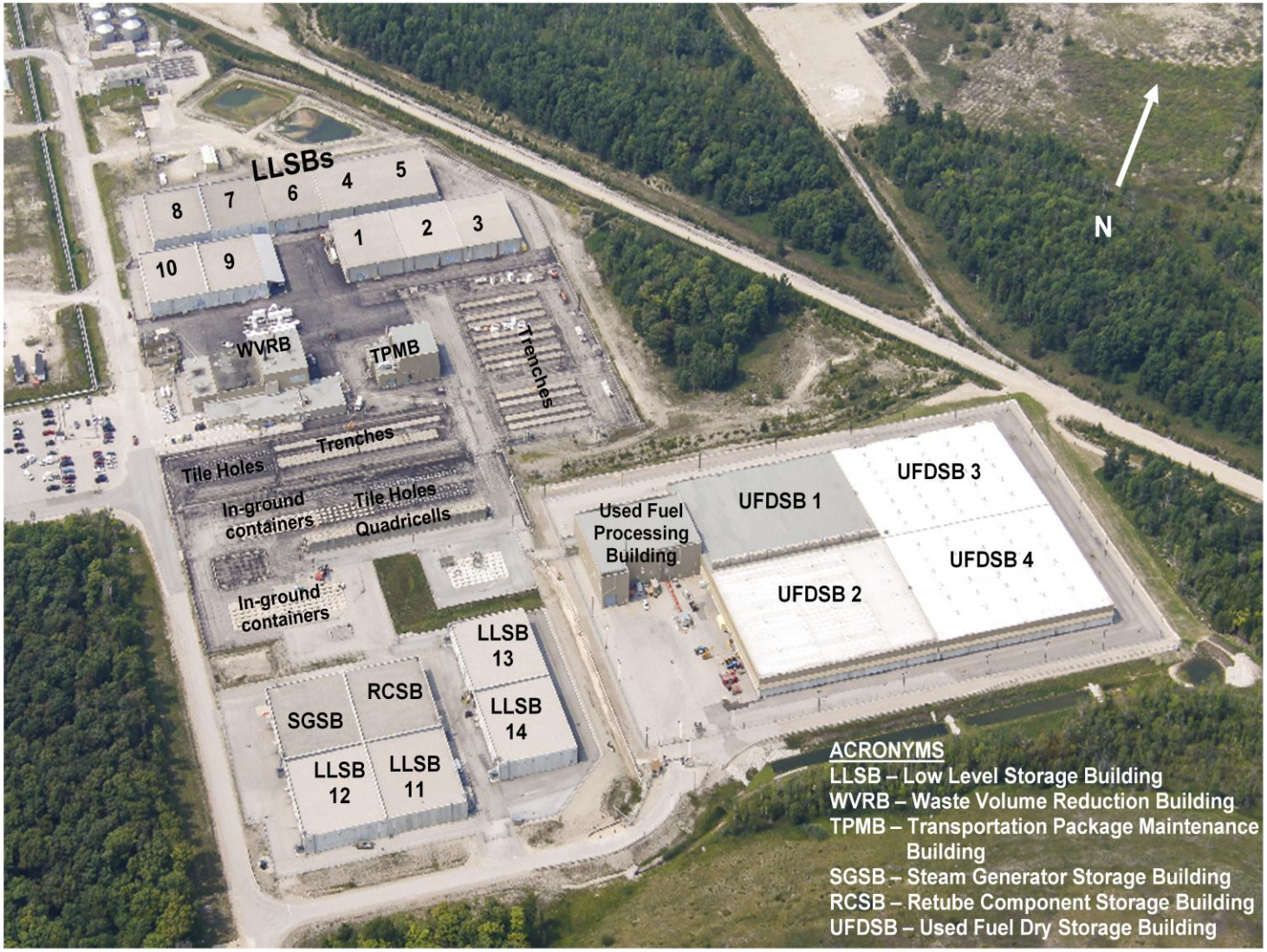


Figure 4: Layout of WWMF in 2016

Table 2: Chronology of Development for L&ILW at WWMF

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

Table 3: Chronology of Development for Used Fuel at WWMF

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

1.3 Management of Low and Intermediate Level Radioactive Waste

Figure 5 shows the flow of radioactive waste starting from generation at a nuclear facility through to packaging and transportation, processing and interim storage at WWMF, to ultimate disposal. This licence application pertains only to the section related to the processing (Sections 1.3.3 and 1.4.2) and interim storage (Sections 1.3.5 and 1.4.3) under the WWMF Waste Facility Operating Licence. The three areas shaded in gray: Generation (Section 1.3.1), Packaging and Transportation (Section 1.3.2), and Disposal (Section 1.6) are briefly described here for context, but are outside the scope of this licence application.

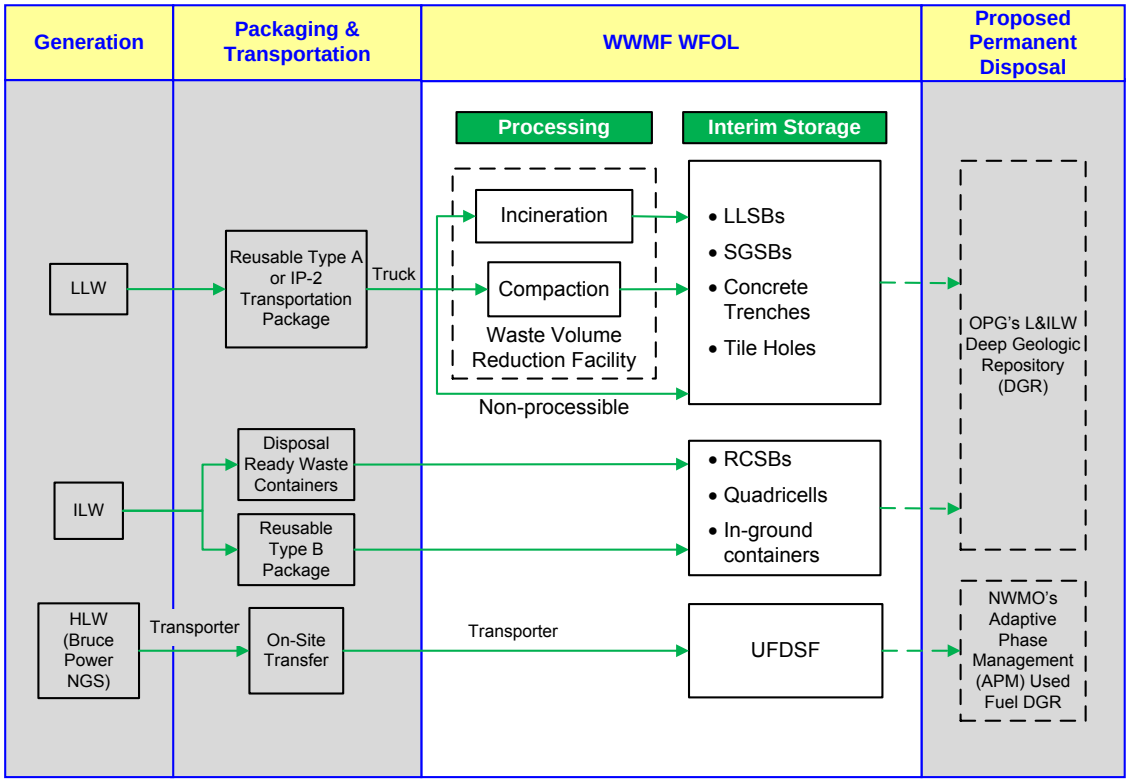


Figure 5: Waste Management of L&ILW and Used Fuel

1.3.1 Generation of L&ILW

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

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

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

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

1.3.2 Packaging and Transportation of L&ILW

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

The type of packaging used for transportation of radioactive material as described in Section 2.11 Packaging and Transportation is dictated by the CNSC's *Packaging and Transport of Nuclear Substance Regulations* and Transport Canada's *Transportation of Dangerous Goods Regulations*. Package types can range from industrial packaging such as boxes to more rugged Type B packages, depending on the radiological hazard.

All LLW is currently transported in packages from Pickering and Darlington NGSs to the WWMF inside exclusive-use, standard, 12m (40 ft) road trailers and Industrial Package (IP)-2 freight containers that meet CNSC transportation package requirements. Intermediate level waste is transported in Type B packages, which are designed to withstand severe accident conditions and have received a package design approval certificate from the CNSC.

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

- Meeting the regulatory requirements on the design of the transportation packages used to move L&ILW waste between sites;

- OPG's existing transportation program;
- Operating experience from more than 45 years of transporting radioactive materials;
- Training of personnel involved with transportation; and,
- A Transportation Emergency Response Plan.

OPG has been safely transporting radioactive materials for over 45 years, and has never had an accident resulting in a radioactive release or serious personal injury. OPG drivers transporting radioactive materials have an excellent safety record on the roads and have travelled over 3 million kilometers during the last 9 years without any at fault incidents.

1.3.3 Processing of L&ILW at WWMF

As shown in Figure 5, processing of radioactive waste is a licensed activity under the WWMF licence. As discussed in Section 1.3.1, LLW that is generated at the nuclear facilities is segregated at the source into processible (for incineration or compaction) or non-processible wastes prior to being transported to the WWMF (Figure 6). All incoming L&ILW received at the WWMF must meet the waste acceptance criteria.

For processible wastes, volume reduction involves processing waste into a smaller volume, either through incineration or compaction, to reduce the handling and storage requirements, and to minimize future disposal needs. About 60% of all LLW sent to the WWMF is either incinerated or compacted at the WVRB. Non-processible LLW received at the WWMF is further sorted prior to it being sent to an LLSB for interim storage.

ILW is packaged in Type B transportation packages or disposal ready waste containers, transported to WWMF and sent directly to an above ground storage building, or an in-ground structure for interim storage.

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

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

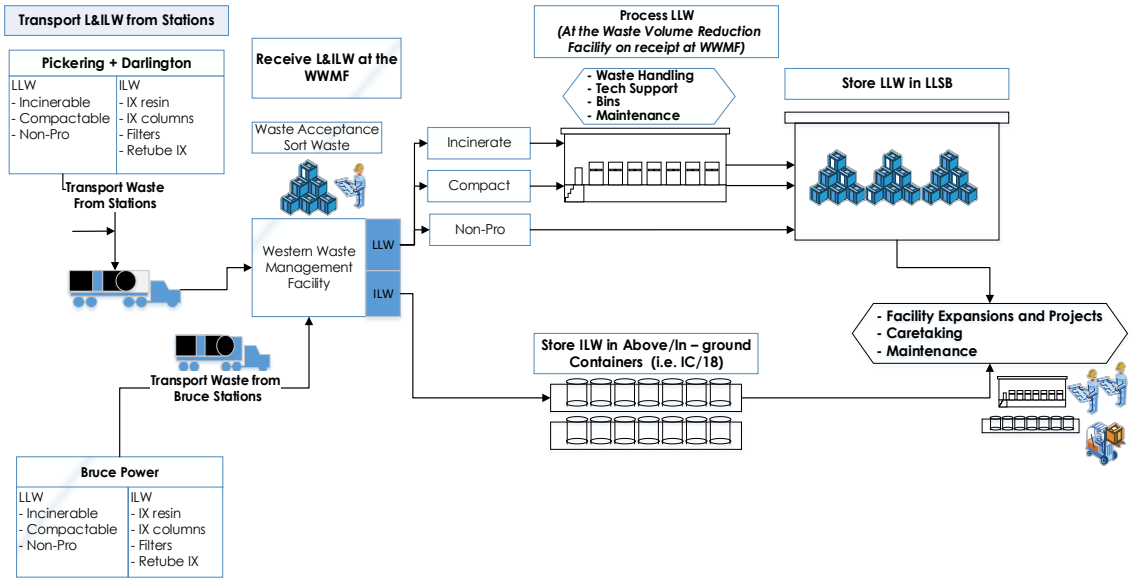


Figure 6: L&ILW Operations Process

Air emissions from the incinerator are continuously monitored and have always been within regulatory limits, as described in Section 2.9.2. The incinerator currently operates under an Ontario Ministry of Environment and Climate Change amended Environmental Compliance Approval (ECA #8047-8GLPAM, dated May 10, 2011) with concurrence by the CNSC.

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

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

The floor drainage within the WVRB is treated as potentially radioactive, and is drained to an active drainage holding sump located in the radioactive incinerator room (Figure 7). The sump is sampled and analyzed for radioactivity and chemical characterization. Depending on the radioactivity concentration, the sump is pumped either to the sewage system or into a tanker for transfer to the Bruce NGS active liquid waste management system.

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

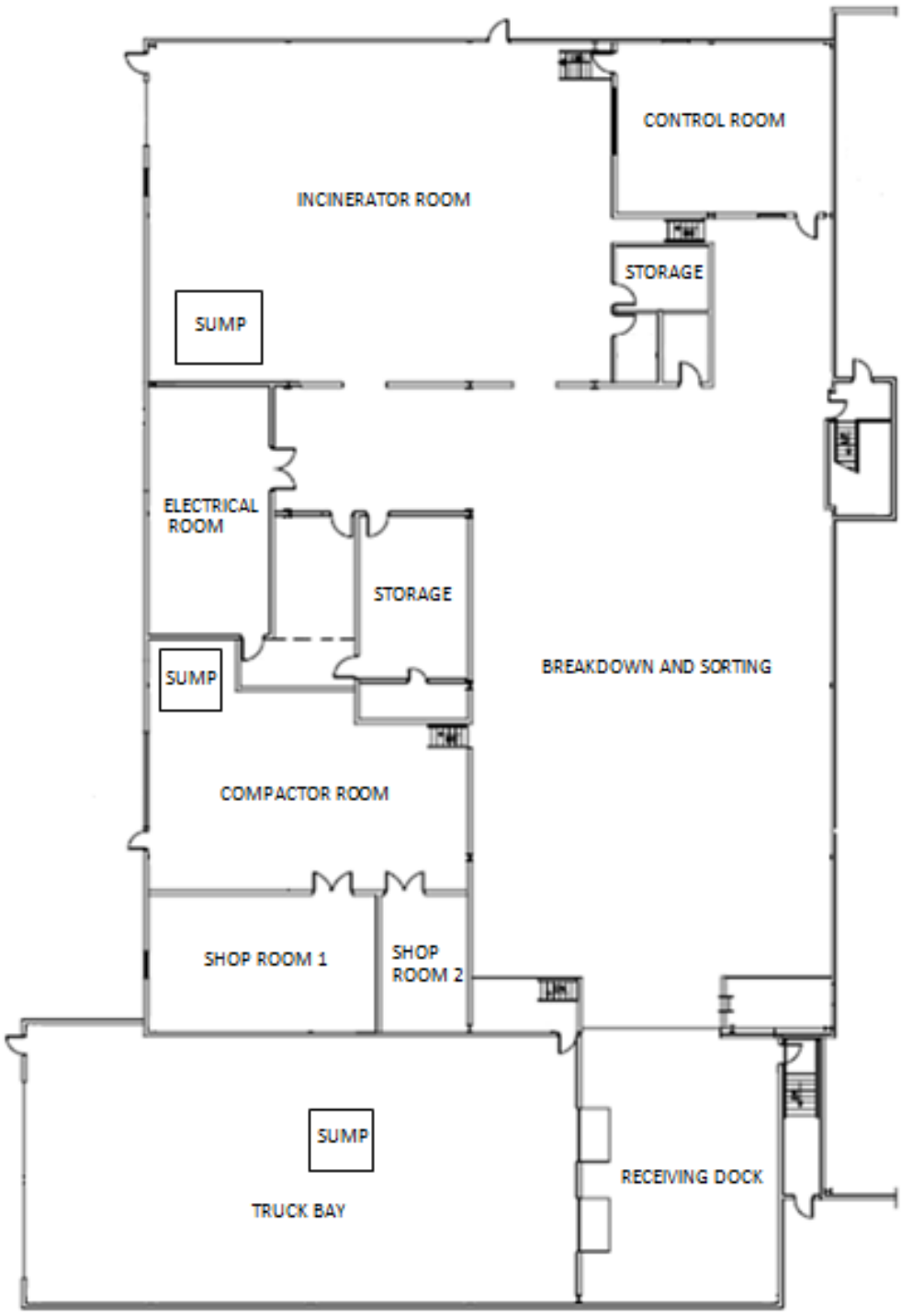


Figure 7: Layout of WVRB

1.3.4 Additional Processing Capability during the Next Licensing Period

(a) Large Object Processing Building

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

The primary function of the large object processing building would be to safely process the steam generators and other large components into segments, and to be able to eventually place these segments in the L&ILW Deep Geologic Repository (DGR). The processing of the large components would also enable OPG to remove and recycle elements of these components that are not radiologically contaminated. The remaining segments will be required to meet the DGR waste acceptance criteria. The potential location for the new Large Object Processing Building is inside the current licensed area of WWMF, and the planned construction date would be 2 to 3 years in advance of the in-service date of the L&ILW DGR.

(b) Waste Sorting Building

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

1.3.5 Storage Facilities for L&ILW at WWMF

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

Table 2 lists the principal storage structures being used and the volumes of waste that are stored in each type of structure. The following sections describe the structures that are used for interim storage.

1.3.5.1 Above-ground Storage Buildings

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

(a) Existing Low Level Storage Buildings

As mentioned above, there are currently fourteen low level waste storage buildings in operation at WWMF. An above-ground LLSB is a warehouse-like building (Figure 8, Figure 9 and Figure 10) used to store LLW with contact radiation fields less than 10 mSv/h at 30 cm. The approximate building dimensions are 50 m long by 30 m wide by 8 m high, and each building can store about 7,000 m^3 of waste.

Figure 8: Low Level Storage Building

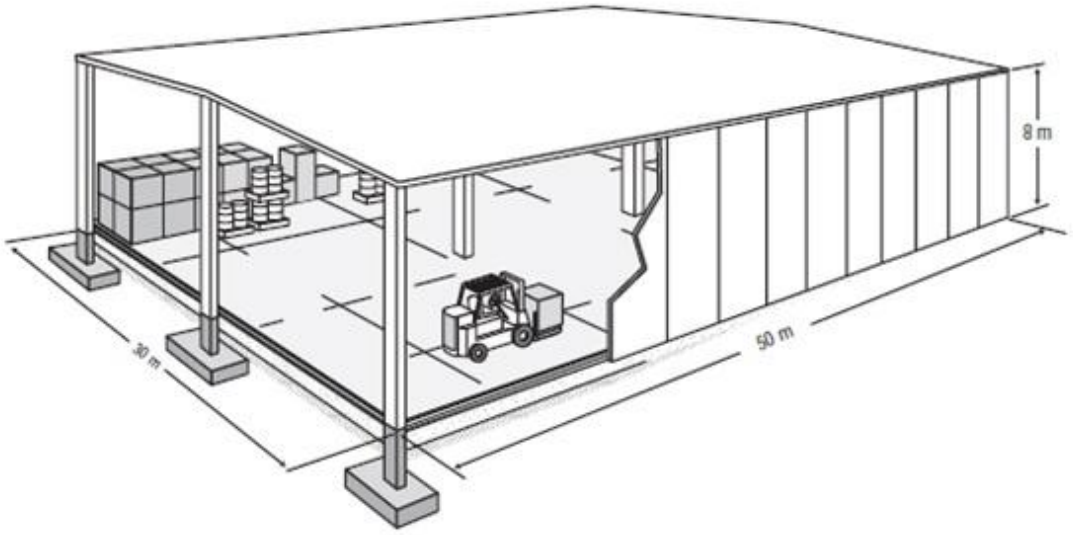


Figure 9: Cutaway of an LLSB

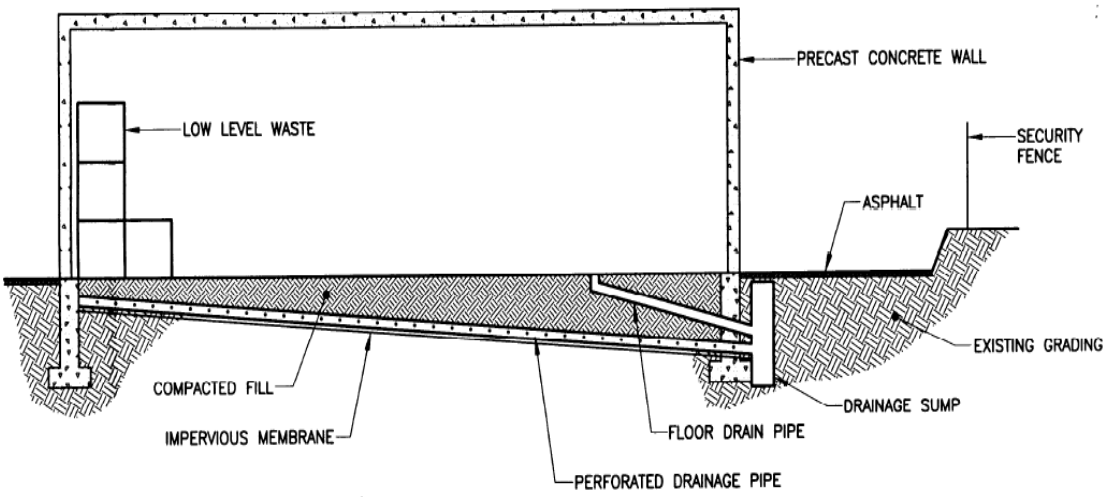


Figure 10: Typical LLSB Layout

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

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

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

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

(b) Steam Generator and Retube Waste Storage Buildings

WWMF currently has one storage building to store steam generators and another storage building to store retube waste in retube waste containers from the refurbishment of Bruce Power Units 1 and 2 (Figure 11 and Figure 12). The design requirements of the steam generator and retube waste storage buildings are generally the same as the low level storage buildings described above. The Fire Hazard Assessment considered the storage of metal components within metal containers, and determined that a carbon dioxide fire suppression (or extinguishing) system was not required for these buildings.

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

Figure 11: RWC Storage at WWMF

Figure 12: Storage of Steam Generators

(c) Quadricells

There are currently fifteen reinforced concrete quadricells at WWMF (Figure 13). Quadricells are designed to store operational ILW e.g. spent resin liners. Each quadricell has a 24 m^3 storage capacity which provides a total storage of 360 m^3 of waste.

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

Figure 13: In-ground Containers (foreground) and Quadricells (background)

1.3.5.2 In-Ground Storage

(a) In-Ground Containers

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

In more recent years, the "IC" series of in-ground containers have been used to store both low and intermediate level waste. The containers have storage capacities of 2 m^3 (IC-2), 12 m^3 (IC-12) and 18 m^3 (IC-18) with the majority of the containers being IC-18s (Figure 13). There are currently 20 IC-2s, 20 IC-12s and 252 IC-18s on site. The IC-12s and IC-18s are designed to accept intermediate level waste, e.g. ion exchange (IX) resin containers.

Except for size, the main design features of the IC series of structures are similar (Figure 14). Each structure has an outer carbon steel liner that is leak-tested before installation. The IC-18s can be fitted with different types of inserts to allow other wastes, such as reactor core components, to be stored. Figure 15 shows the loading of an in-ground container.

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

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

(b) Concrete Trenches

Concrete trenches are in-ground structures that have been designed to accept operational L&ILW such as drummed waste and waste of irregular shapes with radiation fields up to 150 mSv/hr. Most of the trenches are approximately 40 m long by 4 m wide and 3 m deep, and are divided into 3 compartments. The trench walls are 38 cm thick and the in-ground portions of the exterior walls are waterproofed with emulsified asphalt. The bottom of each trench compartment slopes to a sump and standpipe to permit water detection and removal (Figure 16). The technology evolved over time so some design details vary (see Figure 16 a, b). After the waste is placed into the trench, 30 cm precast concrete lid caps with neoprene gaskets are placed on the trenches. The total capacity of the 15 in-ground trenches is approximately 5,800 m^3. There are no plans to build additional trenches.

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

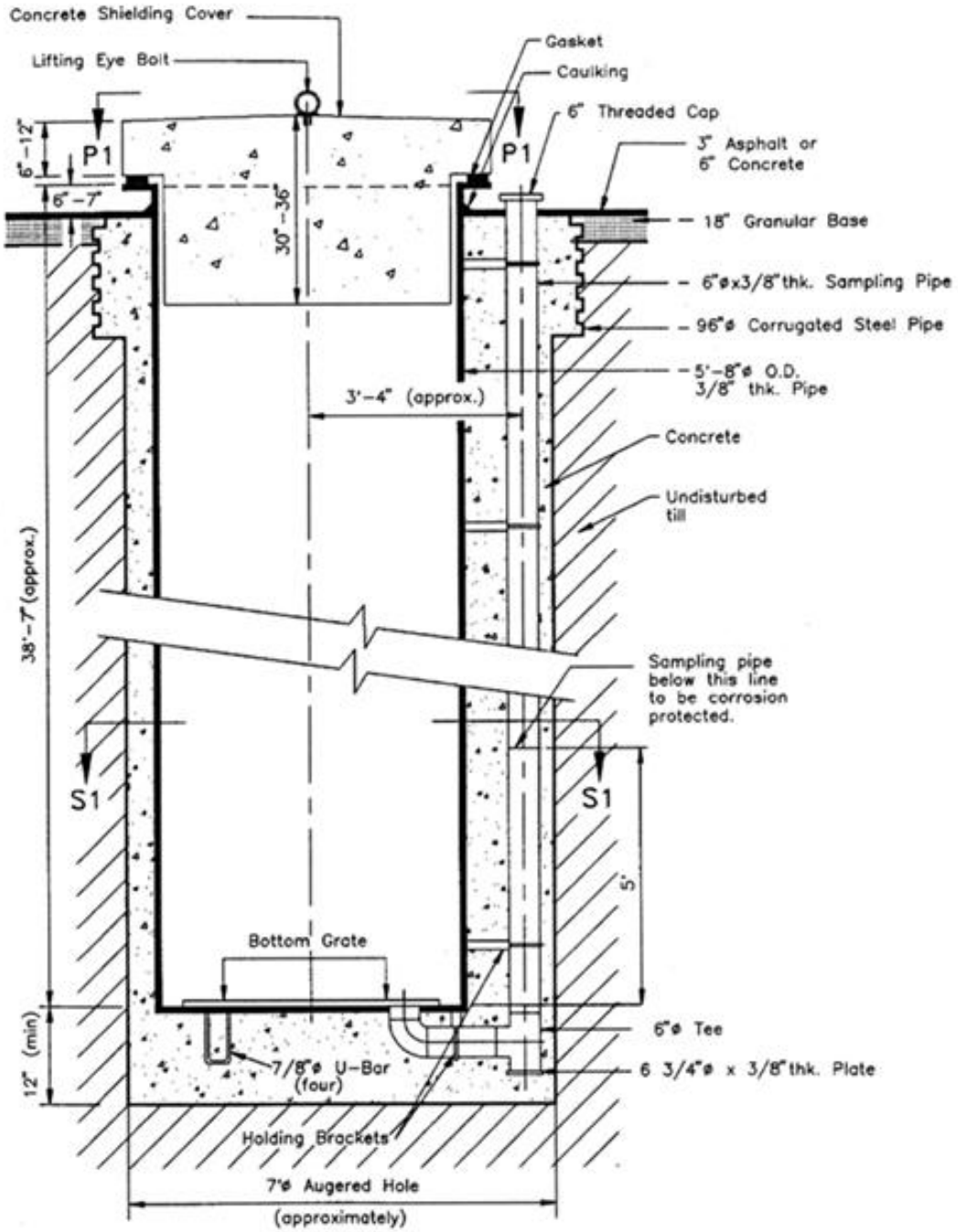
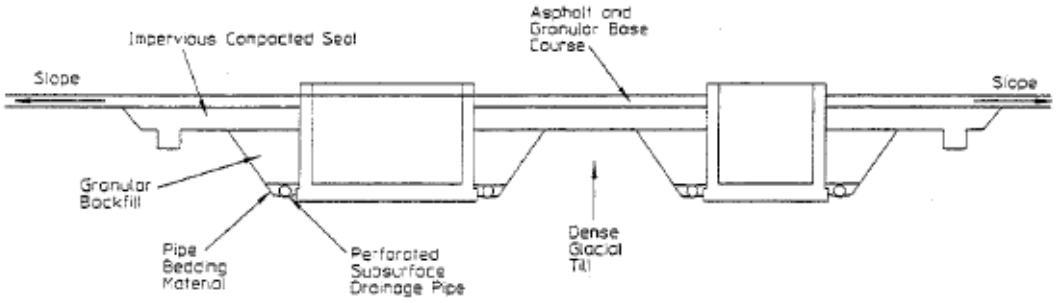
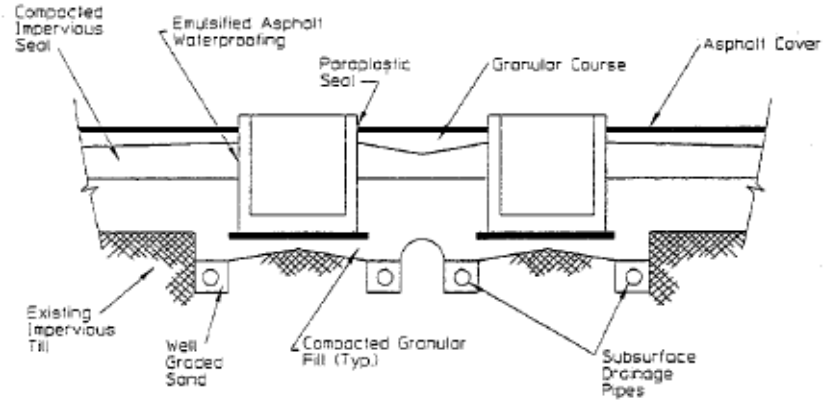


Figure 14: Cross-Section of IC-18

Figure 15: Loading an IC-18



(a) STAGE 1 TRENCHES



(b) STAGE 3 and 3E TRENCHES

Figure 16: Sectional View of Subsurface Drainage and Backfill Material around Trenches

1.3.6 Additional Storage Buildings and Structures for L&ILW during the Next Licensing Period

(a) Additional above-ground Storage Buildings

Over the next licensing period, OPG plans to construct up to 11 above-ground storage buildings, summarized in Section 1.7, to accommodate L&ILW.

- Five of the eleven storage buildings are approved in the current licence, and OPG is requesting that they be carried over into the next licensing period. The planned location for these L&ILW storage buildings is the north area as shown in Figure 1 and in Figure 17.

- Two other storage buildings were assessed in previous environmental assessments as described in Section 3.1, but not included in the current licence. One of the buildings was assessed in the LLSB 9-10-11 Environmental Assessment using the open space between LLSB 1 and 9 and east of LLSB 6 (see Figures 4 and 17), and the other building was assessed in the Refurbishment Waste Storage Environmental Assessment as one of the six storage buildings in the north area, as shown in Figure 17 [R1; R2]. OPG is requesting that these two buildings be included in the licence.
- Because of land constraints on the WWMF, OPG will need to construct four additional storage buildings outside the current licensed area - either in the construction laydown area or woodlot (Figure 1). A predictive effects assessment has been conducted to identify the impacts to human and non-human biota, and is described in Section 3.1.

OPG's strategy of constructing buildings as needed means the specific siting of these buildings will be determined at a later date. Currently, four areas are being considered - two areas are within the current WWMF (north area, and the northeast area as shown in Figure 1) and two areas are outside the WWMF (construction laydown area, and the woodlot area as shown in Figure 1). The north area within WWMF will be developed first for the construction of storage buildings for low and intermediate level waste. This area has already been EA assessed and approved [R1]. Once the land space within WWMF is filled, OPG plans to construct the additional storage buildings for L&ILW in either one of the two locations (construction laydown area and/or woodlot shown in Figure 1) outside the WWMF licensed area.

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

In order to allow operational flexibility, and to utilize existing space within all the above-ground storage buildings for L&ILW, OPG may store compatible waste types in these buildings. These buildings will be referred to as Multi-Purpose Storage Buildings. In addition, one of the existing LLSBs or one of the new LLSBs may be repurposed and used as a staging and overpacking area for LLW before it is transferred to the L&ILW DGR.

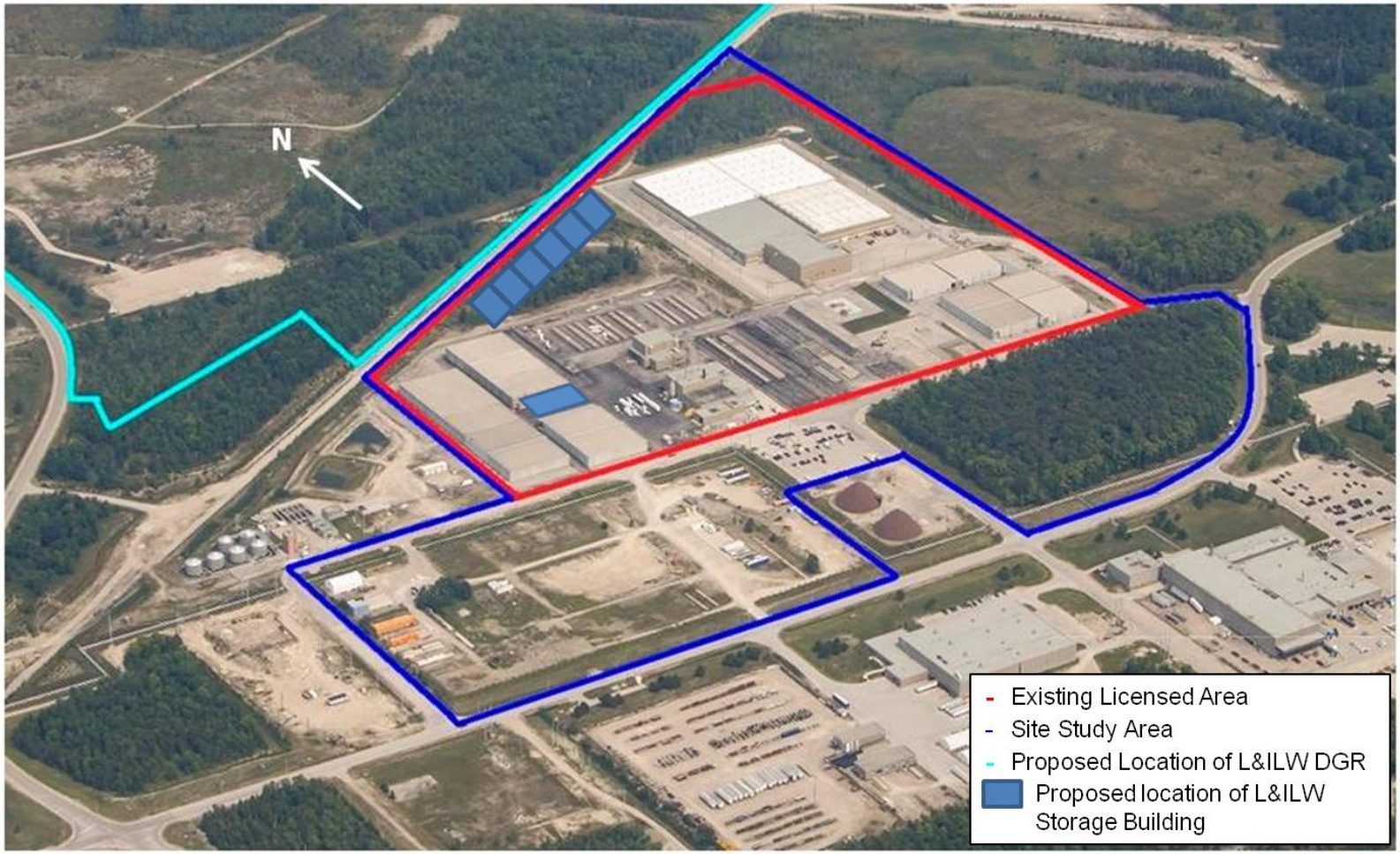


Figure 17: Location of Storage Buildings for L&ILW

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

(b) Additional In-Ground Containers

IC-18s

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

In 2006, OPG conducted the Refurbishment Waste Storage Environmental Assessment, as described in Section 3.1. The scope of the project included 270 IC-18s (5 batches of 54 IC-18s). To align with this Refurbishment Waste Storage environmental assessment which was accepted by the CNSC, OPG is requesting that the 270 IC-18s be included in the next licence.

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

In 2006, OPG conducted the Refurbishment Waste Storage Environmental Assessment, as described in Section 3.1. The scope of the project included 30 IC-HXs. To align with this Refurbishment Waste Storage Environmental Assessment, which was accepted by the CNSC, OPG is requesting that the construction of 30 IC-HXs be included in the next licence.

1.4 Management of High Level (Used Fuel) Waste

The Used Fuel Dry Storage Facility (UFDSF) is a security-protected area located northeast of the L&ILW storage facility area, and consists of a DSC processing building and four (4) storage buildings designed to provide interim storage space for up to 2,000 DSCs (about 768,000 bundles) for used fuel generated by Bruce Power NGS. The UFDSF was placed in service in October 2002 and received the first DSC from Bruce Power NGS in February 2003 (Table 3). A second DSC Storage Building was placed into service in 2007, and two additional storage buildings were constructed and placed into service in 2012. As of the end of 2015, 1,145 DSCs have been safely stored in the DSC storage building at the WWMF. Based on contractual agreements with Bruce Power to process up to 130 DSCs per year, OPG expects that the next storage building will be needed by 2019.

1.4.1 Dry Storage Containers

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

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

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

The DSC is designed with the provision for installing safeguards seals. Two separate U-shaped 25.4 mm outer diameter stainless steel tubes are embedded in the DSC walls and floor in the plane of the outer reinforcing grid. These tubes are placed so that each tube runs across the centre of opposite container walls. Two similar tubes are embedded in the DSC lid and run diagonally across the lid. The configuration of the safeguards tubes is shown in Figure 18. These tubes are used for attaching two different types of International Atomic Energy Agency (IAEA) seals.

1.4.2 Used Fuel Dry Storage Processing

The processing of a DSC begins with the preparation of new DSCs at the DSC processing building and ends with the storage of loaded, hermetically sealed DSCs in storage buildings for used fuel. The steps are summarized in Figure 19.

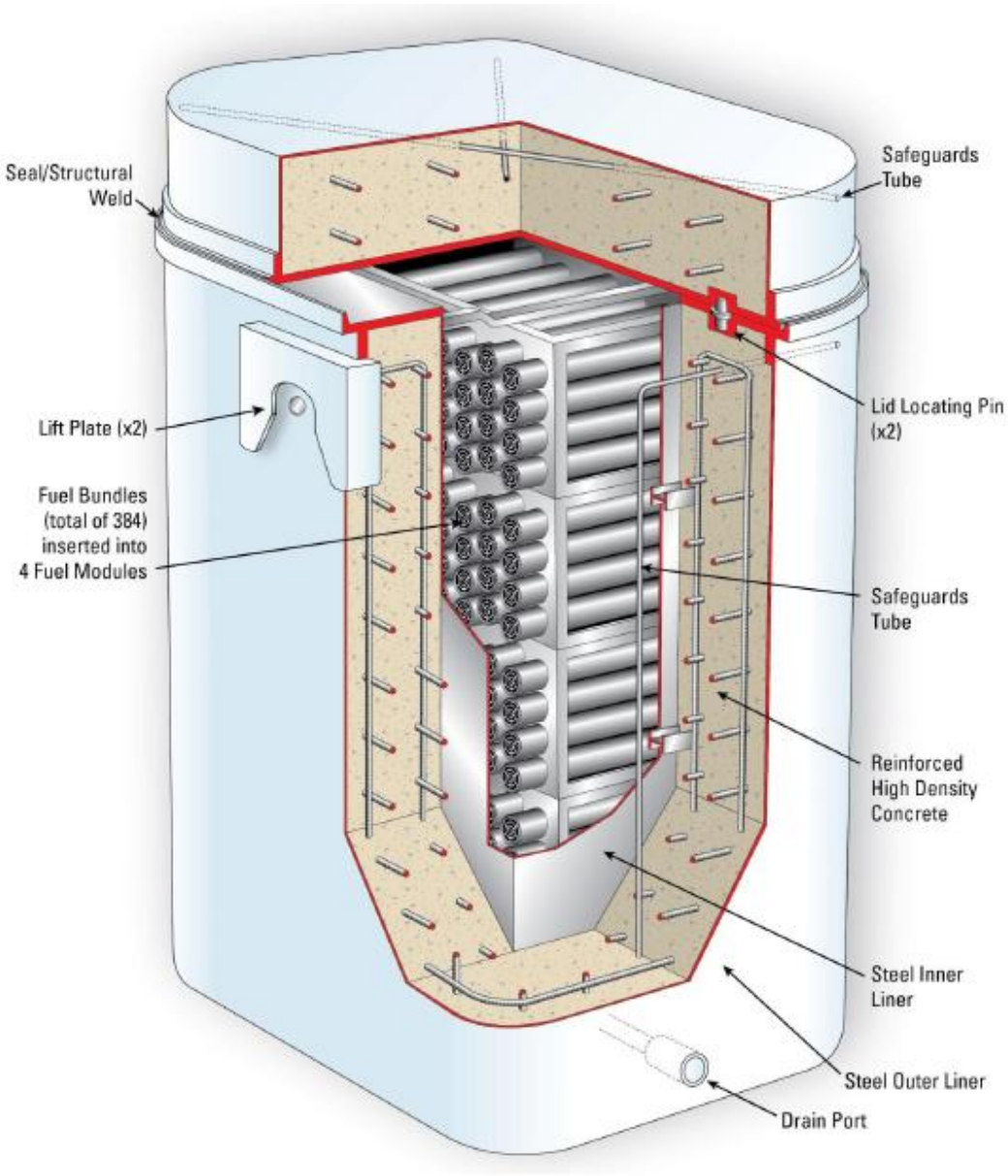


Figure 18: Dry Storage Container

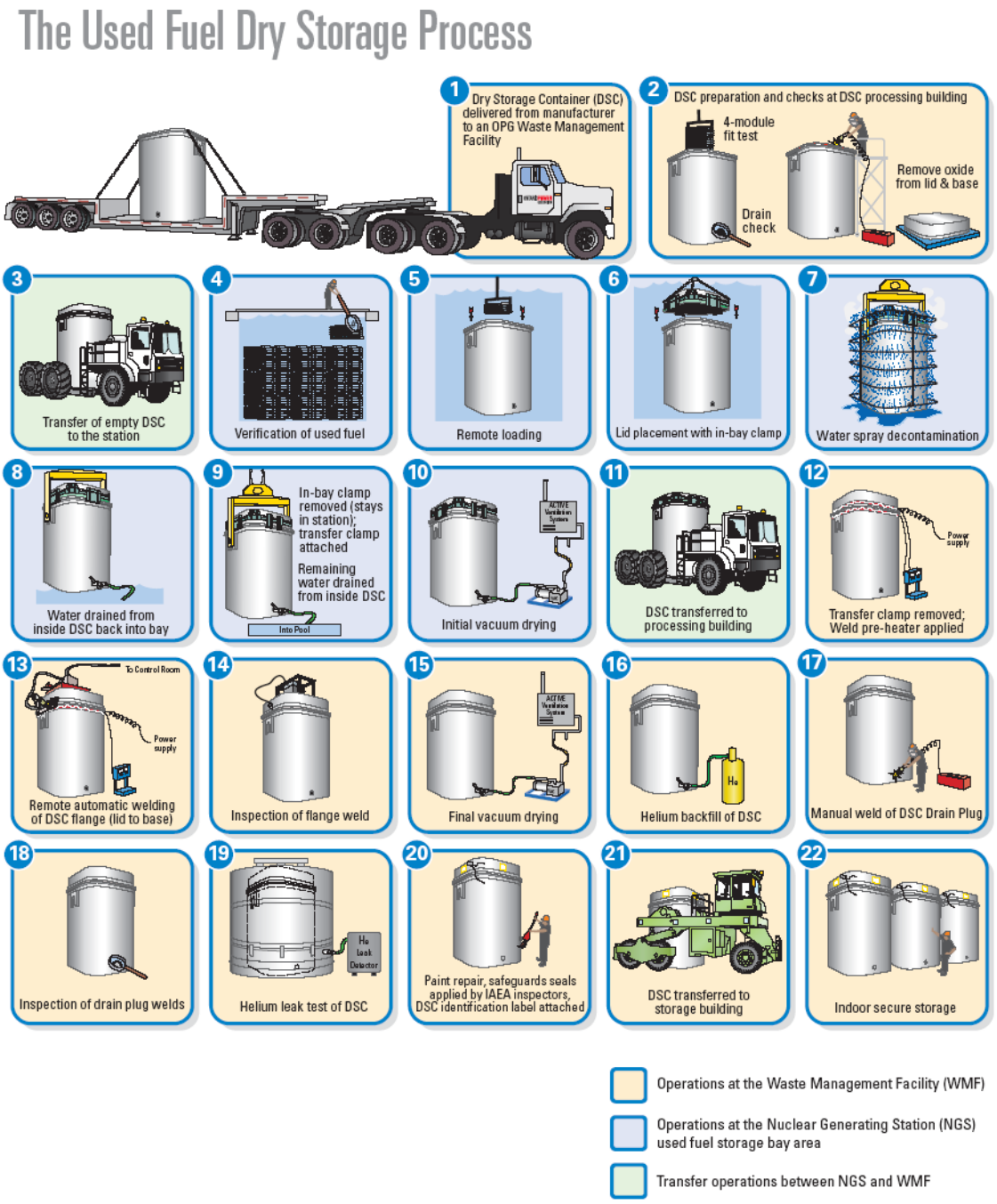


Figure 19: Used Fuel Dry Storage Process

Steps 1-3: Preparing and Transferring Empty DSCs

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

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

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

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

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

Prior to leaving the NGS, Bruce Power will survey and decontaminate the entire exterior surface of the loaded DSC and its components including lid flange, drain housings, and the transfer clamp to ensure there is no detectable loose contamination as per OPG's Waste Acceptance Criteria[1].

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

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

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

[1] The Waste Acceptance Criteria requires that Bruce Power ensure that external dose rates on the DSC are within OPG's specified limits [<100 μSv/h (10 mrem/h) on contact on the sides and top; <200 μSv/h (20 mrem/h) on contact on the bottom]. Whenever the dose rate exceeds 15 μSv/h (2.5 mrem/h) at 30 cm, DNWMD shall be notified in advance of the transfer so that necessary precautions can be assessed.

Steps 12 - 20: Processing a DSC at WWMF

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

- **Receiving a Loaded Dry Storage Container (Step 12) -** Upon arrival at the DSC processing building, both the vehicle and the DSC are re-monitored for contamination. After the loaded DSC is received at the DSC processing building, the DSC is lifted from the receiving bay floor using the overhead crane and lifting beam and moved into the workshop.
- **Dry Storage Container Lid Seal Welding (Step 13) -** The DSC is moved to a welding station where the DSC drain port transfer plug, transfer clamp and seal are removed and the weld pre-heater is installed. The pre-heater is used to heat the DSC weld flange to a prescribed temperature. At the conclusion of lid welding, the weld machine is removed and the DSC is allowed to cool.
- **Welding Inspections (Step 14) -** The Phased Array Ultrasonic Testing system is used for the inspection of the DSC lid-to-base seal weld. The scanner is mounted on the DSC base's top flange and is held in place by three magnetic wheels. A loading ramp is used to minimize the force required by the operator when engaging and disengaging the scanner. The inspection covers 100% of the weld as well as the Heat Affected Zone. After completion of the lid weld inspection, partially processed DSCs may be transferred to the surveillance area and temporarily stored for up to one year from time of loading.
- **Final Vacuum Drying, Helium Backfill, and Drain Port Seal Welding (Steps 15 – 18) -** After successful completion of the weld inspection, the DSC is lifted into another work station for final vacuum drying and helium backfilling. The lifting beam is removed and the vacuum drying/helium backfilling system connected.
- **Helium Leak Testing (Step 19) -** Helium leak testing is carried out using a vacuum chamber (bell jar). The lid of the bell jar is removed and the seal-welded DSC is lifted into the lower half of the bell jar. The bell jar lid is craned over the DSC and sealed onto the base of the bell jar. Using the vacuum skid, air is first removed from the bell jar and then the helium leak detector is activated. If a leak is detected, the vacuum equipment is removed and remedial work is carried out. A follow-up leak test is then performed.
- **Decontamination, Paint Touch Up and Safeguards Seals (Step 20) -** Exterior DSC surfaces are checked for loose surface contamination at the time of receipt and decontaminated if needed. Areas affected by the welding are cleaned and painted. Touch-up paint is also applied to scrapes or scuffs on the DSC that may have resulted from handling. Painting is carried out in the paint bays. Documentation and identification labelling are completed and permanent safeguards seals are installed in a designated IAEA surveillance area.
- **Dry Storage Container Placement and Storage (Steps 21 and 22) -** The DSC is moved, using the Transporter, to a location in a UFDSB for storage (Figure 20). In the UFDSB, the Transporter unloads the DSC in a designated storage location.

Figure 20: Storage of DSCs

1.4.3 Storage Building for Used Fuel

Each UFDSB is designed to have an approximate area of 5,300 m^2, and a nominal storage capacity of approximately 500 DSCs. Walls in the storage buildings for used fuel consist of 0.20 m thick precast concrete panels from ground level to a 4.2 m height. Vertical louvres and metal cladding are installed at upper wall elevations. Reinforced concrete floor slabs are designed to accommodate heavy wheel load traffic and the weight of the loaded DSCs. The floors are constructed for long service with minimal maintenance, to retain surface alignment and provide a hard, smooth and durable surface. Floors are sloped to provide drainage to floor drains. The DSC processing building and the UFDSBs 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.

1.4.4 Additional Storage Buildings for Used Fuel during the Next Licensing Period

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

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

Two locations - either in the woodlot or the construction laydown area south of WWMF (shown in Figure 1) are being assessed during the conceptual design study to determine the best location to site the UFDSBs. These buildings will be within a designated secured area as required by the *Nuclear Security Regulations* under the *Nuclear Safety and Control Act*.

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

1.5 Description of Other Supporting Facilities at WWMF

1.5.1 Transportation Package Maintenance Building

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

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

Radiological emissions from the Transportation Package Maintenance Building are reported along with other WWMF radiological emissions in the WWMF Quarterly Operations Reports.

1.5.2 Amenities Building

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

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

1.6 Long-Term Waste Management

As shown in Figure 5, the long term management or permanent disposal of L&ILW and used fuel is outside the scope of the WWMF licence renewal application. It is included here to demonstrate OPG's commitment to managing its waste from cradle to grave.

1.6.1 OPG's L&ILW Deep Geologic Repository

OPG assumes that the L&ILW DGR which is currently undergoing an environmental assessment and licensing, will be constructed and become operational near the end of the requested licensing period.

OPG's commitment to safely managing its nuclear waste includes the long-term disposal of L&ILW. An environmental assessment for a project to prepare, construct and operate the L&ILW DGR on the Bruce Nuclear Site within the municipality of Kincardine, Ontario, was conducted. The L&ILW DGR would be designed to manage the L&ILW produced from the continued operation of OPG-owned nuclear generations at Bruce, Pickering and Darlington. Additional information is included in Section 3.1 Environmental Assessment.

1.6.2 NWMO 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 (NWMO) to study approaches for managing Canada's used nuclear fuel. NWMO is therefore responsible for the long-term management of Canada's used nuclear fuel waste that currently exists and that which will be produced in the future. The NWMO is now implementing the Adaptive Phase Management which involves the siting and development of a deep geological repository for used nuclear fuel.

1.7 Summary of Buildings/Structures for Next Licensing Period

Table 4 summarizes previous WWMF Environmental Assessment approvals and WWMF operating licences. The first two columns on the left list the buildings and structures, and show what has already been constructed under the previous licence which expired in May 2007. The middle two columns show what is in the current WFOL which includes what was built up to December 2015 and what was approved under the current licence but which has not yet been built. The last two columns on the right show what was previously approved and being carried over into the next licensing period, and the additional buildings (with planned in-service dates in brackets) that are required to support the refurbishment and continued operation of the Darlington, Pickering and Bruce Power NGSs.

In addition to the buildings and structures carried over from the previous licence, and those already assessed and approved within previously conducted environmental assessments, OPG is seeking approval to accommodate additional storage structures over the next licensing period to 2027. These new structures will provide additional storage capacity for used fuel, and L&ILW, as well as processes to manage the wastes. These activities will not alter the basic purpose and activities associated with the WWMF.

OPG is requesting a renewal of the WWMF WFOL for another ten year term from June 1, 2017 to May 31, 2027. Upon renewal, OPG requests a change to the facilities listed in Appendix C associated with Part IV e) of the current licence for the site preparation, construction or construction modification to include, in total as shown in Table 5, authorization for:

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

The planned in-service dates are shown in Table 4 in brackets for each of the buildings and structures to be constructed over the next ten years. These dates would coincide with, and be determined by business decisions.

For the construction of additional L&ILW storage buildings, OPG plans to utilize the north area within WWMF first, and then use areas outside the WWMF licensed area, either in the construction laydown or woodlot areas (Figure 21).

For the siting of the used fuel dry storage buildings, OPG is in the process of assessing both the construction laydown and woodlot areas. The construction laydown area is currently the preferred area to be developed first (Figure 21).

Table 4: Summary of Existing and Planned Storage Buildings/Structures at WWMF

Storage Buildings / Structures at WWMF	Constructed under Previous licence	Current Licence WFOL-W4-314.03/2017* *licensed for 9 additional SB for L&ILW, 108 IC-18, 20 IC-HX and 2 SB for used fuel		Next Licence Renewal (2017 – 2027)	
		Constructed between 2007 – 2015	Buildings Approved, but not yet built (2016 – 2017)	Approved in Previous Licence, not yet built and carried into next licence [a] approved in WFOL-WF-314.03/2017	New Projects to be included in the 2017 – 2027 Licence Period [b] EA assessed, but not in WFOL-W4-314.03/2017 licence [C] In scope of current "PEA"
Storage buildings for used fuel [R4]	SB 1 (Oct 2002) SB 2 (Dec 2007)	SB 3 (Dec 2012) SB 4 (Dec 2012)	0	0	4 SBs for used fuel [R5], c • UFDSB 5 (2019) • UFDSB 6 (2019) • UFDSB 7 (2027) • UFDSB 8 (2031)
Storage buildings for L&ILW [R2], [R3], [R4] (including LLSBs, RCSBs and SGSBs	LLSB 8 (May 2002) LLSB 9 (Dec 2004) LLSB 10 (Jan 2007) RCSB 1 (Jan 2007) SGSB 1 (Jan 2007)	LLSB 11 (May 2009) LLSB 12 (Sep 2011) LLSB 13 (Jun 2013) LLSB 14 (Jun 2013)	5 SBs for L&ILW→	5 SBs for L&ILW: →LLSB 15 (2019) [R1], a →LLSB 16 (2019) [R1], a →RCSB 2 (2020) [R1], a →LLSB 17 (2023) [R1], a →SGSB 2 (2023) [R1], a	2 SBs for L&ILW [R1],[R2], b • LLSB 18 (2025) • RCSB 3 (2025) 4 SBs for L&ILW [R5], c • LLSB 19 (2028) • SGSB 3 (2028) • RCSB 4 (2028) • LLSB 20 (2031)
In-ground containers (IC-18s) [R1], [R3]	198 (last batch of 54 built in Feb 2002) [R3]	Batch 5 (54 IC-18s built in Jul 2013) [R1]	Batch 6 (54 IC-18) →	→Batch 6 (54 IC-18) [R1], a	• Batches 7 - 10 (216 IC-18)[R1],b
In-ground containers (IC-HX) [R1], [R3]	41 (last 4 built in 2002)	0	20 IC-HX →	→20 IC-HX (TBD) [R1], [R3], a	• 10 IC-HX[R1],b
Other Structures					• Large object processing building [R5] (2024) • Sorting Facility [R5] (2020)

Legend:

→ Buildings previously approved and carried over into the next licensing period.

Table 5: Buildings and Structures in Licence and Environmental Assessments

Buildings/Structures	Number Carried Over from WFOL W4-314.03/2017	Number not in WFOL, but approved in previously conducted EAs	Number of New Buildings/Structures Requested	Total
Storage Buildings for used fuel	0	0	4	4
Storage Buildings for L&ILW	5	2	4	11
In-Ground Containers (IC-18s)	54	216	0	270
In-Ground Containers (IC-HXs)	20	10	0	30
Large Object Processing Building	0	0	1	1
Waste Sorting Facility	0	0	1	1

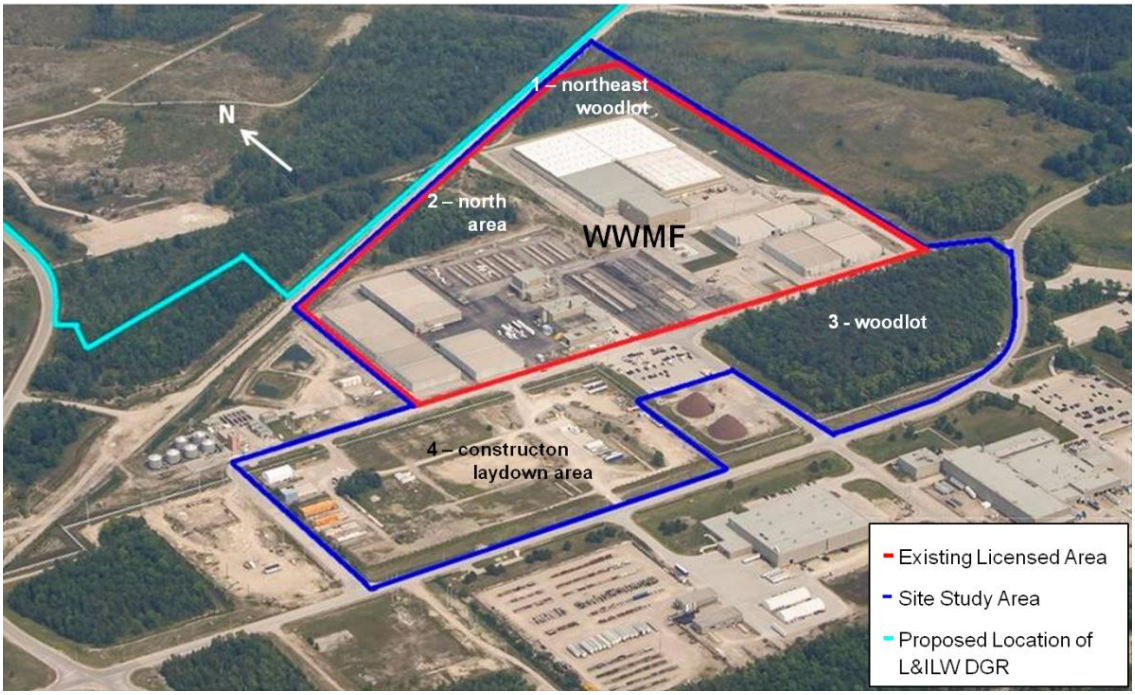


Figure 21: WWMF Expansion Areas

2.0 SAFETY AND CONTROL AREAS

2.1 MANAGEMENT SYSTEM

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 to 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, continuously monitoring performance against the objectives, and fostering a healthy safety culture. WWMF staff understands and manages work and financial liabilities to accurately plan and forecast expenditures, ensuring value for money.

OPG's key documents for the Management System SCAs and the revision at the time of writing are listed in the table presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Nuclear Safety Policy	N-POL-0001	R003
Health and Safety Management System Program	OPG-PROG-0010	R003
Nuclear Management System	N-CHAR-AS-0002	R018
Nuclear Waste Management	W-PROG-WM-0001	R013

2.1.1 Nuclear Safety Policy

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

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

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

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

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

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

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

- Personal Accountability
- Questioning Attitude
- Effective Safety Communication
- Leadership Safety Values and Actions
- Decision-Making
- Respectful Work Environment
- Continuous Learning
- Problem Identification and Resolution
- Environment for Raising Concerns
- Work Processes.

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

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

2.1.2 Nuclear Management System Charter

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

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

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

The nuclear management system implementation is monitored through a series of activities, including external and internal audits, performance metrics designed to capture 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 improve performance and make its operations safer and more reliable.

2.1.3 Nuclear Waste Management Program

One of the programs in the nuclear management system, and as described in the Charter, is the Nuclear Waste Management Program.

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

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

2.1.4 Current Operations

During the current licensing period, WWMF 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 Operations, including WWMF, transitioned from a complete set of stand-alone processes into the OPG nuclear fleet processes. A team was created to ensure a smooth transition to the OPG Nuclear (OPGN) 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 Decommissioning and Nuclear Waste Management (DNWM) Governance Simplification Project mandate included:

- Reducing the current program documents from five to three;
- Superseding or obsoleting DNWM governance by adopting OPGN governance where appropriate and where it makes good business sense; and,

- Streamlining the DNWM processes to avoid duplication of procedures and instructions throughout the DNWM facilities.

During the licensing period, all programs applicable to DNWM transitioned to N286-12, to meet the requirements of the new DNGS licence (effective January 1, 2016). This helped build on the strengths of the Nuclear Management System, including implementation of industry best practices. This initiative is now complete.

Fleetview

Fleetview program health and performance reporting is a fleet-wide functional review and reporting process to monitor and routinely report on overall program effectiveness of those programs as defined within the nuclear management system.

Each Fleetview program health and performance reporting is conducted in accordance to 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 Fleetview Program Health and Performance Reporting now include Nuclear Waste Management Facilities along with OPG Nuclear Power Plants as applicable.

As with all Fleetview programs, oversight of the Fleetview initiative is performed collectively by the senior nuclear management team.

2.1.5 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.

Approved strategies are intended to:

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

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

Pursuant to this process, DNWM has conducted a Business Impact Analysis. The activities performed by DNWM were all assessed as being capable of being unavailable for more than a week (including several weeks or months) without significant consequences. As the activities were assessed to be low risk, Continuity Plans were not developed.

2.1.6 Nuclear Safety Culture

OPG monitors the health of its nuclear safety culture through Nuclear Safety Monitoring Panels. These panels were established based on the industry best practices documents in the Nuclear Energy Institute's NEI-09-07, *Fostering* a *Strong Nuclear Safety Culture.* The Nuclear Safety Culture Monitoring Panel examines information from a variety of the processes that have been implemented, such as the corrective action process, the human performance program, audits and self-assessments, external inspections such as CNSC inspections or industry evaluations, employee concerns, and business performance monitoring. This information is evaluated against the traits of a healthy nuclear safety culture to identify strengths and areas for focused attention within the organization. The panel, which is composed of all of the managers and senior leadership within DNWM, jointly evaluate the information and approve any initiatives or re-enforce communications as needed.

In 2015 a Nuclear Safety Culture Assessment was performed consistent with our practice for safety culture assessments of our nuclear power plants. The Assessment found, based on information from a review of Station Condition Records and other documents, an 81 question survey sent to all DNWM personnel, and interviews and field observations, that DNWM has a healthy Nuclear Safety Culture. The Assessment identified some areas for improvement, such as improving the communication of OPEX, enhancing employee awareness of the processes for the effective escalation and timely resolution of issues, and improving the communication between work groups. DNWM's Nuclear Safety Culture will be assessed again in 2018, in accordance with the 3 year cycle required by OPG's Nuclear Safety Culture Assessment Procedure.

2.1.7 Independent Assessments

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

Audits of OPG's Nuclear Management System and related activities are performed by the Nuclear Oversight organization in accordance with OPG's Independent Assessment program. Managed processes are subject to audits once every three years, unless otherwise specified.

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.

2.1.8 Self Assessment and Benchmarking

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

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

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

2.1.9 Management of Contractors

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

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

The contractors OPG uses have a long history of working in the nuclear industry and with OPG in particular. They have proven capability to meet the quality standards necessary for a nuclear facility.

These contractors are equally careful in the selection and use of sub-contractors. OPG requires that any sub-contractors must work under the contractor's quality program to ensure there is an assurance that the agreed quality standards and expectations will be met, regardless of who is performing the work in the field. Field verification activities are performed by OPG personnel to ensure the quality program requirements are being achieved.

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

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

2.1.10 Organization

During the licensing period, OPG adopted a center-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.

Central functions establish one point of accountability for an entire function, to deliver functional support across all business units. Examples of such central functions include 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 Senior Vice-President, DNWM has the authority to act for OPG in dealings with the Commission, and is responsible for the management and control of licensed activities at the WWMF. The day-to-day operations and management of the WWMF is the responsibility of the Operations Managers for Low & Intermediate Level Waste and Used Fuel, who report to the Directors of Low and Intermediate Level Waste Operations and Used Fuel Operations, respectively. Only those persons authorized by the Operations Managers supervise operations at the WWMF. The operations organizations receive direct support from the central functions.

Organizational changes are managed following OPG's Organization Design Change procedure. The organization chart for WWMF and supporting center-led organizations is shown in Figure 22.

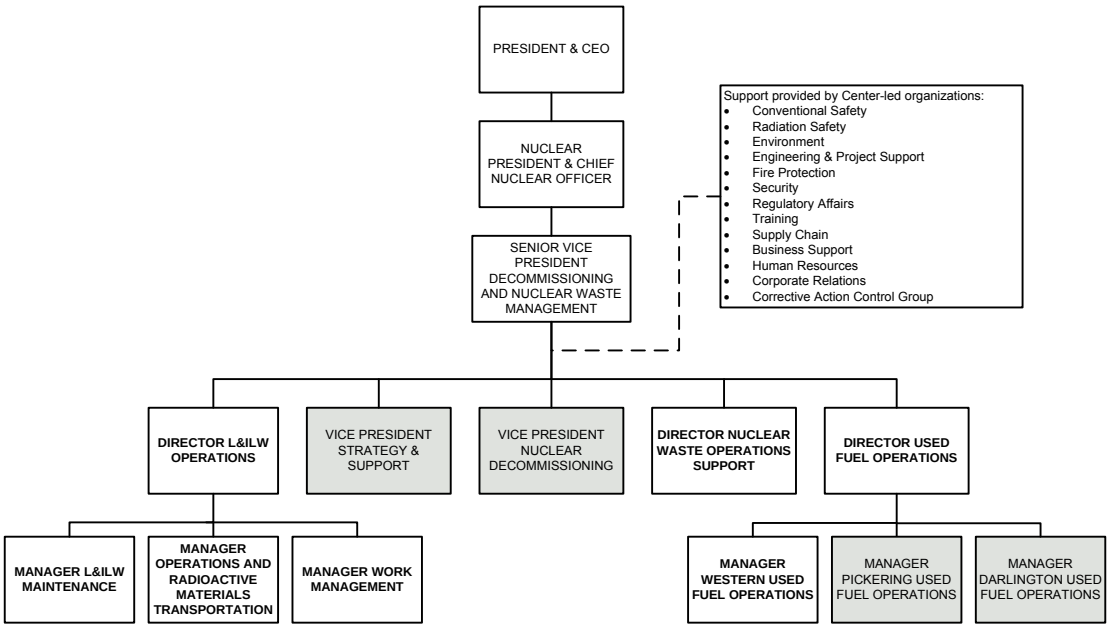


Figure 22: WWMF Organization Chart

2.1.11 Event Reporting

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

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

2.1.12 Future Plans for Improvement

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

- Continued adoption of OPG Nuclear governance as appropriate;
- Ongoing use of Fleetview Program Health and Performance Reporting to assist with overall program effectiveness;
- Manage the business to ensure a focus on long-term sustainable performance excellence; and,
- WWMF will develop leadership and management capability at all levels of the organization with a bias toward teaching and learning moments.

OPG does not foresee, during the next 10 years, any substantive changes to the management system. The main focus for the next 10 years at the WWMF will be addressing the increased volume of radioactive waste materials that will arise from the projects that are underway to extend the operational life of the nuclear power generating units at Darlington and at Bruce Power. These are not expected to result in substantive changes to the management system. They will result in new facilities being required.

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

2.2 HUMAN PERFORMANCE MANAGEMENT

The Human Performance Program at WWMF is defined by 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.

OPG's key documents for the Human Performance Management SCA and the revision at the time of writing are listed in the table presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Human Performance	N-PROG-AS-0002	R015
Training	N-PROG-TR-0005	R016

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

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

2.2.1 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.

2.2.2 Current Operations

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.

In the licensing period there have been two Site Event Free Day Resets as a result of operations at the WWMF. Both events occurred in 2013. The first event involved damage to an outdoor glycol heat exchanger which led to an extended incinerator outage. The second event involved a crane coming into contact with an overhead power line (see section 2.8.2 for details). Detailed investigations were performed following these events and corrective actions to prevent recurrence implemented.

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 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 that procedures will be followed as written, and that if the procedure cannot be executed as provided, for the employee to stop and seek additional direction from their supervisor. Any procedures that cannot be executed as written are rapidly revised and re-issued. This ensures procedural compliance is achievable the next time the document is used.

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, initiatives have been developed to enhance procedural use and adherence. Some elements of these initiatives are currently in progress; others will be developed and implemented over the next year; and other elements will be developed and implemented as necessary based on results.

2.2.2.1 Procedure Use and Adherence

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

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

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

2.2.2.2 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.

2.2.2.3 Pre-Job Briefings

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

2.2.2.4 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.

2.2.2.5 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 aquire 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, identifying the training needed to meet the skill and knowledge requirements of the position. Specialized training is provided where appropriate. The employees' training status is maintained in a Training Information Management System.

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

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

2.2.3 Future Plans for Improvement

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

2.3 OPERATING PERFORMANCE

2.3.1 Operations Program

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

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

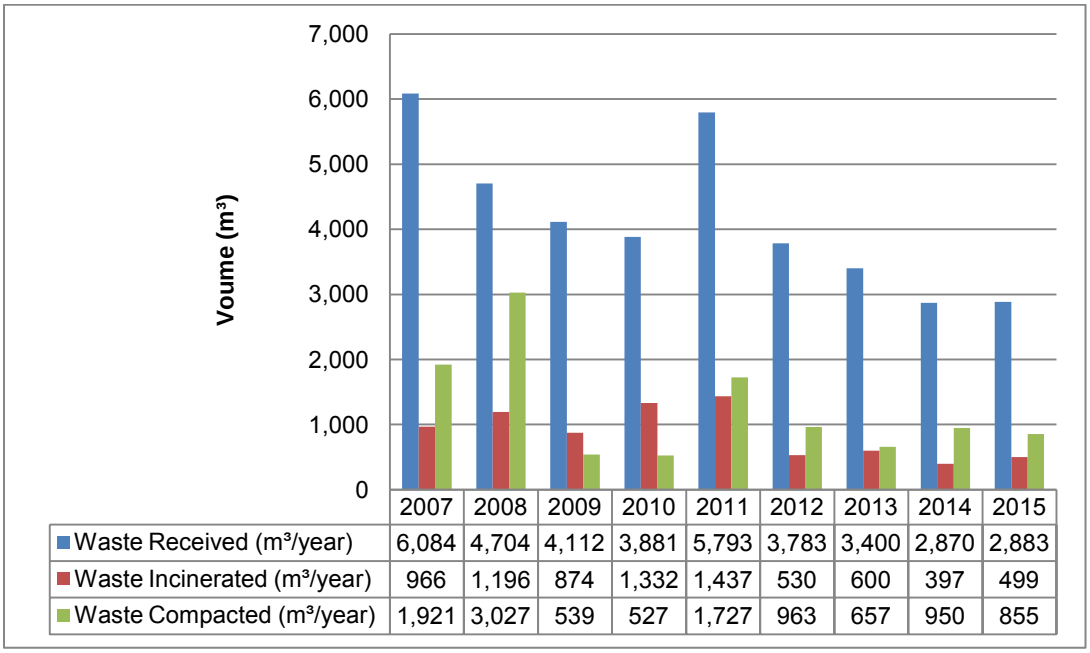
OPG's key documents for the Operating Performance SCAs and the revision at the time of writing are listed in the table presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Nuclear Waste Management	W-PROG-WM-0001	R013
Conduct of Regulatory Affairs	N-PROG-RA-0002	R008
Corrective Action	N-PROG-RA-0003	R010

2.3.2 Low and Intermediate Level Waste Operations

2.3.2.1 Current Operations

Figure 23 shows the approximate total volume of L&ILW received each year and the amount processed at the L&ILW Storage Facility since 2007. The general decline in volume of waste received over the years is mostly due to more effective waste reduction initiatives at the source (see also section 2.11.2 on Waste Management).



	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste Received (m³/year)	6,084	4,704	4,112	3,881	5,793	3,783	3,400	2,870	2,883
Waste Incinerated (m³/year)	966	1,196	874	1,332	1,437	530	600	397	499
Waste Compacted (m³/year)	1,921	3,027	539	527	1,727	963	657	950	855

Figure 23: L&ILW Volumes Received, Incinerated and Compacted at WWMF

The following results were achieved over the period from 2007 to 2015:

- LLSBs 11, 12, 13 and 14 were constructed and placed in service;
- 54 new IC18's were constructed and placed in service;
- Planned incinerator outages were completed in accordance with an improved outage process and schedules; and,
- Lighting upgrades were completed throughout the WVRB and yard areas.

Fire Hazard Analyses, described in Section 2.4.3, were completed for all L&ILW facilities and the recommendations were implemented, or planned for execution. The recommendations included:

- A transportation packaging and maintenance building operating procedure which was updated to require the doors be closed during normal operation and off-hours;
- All waste going into any LLSB has a lid; and,
- There be no waste oil totes stored in LLSBs 12-14.

(a) Incinerator Performance

Throughout the reporting period (2007- 2015), the incinerator met all emissions requirements including successful completion of annual stack testing as required by the Ontario Ministry of Environment and Climate Change Environment Compliance Approval. The incinerator continued to perform very well in the environmental area, well below limits set for parameters such as dioxins/furans, metals and particulate.

Emissions are discussed in Section 2.9.2 Environmental Protection – Current Operations.

There were two notable events, in 2013 and 2014, involving overheating of an air duct that is designed to provide combustion air to the incinerator's primary chamber for waste incineration. In response to these events, all incineration of solid waste was stopped until the system was modified to prevent the potential for recurrence. Details of these events can be found in Section 2.5.2.

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

(b) Compactor Performance

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

(c) In-ground Storage

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

(d) Large Metal Components

A pilot project in 2014, described in Section 2.11.2, sent 3 heat exchangers off site to a licensed third party vendor for volume reduction. The ferrous components of the heat exchangers were put through a metal melting process and produced ingots for sale in the shielding block market. The non-ferrous components (such as copper tube internals) were returned to the WWMF for storage.

2.3.3 Future Plans for Improvement - L&ILW

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

(a) Operating Initiatives

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

- Reduction in maintenance backlogs, to ensure a high availability for equipment required to process L&ILW;

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

(b) Improving Structures and Storage Containers

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

- Re-packaging of L&ILW containers from some of the trenches. This re-packaging is based on the results of on-going aging management investigations to verify the material conditions of waste containers. This is to ensure that the waste containers can be easily and safely handled in the future;
- Upgrading of the fire detection systems in the LLSBs by installing more reliable linear heat detector systems; and,
- Continued sorting and segregating of stored wastes in LLSBs to identify opportunities for further processing and volume reduction or waste that can be free-released to conventional waste streams.

2.3.4 Used Fuel Operations

In order to ensure adequate wet fuel bay space for operation of the Bruce Power NGS, the UFDSF at WWMF operates safely and reliably to transfer, process, and store DSCs from the Bruce Power NGS until a long-term management facility becomes available.

2.3.4.1 Current Operations for Used Fuel

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

(a) DSC Transportation

Empty DSCs, and those loaded with used fuel, are transported on site roads between the Bruce Power NGS and the WWMF by OPG. Since the inception of the WWMF UFDSF in 2002, there have been more than 1,100 on-site transfers of loaded DSCs without incident. Table 6 shows 957 DSCs were processed and stored between 2007 and 2015.

(b) DSC Reverse Loading

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

(c) DSC Weld Wire Operational Impact

In 2013, 26 DSCs at WWMF (20% of production) had issues with the quality of the completed welds. These were discovered during the post welding inspection using Phased Array Ultrasonic Testing. The root cause was discovered to be a manufacturing change that introduced contaminates in the weld wire that directly influenced the quality. As a result, defects were detected. The specifications for the weld wire were revised by OPG and as a result there have been no further weld porosity issues that can be attributed to this issue. With the exception of the year 2013 the weld quality defects from 2007 through 2015 have been less than the rework target of 10%.

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

(d) DSC Base Flange Laminations

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

(e) Phased Array Ultrasonic Testing

Phased array ultrasonic testing was introduced for inspecting the DSC lid-to-base containment weld. Phased array ultrasonic testing is a volumetric, non-destructive inspection method that involves electronically steering a beam of sound waves through the weld (and adjacent base materials) to inspect the weld. Phased array ultrasonic testing replaces radiographic inspection, thereby eliminating the health and safety

hazards of the latter method's radiation exposure. Use of radiography to inspect DSCs ceased in 2011. The change in the inspection method was supported through third party expert review and approval of OPG's technical justification (which included the results of physical testing) provided under the auspices of the CANDU Inspection Qualification Bureau in 2010.

(f) Production History

The number of DSCs loaded at WWMF between 2007 and 2015 is shown in Table 6. In 2009 Bruce Power identified the need to increase the number of DSCs processed and stored in order to reduce the quantity of used fuel stored in the Bruce B secondary fuel bay, and support Bruce Power in returning Bruce A Units 1 and 2 back to service. Based on this, the Western UFDSF increased production up to a maximum of 130 DSCs per year, as amended in the Bruce Power lease agreement.

Table 6: DSCs Loaded at WWMF per Year

Year	Number of DSCs Loaded at WWMF between 2007-2015
2007	75
2008	77
2009	70
2010	130
2011	120
2012	130
2013	130
2014	110
2015	115
TOTAL	**957**

2.3.5 Future Plans for Improvement - Used Fuel

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

At WWMF, the following future improvements are planned:

- Facility configuration is being reviewed and improved to increase equipment reliability and ensure employee safety;
- Installation of new updated security equipment;

- A new generation DSC Transporter vehicle (the Gen IV) has been designed. The first of this new Transporter was tested in 2013 and remains at Pickering Waste Management Facility. Following modifications and completion of a second vehicle, it will be put in service in 2016 at the Western UFDSF.
- A Work Management process effectiveness review (T16 planning model, adopted from the Generating Stations) is in progress, to ensure a high availability target for equipment required for facility operations.

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

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

OPG's key document for the Safety Analysis SCA and the revision at the time of writing is presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Reactor Safety Program	N-PROG-MP-0014	R005

2.4.1 Current Operations

The WWMF safety report addresses the health and safety of workers and the public, and the protection of the environment. It contains information on the UFDSF and L&ILW storage facility and demonstrates that dose rates and emissions from the WWMF under normal and abnormal operating conditions as well as postulated accident conditions are within allowable limits, and pose a negligible risk to the public, the workers, and the environment.

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

The current version of the WWMF safety report was submitted to CNSC in 2012, and accepted by the CNSC in 2013. The current safety report was updated in accordance with Condition 4.2 of OPG's waste management facility licence WFOL-W4-314.02/2017. The report demonstrates that dose rates and emissions from the WWMF under normal and abnormal operating conditions as well as postulated accident conditions are within allowable limits, and operation of the facility continues to pose a negligible risk to the public, the workers, and the environment. The next update will be in 2017.

Self assessments are performed after selected safety report updates in order to identify issues and to continually improve the update process. For example, a requirement has been documented for a detailed work plan to be prepared approximately 2 years prior to the safety report update. This plan documents the update process, including safety analysis reviews and updates.

Safety analyses for OPG's nuclear waste facilities are conducted using specific procedures unique to these facilities. In 2013, the Safety Assessment group transitioned to the OPGN Nuclear Safety Division. As part of the transition plan, these procedures were updated and brought under the authority of the OPGN Reactor Safety Program in 2015. This Program defines organizational responsibilities and key program elements for the management of issues relating to nuclear safety analysis for all OPGN Class I operating facilities.

2.4.2 Safety Assessment Results for WWMF Structures

Low and Intermediate Waste Structures – Normal Operating Conditions

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

Low and Intermediate Waste Structures – Malfunctions and Accidents

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

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

2.4.2.3 Used Fuel Dry Storage Safety Analysis - Normal Operating Conditions

Shielding analysis is performed to determine dose rates from individual DSCs, and both inside and outside of the storage buildings. Dose rates external to the buildings are determined for workers on site and for members of the public off site. In all cases, assuming storage buildings filled to capacity with 500 DSCs containing 10 year old fuel, predicted doses are well below the regulatory limits. Predicted dose at the site

boundary and for the nearest resident are estimated to be well below detectable levels, and accordingly are well below the CNSC regulatory public dose limit of 1 mSv/year.

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

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

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

In March 2010, OPG identified potential abnormal scenarios involving multiple vehicles in DSC Processing and Storage Buildings at the WWMF's UFDSF. OPG performed the appropriate assessment and confirmed that the consequences of the postulated scenarios involving operation of multiple vehicles inside the DSC Processing and Storage Buildings at the WWMF's UFDSF are within the safety and design envelope.

A second new DSC transporter (Gen IV) has been manufactured and delivered to the WWMF UFDSF. An assessment confirmed that the new transporter can be operated within the waste management facility's safety and design envelope. The new DSC transporter will be put in service at WWMF in 2016.

Criticality

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

It has been demonstrated that there is not enough plutonium which could be released from failed fuel elements to achieve critical mass, even using extremely conservative fuel defect rates.

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

2.4.3 Fire Hazard Analysis

OPG completed Fire Hazard Analyses for the LLSBs, to determine the potential risks of a fire within the buildings and to ensure the most appropriate means to mitigate and minimize these risks were included in the design of these facilities. Fire Hazard Assessments were completed by a third party using the current licence codes.

Separate analyses were completed for LLSBs 1-11, LLSBs 12 to 14, the WVRB, and the Transporter Package Maintenance Building. Results are briefly discussed below.

- **LLSBs No.1 to 11**

  The report provided numerous recommendations which OPG continues to address.

  OPG also completed an environmental dose assessment report on LLSB fire water runoff, which concluded that fire water runoff would not create an unreasonable risk to the environment and the non-human biota at the population level.

- **Waste Volume Reduction Building (WVRB)**

  The report recommended a change in the incinerator operating procedure; installation of a manual pull station; and a risk assessment study of a propane explosion and boiling liquid expanding vapour explosion (BLEVE) by an external contractor. All three recommendations have been completed.

  The latter risk assessment concluded that the blast wave and thermal radiation from the BLEVE would not damage adjacent structures beyond breaking windows. It further concluded that the propane storage tank installation is well arranged and the risk of fire exposure to the tanks required to create the conditions for a BLEVE is very low.

- **Transportation Package Maintenance Building**

  The assessment recommended a change in the operating procedure to include a requirement for interior doors to be closed at night. This has been completed.

- **LLSBs 12 to 14**

  The report provided two minor recommendations, that lids be provided for the backlog processible waste stored in LLSBs 12 to 14 to reduce the risk of fire ignition and spread, and that the plastic containers of waste oil should not been stored in LLSB 12 to14 as was the practice. OPG has implemented both recommendations.

2.4.4 OPG's Response to Fukushima

Following the 2011 event at Fukushima, OPG assessed the impact of consequential event sequences on the existing safety envelope of the WWMF. The initiating and consequential events considered included a seismic event, fire, explosion, loss of power, tornado and thunderstorm. In all scenarios assessed for the WWMF, the consequences of the resulting events were found to be within the existing safety envelope as defined in the safety report for the nuclear waste facility. Further details of OPG's response to this event are described in Section 3.4.

2.4.5 Future Plans for Improvement

- Safety Analysis Methodology

  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 (MCNP) transport code for dose rate calculations. DSC models (including fuel) are being updated to better represent actual geometries, and analysis assumptions are being reviewed to ensure reasonable conservatisms exist. This demonstrates OPG's goal of continuous improvement. These improvements are expected to be used for the 2017 Safety Report update.

- Support for Additional Facilities

  In the current WWMF operating licence, there is provision and authorization for additional storage structures remaining to be built at the WWMF site, as described in Section 1.

  Since no significant changes are expected for the additional storage facilities, the current safety assessment for accidents with respect to the storage buildings for used fuel, LLSBs, and in-ground containers (IC-HXs and IC-18s) will remain the same and applicable to these additional buildings/structures. If there are significant changes to the design of these buildings/structures, an assessment will be performed to confirm that the design of the required structures is adequate and meets all radiological safety requirements required by *Nuclear Safety and Control Act* and its Regulations.

  Furthermore, an additional two buildings are also being requested, namely a Large Object Processing Building and a Waste Sorting Building. Detailed safety assessments will be performed for these new buildings once additional design and location information is available. This is to ensure that the designs of the buildings are adequate and that all radiological safety requirements provided in the *Nuclear Safety and Control Act* and its Regulations are met.

- Safety Analysis Update

  Safety analyses will be reviewed and/or performed as necessary prior to requesting permission to construct 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.

2.5 PHYSICAL DESIGN

Physical design relates to activities that impact on the ability of systems, structures and components, as described in Section 1, to meet and maintain their design basis given new information arising over time and taking changes in the external environment into account.

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

OPG's key documents for the Physical Design SCA and the revision at the time of writing are presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Engineering Change Control	N-PROG-MP-0001	R014
Pressure Boundary	N-PROG-MP-0004	R016
Configuration Management	N-PROG-MP-0005	R005
Software	N-PROG-MP-0006	R009
Conduct of Engineering	N-PROG-MP-0007	R012
Design Management	N-PROG-MP-0009	R011

2.5.1 Design Programs

Management of the design basis at the WWMF is now governed by the OPG Nuclear Conduct of Engineering Program. This program provides the framework for performing engineering work in a consistent manner across all OPG Nuclear facilities. Engineering activities, including design management, are implemented via procedures and work instructions to satisfy the following requirements:

(1) The WWMF configuration is maintained in accordance with the design basis and the facility is operated within its safety envelope;

(2) All modifications to the facility are designed, constructed, installed, and commissioned in accordance with the design basis;

(3) Essential facility systems, structures, and components perform their functions safely and reliability within the design basis;

(4) All relevant legal and regulatory requirements are met; and,

(5) Continuous improvement is encouraged and fostered to improve facility performance.

The Conduct of Engineering Program is supported by the following additional programs.

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

- 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 DNWM 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 WWMF pressure boundary systems meets the requirements of CSA N285.0-08 and Update No. 2 (including Update No. 1 and Annex M), and additional requirements per Appendix D of the WWMF Operating Licence. The CNSC has regulatory jurisdiction over pressure boundary requirements, including approval of any deviations from those requirements. Authorization for OPG to perform pressure boundary activities is granted by the Technical Standards and Safety Authority, on behalf of CNSC staff.

2.5.2 Current Operations

DNWM 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 DNWM governance was accomplished through a managed process of governance management records that ensured a controlled and thorough adoption process.

Per the current WWMF operating licence, the following codes and standards are used in design:

- *National Building Code of Canada* (2005)
- *National Fire Code of Canada* (2005)
- CSA B51 (2003)
- CSA N285.0-08 including Update 2

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

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

(2) Phased Array Ultrasonic Testing was introduced for inspecting the DSC lid-to-base containment weld. Phased Array Ultrasonic Testing is a volumetric, non-destructive inspection method that involves electronically steering a beam of sound waves through the weld (and adjacent base materials) to inspect the weld. Phased Array Ultrasonic Testing replaces radiographic inspection, thereby eliminating the health and safety hazards of the latter method's radiation exposure. Use of radiography to inspect DSCs ceased in 2011. The change in the inspection method was supported through third party expert review and approval of OPG's technical justification (which included the results of physical testing) provided under the auspices of the CANDU Inspection Qualification Bureau in 2010.

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

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

(5) Operating experience with the beam detector fire detection systems in LLSBs 1-11 has shown this technology to be less reliable than desired in the prevailing environmental conditions. A modification is underway to replace the beam detector systems with more reliable linear heat detection systems. LLSB 11 was completed in fourth quarter of 2015 and work will continue through 2016 on the remaining buildings.

In 2012, DNWM 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 DNWM. Quality of design products is monitored using recorded verification results and cold-body design review boards within DNWM. A monthly report card is used to record and track DNWM's performance and to ensure that corrective actions are being taken to address any weaknesses or deficiencies that are observed.

2.5.3 Future Plans for Improvement

DNWM plans to complete the remainder of the LLSB Fire Detection Upgrade modifications on LLSBs 1-10 to improve equipment reliability.

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

- CSA N286-12, *Management system requirements for nuclear facilities*
- CSA N393-12, *Fire protection for nuclear power plants*
- NRCC NBCC (2010), *National Building Code of Canada*
- NRCC NFCC (2010), *National Fire Code of Canada*

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

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

OPG's key documents for the Fitness for Service SCA and the revision at the time of writing are listed in the table presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Equipment Reliability	N-PROG-MA-0026	R002
Conduct of Engineering	N-PROG-MP-0007	R012
Integrated Aging Management	N-PROG-MP-0008	R006

2.6.1 Equipment Reliability

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

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

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

2.6.2 Maintenance

Under DNWM's Nuclear Waste Management Program, 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.

2.6.3 Structural Integrity

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

At the Western UFDSF, OPG conducts Phased Array Ultrasonic Testing to verify the integrity of the lid closure weld on each loaded DSC. The radiographic inspection system was replaced by the Phased Array Ultrasonic Testing inspection system in 2010 to improve inspection sensitivity and eliminate inspection radiation hazards. As of February 2016 approximately 750 DSCs have been inspected with the Phased Array Ultrasonic Testing system demonstrating the reliability of this improved inspection system.

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

Groundwater monitoring has identified higher tritium levels in the groundwater north of the LLSBs. More details on tritium in groundwater can be found in section 2.9.3.2. Follow-up investigations identified a pathway for contaminated condensation to migrate from older LLSBs into the below-grade electrical conduit system and then to groundwater. Stored waste currently blocks access to these conduit penetrations; however, during the LLSB Fire Detection Upgrades in 2017, as these conduit penetrations become accessible, they will be sealed. In the interim, a program of regularly scheduled pump-outs of the affected below grade electrical conduit system

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

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

2.6.4 Current Operations

2.6.4.1 Aging Management

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

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

(a) <u>Dry Storage Containers</u>

The DSC Aging Management Plan addresses aging mechanisms, such as corrosion, which could potentially affect DSCs. Current aging management activities include:

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

Results to date:

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

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

(b) Transportation Packages

The current aging management activities for transportation packages include:

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

Results to date:

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

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

(c) Low & Intermediate Level Waste Storage Structures

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

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

- LLSB roof inspections were completed in 2008.
- Roof membranes for LLSBs 1 to 5 were replaced in 2011 and 2013 based on the 2008 inspection and life assessment results.
- Internal inspections of WWMF trenches were completed in 2007 and follow-up inspections were completed in Q3 2015. During the 2015 inspection water was found in the bottom of trench 3-2 and corrosion was observed on the surfaces of the waste drums stored in the trench. The trench was pumped out and the source of the water is being investigated. An inspection of the trench and repackaging of the corroded drums is planned in 2016. To ensure safe handling of the corroded drums during repackaging, specialized equipment and procedures are being developed.
- To address corrosion concerns for carbon steel resin liners identified in previous studies, 350 carbon steel resin liners were removed from IC-18 storage, over-packed in stainless steel containers and then returned to the IC-18 storage in 2007 and 2008.

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

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

2.6.5 Future Plans for Improvement

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:

(a) Used Fuel Dry Storage Facility

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

(b) Transportation Packages

- Two new Multi-Purpose Transportation Packages will be placed in-service by 2018, to replace existing heavy water (“TDO”) packages. The Multi-Purpose Transportation Package design offers an improved seal testing capability over the older package design.
- Nine new ISO transportation packages will be placed into service in 2018.

(c) Low & Intermediate Level Waste Storage Facility

- Replace obsolete overhead doors on older Low Level Storage Buildings;
- Replace obsolete components in Low Level Storage Buildings fire detection and fire suppression systems; and,
- Replace roof membranes for Low Level Storage Buildings 6, 7 and 8.

(d) Waste Volume Reduction Building

A number of replacements are planned to improve incinerator reliability and address obsolescence concerns including replacement of:

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

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

(e) Planned Inspections and Improvements

Repackaging of corroded waste drums from trench 3-2, as well as a condition assessment of this trench section is planned to start in 2016. Other plans include condition assessments of selected tile holes and selected In-ground Containers between 2016 and 2019 using remote camera inspection techniques.

(f) Compliance with REGDOC-2.6.3

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

2.7 RADIATION PROTECTION

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.

OPG's key document for the Radiation Protection SCA and the revision at the time of writing is listed in the table presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Radiation Protection	N-PROG-RA-0013	R009

2.7.1 Radiation Protection Program

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 (ALARA).

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

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

(a) <u>Radiation Protection Program Monitoring and Oversight at WWMF</u>

In addition to Fleetview reporting and assessments described in Section 2.1, 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
  - Monthly Nuclear Oversight Meeting
  - Weekly Management Review Meeting
- Exceptional dosimetry and dose control device measurement results.
- Dose trends.
- 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.
- External assessments performed by the CNSC.
- Adoption of World Association of Nuclear Operators best practices.
- Investigation of events in which an Action Level has been exceeded.
- Improvements to the Radiation Protection Program, such as enhanced alpha monitoring through workplace controls and specialized alpha radiation protection equipment.

- Trending of Radiation Protection Program measures commonly used in the nuclear industry.
- Benchmarking of OPG practices with the rest of the nuclear industry.
- Reviews of industry operating experience.
- CANDU Owners Group and other research and development programs.

(b) Performance Indicators

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 DNWM Scorecards and Radiation Protection Indices. Specific measures include: personnel contamination incidents, regulatory infractions as well as dose performance versus dose targets.

(c) Management Control over Worker Practices for Dose and Contamination Control

Performing radioactive work and exposure to radiation within WWMF requires a systematic approach and is managed through the following processes:

- Limiting individual worker dose.
- Managing dose as a resource, in terms of constraints on work activities.
- Establishing facility design consistent with ALARA principles.
- Assessing hazards for planning and maintaining knowledge of conditions.
- Controlling the use of licensed radioactive devices and equipment.
- Planning all radioactive work taking into account personnel, hardware, procedures, supervision, and the physical environment of the job.
- The planning process includes the anticipation and evaluation of radiation hazards and the selection of appropriate protective measures and dosimetry. The degree of formalization of the planning process and the approval levels for a job is proportional to the potential for exposure. Plans include backout conditions and contingencies. Radiation protection planning decisions are documented in a radiation exposure permit.
- The program elements described in this section ensure compliance with the regulatory requirements to keep exposures ALARA, implement control of occupational and public exposure, and plan for unusual situations.

d) Licenses

OPG holds the following Nuclear Substances and Radiation Devices Licences:

- Licence # 12861-2-20.3 for consolidated uses of nuclear substances (815) for nuclear substances and prescribed equipment.
- Licence # 12861-15-17.1 for temporary possession – no use (918) for nuclear substances.
- Licence # 12861-17-20.0 for servicing, installation and dismantling of devices – basic servicing (822) for prescribed equipment.

OPG also holds Dosimetry Service Licence # 12861-11-25.0 for in-house dosimetry services – consolidated (598) for the operation of a dosimetry service.

2.7.2 Current Operations

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

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

There have been no action level exceedences related to dose to workers during the current licence period.

During the current licensing period, there were no recordable doses at the WWMF that exceeded legal limits in the *Radiation Protection Regulations* or that were in excess of OPG's administrative limits. 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.

Similarly, during the current licensing period, there was no loss of contamination control events in excess of WWMF's contamination control action level.

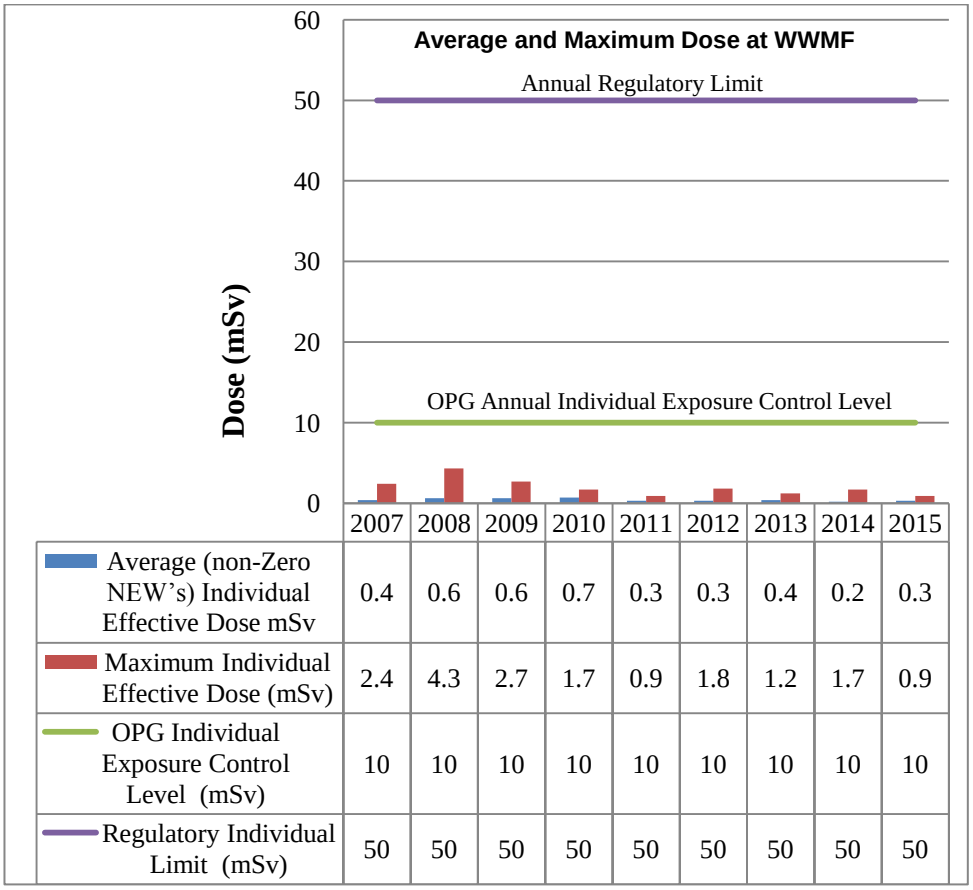
(a) Collective Dose and Maximum Individual Dose per Year

OPG's exposure control program continues to be in full compliance with regulatory requirements. In particular, the OPG individual exposure control level of 10 mSv (1 rem) per calendar year is significantly below the single year regulatory limit of 50 mSv (5 rem) per year, and the five-year regulatory limit of 100 mSv (10 rem) averaged over five years for a nuclear energy worker. ALARA targets are

generated on a yearly basis and are based on outages, normal operations, and waste to be received on a volume basis along with special projects (such as movement of waste to accommodate fire detection upgrades). Figure 24 and Table 7 outline the key dose statistics for OPG's WWMF.

In the last licence period, enhanced radiological contamination monitoring equipment has been procured and installed at OPG's WWMF to increase OPG's capability and reliability to detect low levels of radioactive contamination. This consists of new personal whole body contamination monitors and enhanced gamma sensitive portal monitors, as well as large object monitors to detect extremely low levels of radioactivity.

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



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

Figure 24: Average and Maximum Dose at WWMF

Table 7: Key Dose Statistics for OPG's Western Waste Management Facility

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

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

(b) Contamination Control

Radioactive contamination controls are in place to reduce occupational and public exposure, and to ameliorate the release of radioactive materials to the environment. The objectives are to prevent a loss of radioactive contamination control, to minimize the area affected if contamination occurs, and to restore the condition to acceptable levels as soon as possible. During the reporting period, no contamination events in excess of regulatory limits have occurred.

(c) Results of Corporate-wide Radiation Protection Audit

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

2.7.3 Future Plans for Improvement

Based on industry best practices, OPG's WWMF will implement new whole body contamination monitors, and will evaluate the alarm set-points and Radon rejection software to reduce spurious alarms.

As the WWMF incorporates new waste storage structures and facilities, culminating in the eventual operation of the L&ILW DGR, there is an opportunity to reduce dose and increase efficiencies through the adoption of a wireless infrastructure for radiation protection equipment. Further opportunities include telemetry for personnel monitoring as an additional safety barrier.

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

2.8 CONVENTIONAL HEALTH AND SAFETY

2.8.1 Conventional Safety Program

OPG's key documents for the Conventional Health and Safety SCA and the revision at the time of writing are listed in the table presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Employee Health and Safety Policy	OPG-POL-0001	R009
Health and Safety Management System	OPG-PROG-0010	R003
Work Protection	N-PROG-MA-0015	R011

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

The *Employee Health and Safety Policy* states:

- 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.

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

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

2.8.2 Current Operations

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. All Injury Rates and Accident Severity Rates provided are for the entirety of DNWM which the WWMF is part of.

(a) All Injury Rate

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

DNWM's All Injury Rate performance was better than target from 2010 through 2015 as shown in Figure 25. There were three medically treated injuries in 2010 (rolled ankle, back strain, and back pain); one lost time accident in 2011 due to arc flash; and one medically treated injury in each of 2012 (arc flash), 2013 (slip in a parking lot) and 2014 (elbow pain while working at computer workstation). There were no medically treated or lost time injuries in 2015.

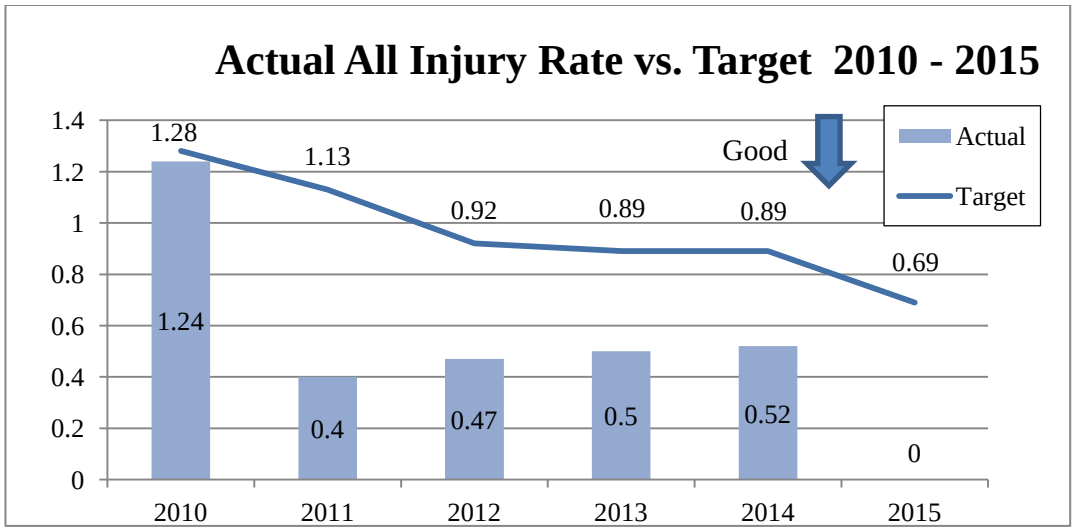


Figure 25: DNWM All Injury Rate vs. Target

(b) Accident Severity Rate

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

DNWM's Accident Severity Rate was better than target from 2010 through 2015 as shown in Figure 26. There was one Lost Time Injury in 2011, where a worker was exposed to a weld arc flash which resulted in one missed day of work. A root-cause investigation was conducted and corrective actions were implemented including training and procedural requirements for welding of DCSs.

Since that day in 2011, DNWM has showed its continued focus on safety performance by working over 1,825 days (or 5 years) without a lost time accident. There has also been a steady decline in medically treated injuries over the last 5 years.

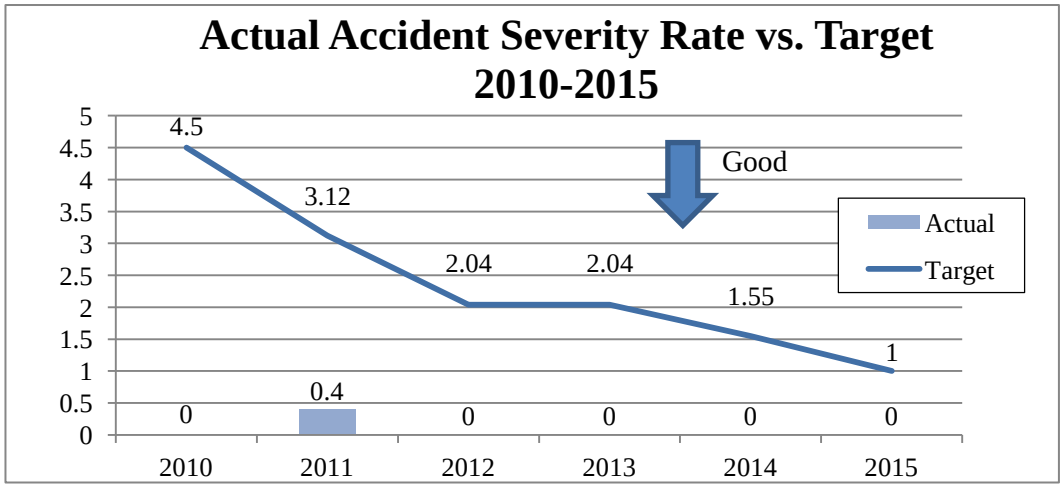


Figure 26: DNWM Accident Severity Rate vs. Target

(c) High Maximum Reasonable Potential for Harm Events

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

During this reporting period (2007 – 2015), there were seven High Maximum Reasonable Potential for Harm events that occurred at OPG's WWMF, as described below.

Material Handling

(1) In June 2011 an employee attempted to assist a fork lift operator with a stuck oil pallet when a steel frame suddenly moved and made contact with the individual's shoulder. Operating Experience of this event was communicated to staff to ensure alignment with management expectations with regard to safe production at all times. A procedure was developed for the task being performed, and a roll out of the Internal Responsibility System was completed to L&ILW staff in November 2012. There have been no repeat events similar to this.

Mobile Crane

(2) In October 2013 a mobile crane contacted live overhead power lines while an employee was driving the mobile crane from a lay down area to the L&ILW Storage Facility. While exiting the lay down area, the boom of the mobile crane came in contact with live overhead power lines (4.16kV). The overhead power lines were replaced / repaired and power was restored by Hydro One. The event was communicated to staff, warning flags were applied to the over head power lines by Hydro One and expectations for crane travel with the boom lowered were re-communicated and reinforced.

Falling Object

(3) In February 2007, an overhead door (estimated to weigh about 1,500 pounds) was in the raised position to allow a worker to bring in a snow blower. A worker returned to lower the door, pressed the down button and the panel door crashed to the floor in an uncontrolled descent. The immediate cause of failure was determined by an outside contractor to be a loose set screw on one of the drive sprockets. Lessons learned from this event were communicated, maintenance program confirmed in place for all overhead doors and preventive maintenance program on in-service overhead doors reviewed to ensure they contain required elements.

(4) In January 2014, two employees were moving a single person Genie lift from the Bruce Power Central Maintenance Facility garage to the WWMF Transportation Package Maintenance Building using a pick-up truck fitted with a power tailgate. During the move the swivel casters caught against an uneven surface, and the lift inadvertently came into contact with the Transportation Package Maintenance Building garage door and landed on the ground. Lessons learned from this event were communicated to L&ILW staff, a safe work plan was developed for moving single person Genie lifts, and Supervisors conducted Observations and Coaching activities focused on pre-job briefs.

Flying Object

(5) In August 2009, during post-maintenance testing of the dry leg of a fire protection system in UFDSB 1, the fire hose in the cabinet furthest from the deluge valve became energized, breaking the cabinet glass and exiting the cabinet with considerable force. The hose became energized because its valve was passing due to improper setup, and because a safety clamp designed to keep the hose from becoming pressurized until the hose was fully deployed was not in its proper position at the time of the incident. A legacy configuration issue was determined to be a contributing cause in this event. Corrective actions included implementation of a strategy with respect to Nuclear Waste Fire Protection Program, training of WWMF operators with responsibility for fire system operation and testing assignments and training of Fire System Engineer(s) for DNWM.

Working at Heights

(6) In November 2014 a recycling truck operator working for an external company was at the WWMF site to pick up recycling material. An OPG employee observed the recycling truck operator climb to the top of the truck and into the back of the truck exposing the operator to a potential fall from height. The contractor confirmed the company has a policy on workers accessing the top of the vehicle. The contractor also confirmed they have discussed the incident with the worker, outlined their expectations, and changed their policy for work at the Bruce Power NGS / WWMF so that their workers were no longer allowed to access the top of the vehicle while on site.

(7) In January 2015, a contract scaffold worker slipped and fell while building a scaffold in the L&ILW zone 3 incinerator room. At the time of the incident, the worker was wearing fall arrest; however, the fall arrest equipment was not tied off. Follow up was conducted with the contractor to reinforce expectations around working at heights and additional oversight was put in place for scaffold work within the facility.

(d) Internal Responsibility System

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

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

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

2.8.3 Future Plans for Improvement

A number of health and safety improvement initiatives have been identified for the WWMF as part of the continuous improvement cycle of the health and safety management system. These include further implementation of the OPGN Human Performance Program tools and processes, an increased focus on Situational Awareness particularly around routine activities such as walking, continued focus on improvements to the Internal Responsibility System as well as a "Total Health Initiative" supporting employees and their families in their efforts to achieve an optimal level of health and functioning, primarily through health education, health promotion, disease and injury prevention, and crisis intervention.

In addition, to reflect WWMF's commitment to continuously improving and challenging performance, targets for All Injury Rate and Accident Severity Rate have been decreasing.

2.9 ENVIRONMENTAL PROTECTION

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

OPG's key documents for the Environmental Protection SCA and the revision at the time of writing are listed in the table presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Environmental Policy	OPG-POL-0021	R004
Environmental Management System	OPG-PROG-0005	R004
Environmental Management	N-PROG-OP-0006	R018

2.9.1 Environmental Management Program

OPG's Board of Directors has established an environmental policy that requires OPG to maintain an Environmental Management Program consistent with the International Organization for Standardization (ISO) 14001 *Environmental Management System Standard.* OPG's Environmental Management Program requires assessment of environmental risks associated with the facility's activities, and to ensure that these activities are conducted such that any adverse impact on the natural environment is ALARA. This program includes OPG's approach to ensure compliance with applicable statutory and regulatory requirements. The Environmental Management System provides the structure and processes to ensure implementation and follow-up on management programs needed to deliver the environmental policy.

OPG's Environmental Management System has been implemented at the WWMF site. This is further defined through the framework specified in OPG Nuclear's Environmental Management Program. This is aligned with OPG's Plan-Do-Check-Act business model. Through this model, objectives, targets and programs are established, executed, monitored and reviewed with the commitment to continual improvement.

OPG 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.

2.9.2 Current Operations

2.9.2.1 Environmental Management System

As part of OPG's Environmental Management System, environmental performance targets, including reportable spills, environmental compliance, and radioactive waste generation are reviewed annually to ensure that opportunities for continuous improvement are identified and implemented. Programming is in place to ensure that facility spill environmental compliance risks and waste generation are reviewed and opportunities for improvement are identified and implemented.

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

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

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

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

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

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

Reportable Spills

On June 20, 2014, there was a leak in the domestic water supply resulting in a chlorinated discharge to the environment.

On March 1, 2013, approximately 50 litres of mixed ethylene glycol and water spilled onto an asphalt surface with some residual ethylene glycol entering the ditch adjacent to the site.

On May 7, 2010, 90 kg of powdered lime spilled onto an asphalt surface with some of the lime entering the ditch adjacent to the site due to rainfall.

On September 16, 2009, approximately 200 litres of water with trace amounts of ethylene glycol spilled onto an asphalt surface with trace amounts of ethylene glycol entering the ditch adjacent to site.

Environmental Infractions

On June 10, 2013, the frequency of groundwater sampling for the conventional landfill was reduced prior to receiving Ministry of Environment approval. Approval has since been granted.

On October 29, 2008, a physical change to improve incinerator performance was completed without approval from the Ministry of Environment and Climate Change as required through the Environmental Compliance Approval process. The Environmental Compliance Approval was subsequently amended to address the change.

On October 29, 2008, the incinerator emissions exceeded operational requirements for carbon monoxide and hydrogen chloride as per the Environmental Compliance Approval. Operational improvements were subsequently implemented to address these exceedances.

On June 7, 2007, an Environmental Compliance audit showed that a number of waste manifests were not in compliance with Regulation 347. The Hazardous Material Control procedure was revised to include an instruction for the shipping of Hazardous Waste and the control of Waste Manifests at the Western Waste Site. A roll out of the procedure was made to affected staff.

2.9.2.2 Radiological Effluent Monitoring Program

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

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

- Groundwater within, and in the vicinity of the WWMF.

The 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. A summary of the results from the past 9 years are provided in the following subsections.

Radiological Environmental Monitoring Program

Radiological emissions from the WWMF are a small fraction of the overall emissions from the Bruce nuclear site. The offsite radiological impacts from the operation of the WWMF, in addition to the other facilities on the Bruce nuclear site, are monitored under Bruce Power's Environmental Monitoring Program. Bruce Power's radiological environmental monitoring includes air, precipitation, water (municipal, well, lake/stream), aquatic samples (fish, sediment, sand), and terrestrial samples (animal products, vegetation, soil). Data gathered from this program, along with emissions data, are used to assess the annual radiological dose to members of the public living or working in the vicinity of the Bruce nuclear site. Results of monitoring and public dose assessment are published in Bruce Power's annual Environmental Monitoring Program report which is submitted to the CNSC and made available to the public. As discussed in Section 2.9.3.1, dose to the public from operation of facilities on the Bruce nuclear site is a very small fraction of the public dose limit.

Derived Release Limits

Derived release limits are derived using CSA N288.1 and approved 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 OPG's WWMF have been consistently less than 1% of the derived release limits. WWMF's current derived release limits are shown in the following table.

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

Action Levels

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

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

In 2011, the new action levels were developed using CNSC Regulatory Guide G-228, *Developing and Using Action Levels* as a guide. The derived release limits were updated in parallel, due to the availability of new site and meteorological data, as well as updated derived release limit methodology, primarily CSA Standard N288.1-08 *Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities.*

In accordance with Licence Condition 4.2 of the WWMF Operating Licence, WFOL-*W4- 314.02l2017,* OPG has assessed the proposed changes to the derived release limits and action levels, and found them to be within the existing safety and design envelope, not likely to adversely affect the safe conduct of any licensed activities, nor outside the scope of the licence. Changes are made in accordance with OPG's change control program established in the former NWMD conduct of engineering program.

Radiological Waterborne Emissions

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

The results of the radiological waterborne emission monitoring programs are reported in the WWMF's quarterly operations reports submitted to the CNSC. Over the past 9 years, six exceedances of the action level have occurred for gross beta waterborne emissions at the WWMF. These occurred between the third quarter of 2010 and fourth quarter of 2012.

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

A summary of WWMF's annual radiological waterborne emissions is provided in the following figures. The action level exceedances as noted above are based on total monthly releases. These exceedances are not directly reflected in Figure 28 as these emissions are presented as annual releases not monthly.

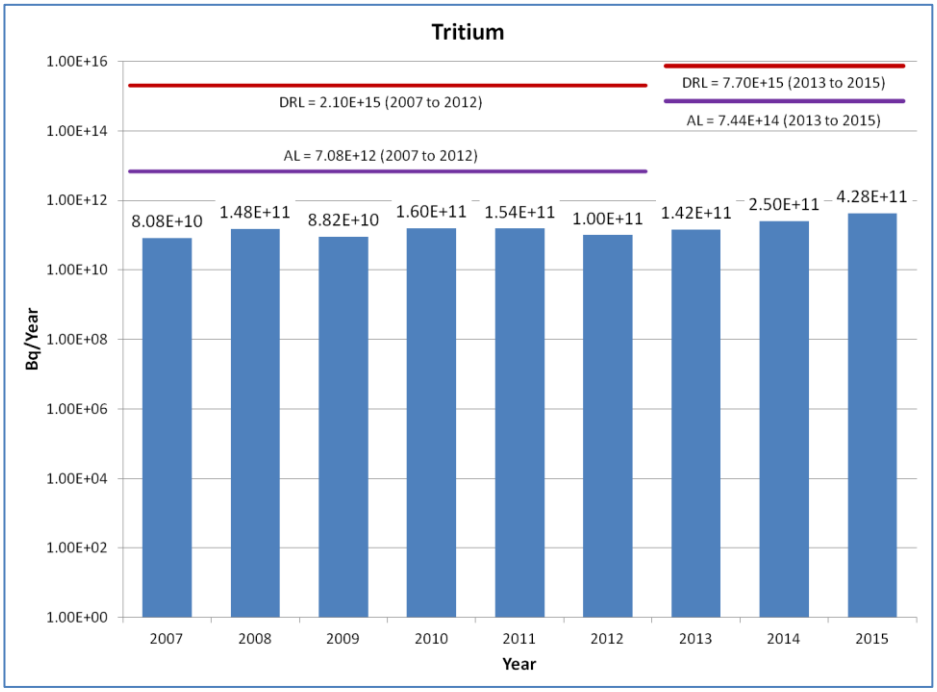


Figure 27: WWMF Annual Tritium Waterborne Emissions, 2007-2015

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/month for comparison to annual emissions.

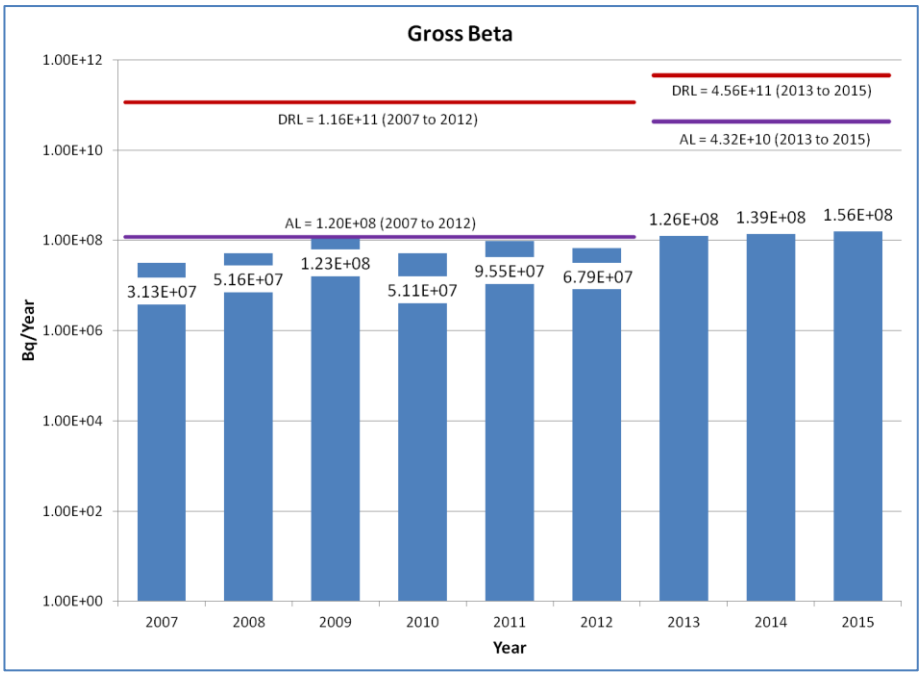


Figure 28: WWMF Annual Gross Beta Waterborne Emissions, 2007-2015

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/month for comparison to annual emissions.

As shown in Figure 27 and Figure 28, the annual waterborne emissions are orders of magnitude below the derived release limits and the current action levels. Over the past 9 years, there has been a slight increasing trend in waterborne emissions. This is attributed to more storage buildings being in operation and increase in subsurface drainage.

Radiological Airborne Emissions

At the WWMF, the WVRB radioactive waste incinerator stack and ventilation exhaust stack are monitored for tritium, particulate and Iodine-131 emissions while Carbon-14 emissions are monitored on the incinerator stack only. The Transportation Package Maintenance Building ventilation stack is monitored for tritium and particulate emissions.

The UFDSF at WWMF has a ventilation exhaust stack that is monitored for particulate emissions.

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

As shown in Figure 29 to Figure 32, the annual airborne emissions are orders of magnitude below the regulatory derived release limits and action levels with the overall trend in emissions being relatively stable over the past 9 years.

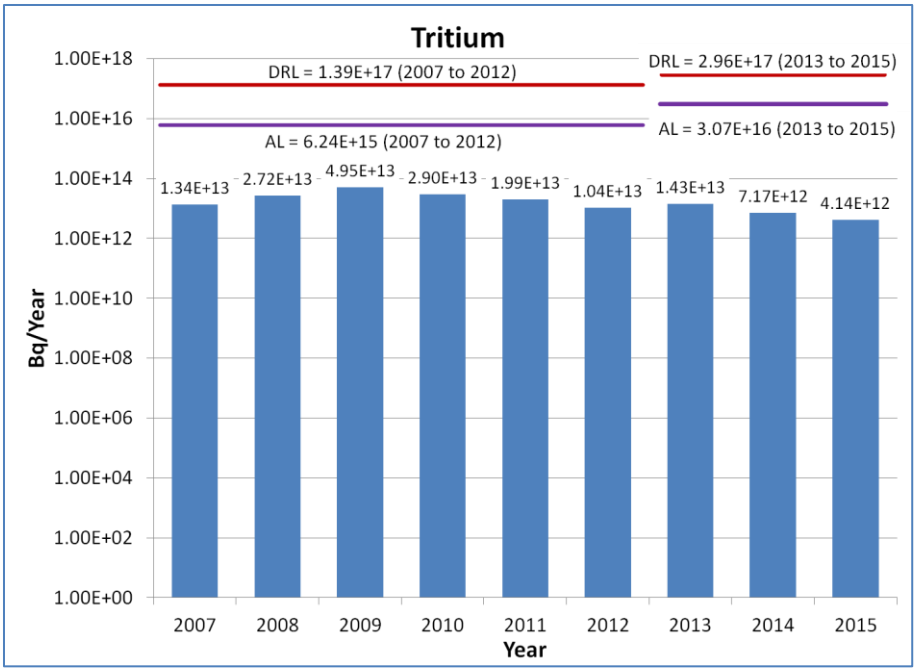


Figure 29: WWMF Annual Tritium Airborne Emissions, 2007-2015

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/week for comparison to annual emissions.

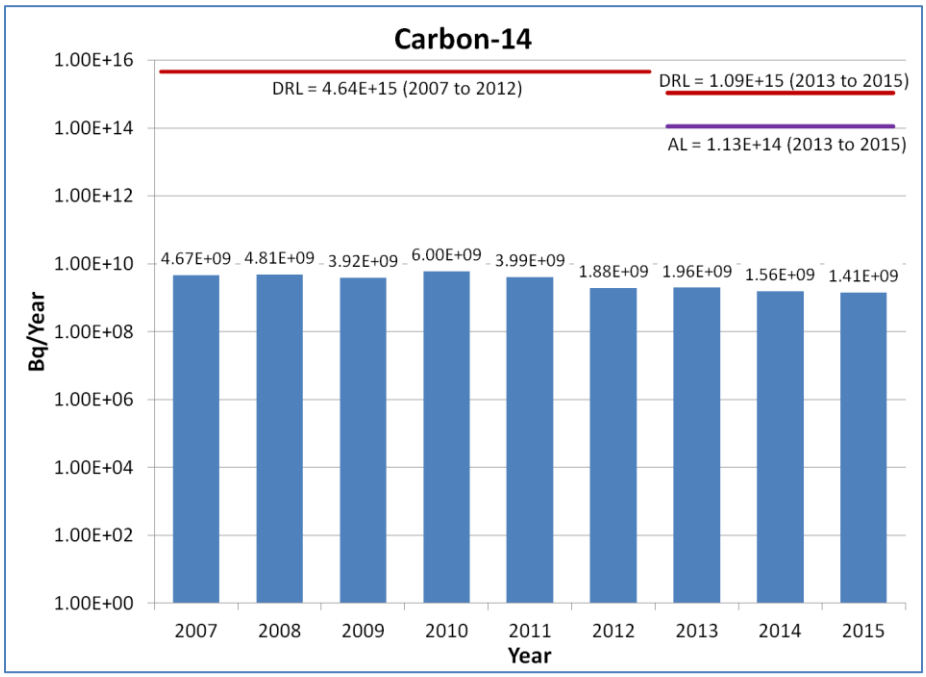


Figure 30: WWMF Annual Carbon-14 Airborne Emissions, 2007-2015

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/week for comparison to annual emissions. No action levels were in place for Carbon-14 prior to 2013.

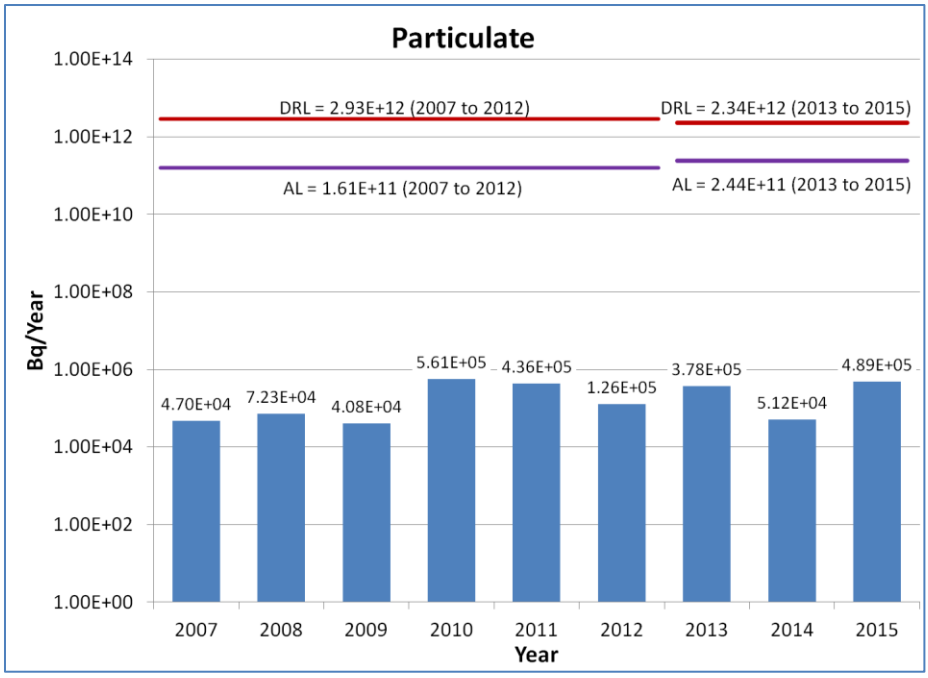


Figure 31: WWMF Annual Particulate Airborne Emissions, 2007-2015

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/week for comparison to annual emissions.

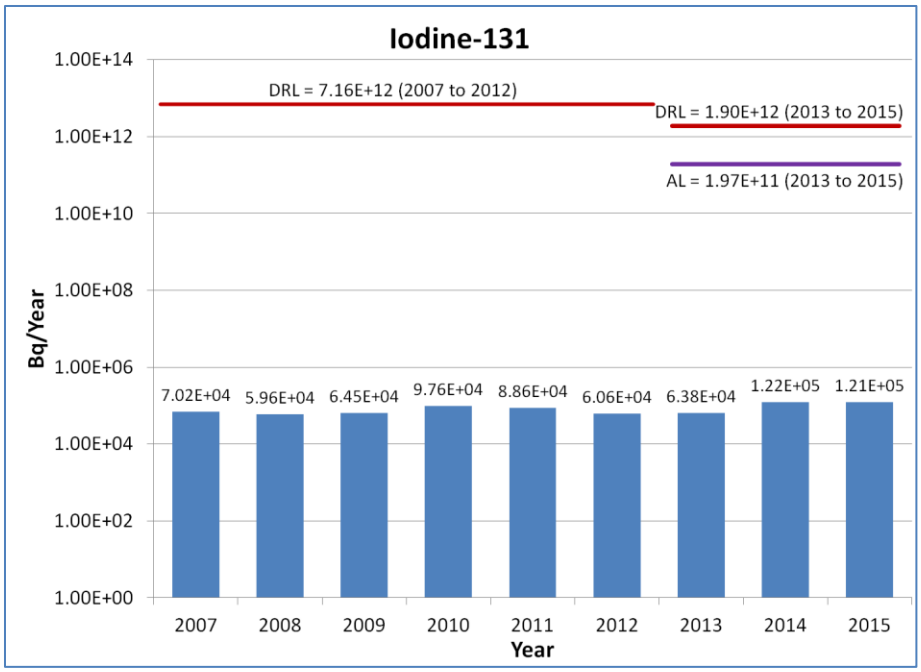


Figure 32: WWMF Annual Iodine-131 Airborne Emissions, 2007-2015

Note: Derived release limits and action levels have been converted to Bq/yr from Bq/week for comparison to annual emissions. No action levels were in place for Iodine-131 prior to 2013.

2.9.2.3 Non-radiological Emissions

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

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

The annual source testing results indicate that incinerator emissions are well within the regulatory limit. Provided in Table 8 below is a summary of the source testing results since 2007 for incinerator stack emissions in comparison to the allowable limits specified in the Environmental Compliance Approval. Particulate matter, mercury and total hydrocarbons emissions are less than 0.5% of the allowable limit and dioxins and furans are just 5% of the allowable limit.

Table 8: 2015 Source Testing Results

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

Note: Emission source testing was exempted for 2014 with MOECC approval due to the unavailability of solid waste burning.

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

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

2.9.3 Assessment and Monitoring

2.9.3.1 Perimeter Dose Monitoring Program

WWMF has a perimeter dose monitoring program where Environmental Thermoluminescent Dosimeters are mounted on the perimeter fence of the WWMF as shown on Figure 33 and are changed and analyzed quarterly. Annual performance is reported as the average of all dose rates. Any contributions from WWMF to the public dose from this perimeter monitoring program are incorporated into the Bruce Power Radiological Environmental Monitoring Program.

A dose rate of 0.0005 mSv/h for 2,000 hours of exposure would result in a dose to the public of 1 mSv, the regulatory limit. The average actual perimeter dose rate at the WWMF has consistently been less than the 0.0005 mSv/h, with an overall average less than 0.0001 mSv/h.

2.9.3.2 Groundwater Monitoring Program

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

In 2014, 22 additional wells were installed as part of a groundwater study and monitoring network assessment to increase the distribution of the groundwater data over a two-year period. An additional 13 existing monitoring wells (not part of the routine monitoring program) and 6 surface water sampling locations were also incorporated into the study/assessment. The groundwater study and monitoring network assessment includes eight sampling intervals completed quarterly to monitor seasonal variations in groundwater and surface water conditions with respect to radiological parameters (tritium, Carbon-14, cesium, etc.) as well as conventional parameters (e.g., metals, inorganics, hydrocarbons, etc.) and water levels. The project is scheduled to be completed by the end of 2016 at which time the groundwater monitoring program will be established. Figure 34 shows the locations of all groundwater wells currently on the WWMF.

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

As reported through the quarterly operations report, localized elevated concentrations of tritium are present onsite in the middle sand aquifer as identified at monitoring well location WSH231 (located directly down gradient of LLSBs 1 to 10). The source of the elevated tritium at WSH231 is thought to be from evaporation in the LLSBs. An extensive study was completed in 2010 to identify the migration pathway to WSH231. Based on the findings of the study, the most probable pathway was identified to be via

an electrical manhole that intersects the groundwater table. The electrical manhole connection to the LLSBs is through electrical conduits that service the buildings. Particle traces in the groundwater completed during the 2010 study identified the preferential flow pathway from the electrical manhole to be towards WSH231 in the middle sand aquifer.

Since 2010, various mitigating measures have been taken including asphalt sealing, LLSB sump sealing, monitoring and pump down of electrical man holes and sealing of some electrical penetrations. Based on the monitoring results from well WSH231, these mitigation measures appear to be improving the groundwater quality in the middle sand aquifer. Presented in Figure 35 is a graph of the tritium concentrations at WSH231 displaying the downward trend in recent years.

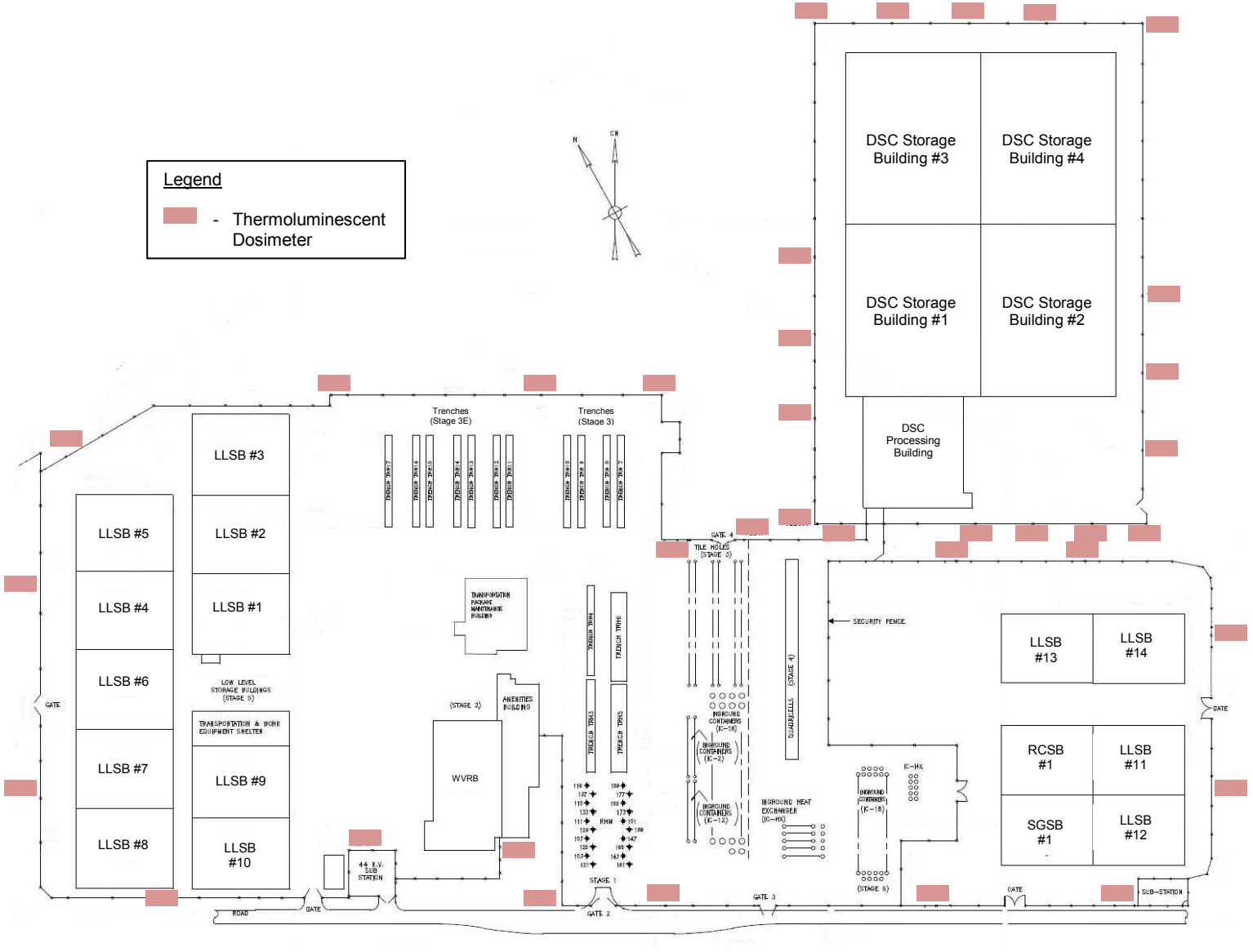


Figure 33: Location of Thermoluminescent Dosimeters at WWMF

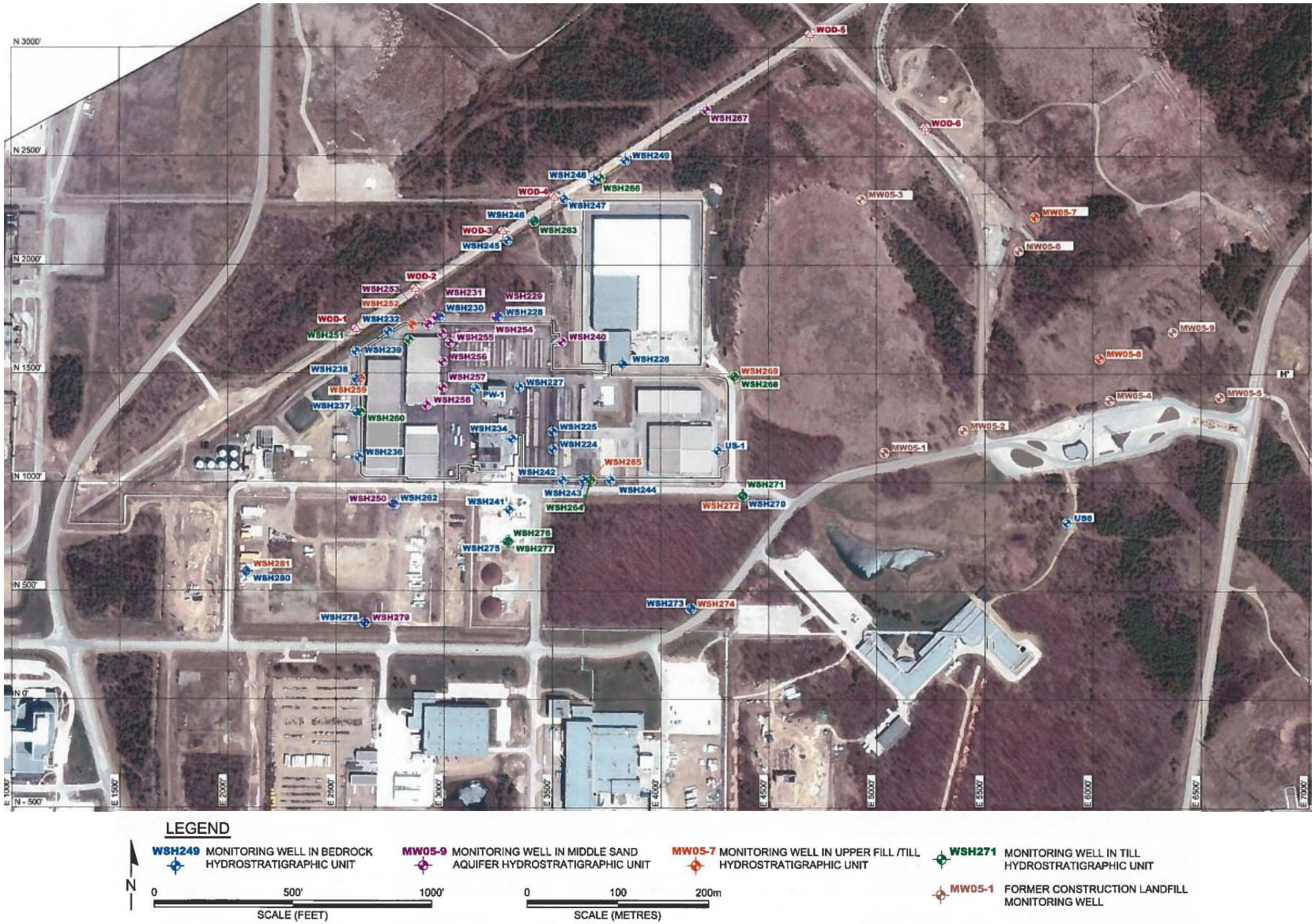


Figure 34: Groundwater Well Locations at the WWMF

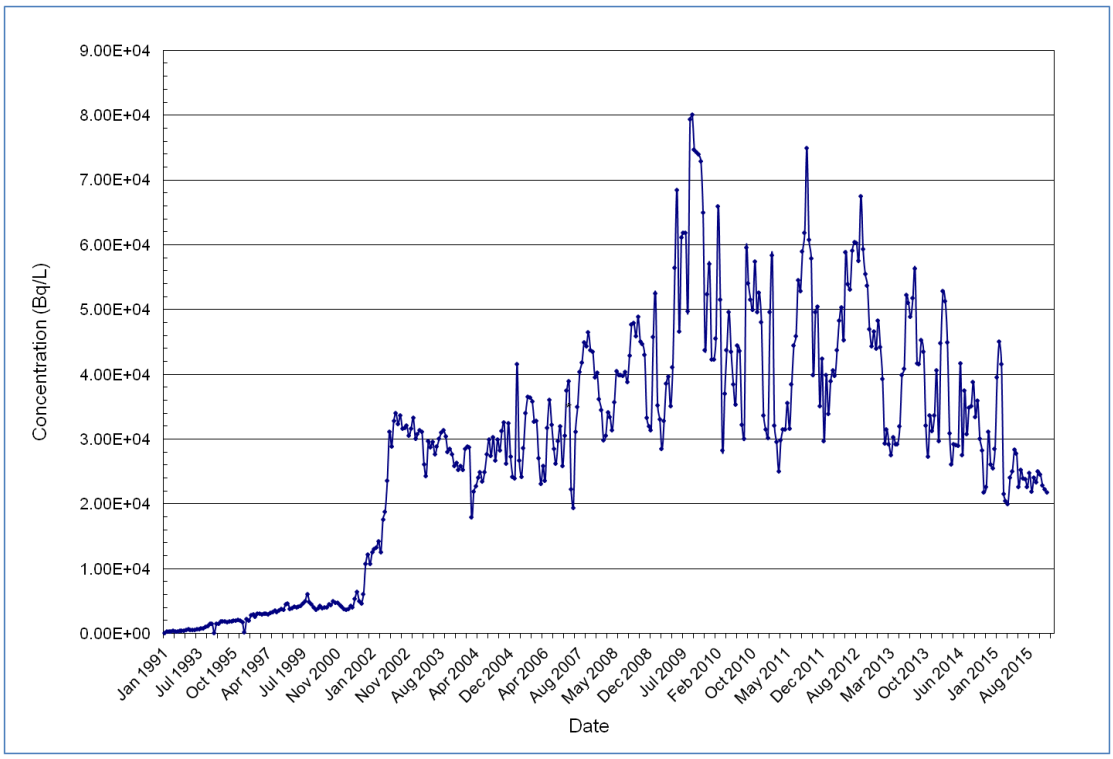


Figure 35: Tritium Concentration in WSH231 (1991 - 2015)

2.9.4 Biodiversity Management

OPG has had a very extensive and diverse biodiversity program at the WWMF for many years. In 2012, OPG successfully re-certified the WWMF under the Wildlife Habitat Council's Corporate Wildlife Habitat certification. The WWMF was initially certified in 2007. The Wildlife Habitat Council's *Corporate Wildlife Habitat Certification and International Accreditation Program* recognizes commendable wildlife habitat management and environmental education programs at individual sites. The Wildlife Habitat Council certification adds value to programs by providing third-party credibility and an objective evaluation of projects. An ecological survey is scheduled to be completed in 2016 to identify further biodiversity enhancement initiatives for implementation at the WWMF in 2017 and 2018.

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

- A partnership with Laurentian University to study Endangered Species at the Bruce Site (2008 to 2015);
- Invasive species monitoring and control to maintain and enhance the ecological resilience of wildlife habitat (2008 to 2012);
- Landfill cap and WWMF Laydown Area Berm naturalization to promote local wildflower and grass biodiversity (2012);

- Completion of a Natural Heritage Study to identify species and features of ecological significance (2008); and,
- Donations to Conservation, Non-Government Organizations and interested parties to support habitat protection and stewardship through the corporate charity program (ongoing).

2.9.5 Environmental Risk Assessment

In 2016, OPG completed an Environmental Risk Assessment for the WWMF in accordance with the CSA Standard N288.6-12 *Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills* [R5]. The Environmental Risk Assessment considered previous studies, and includes a Human Health Risk Assessment, and an Ecological Risk Assignment, as described below.

2.9.5.1 Human Health Risk Assessment

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

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

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

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

2.9.5.2 Ecological Risk Assessment

The ecological risk assessment evaluated radiological and non-radiological contaminants in different media, as well as physical stressors resulting from the operations at the WWMF (Table 9).

Ecological receptors present at the WWMF included terrestrial plants and invertebrates (including insects), aquatic plants and invertebrates, fish, herpetofauna, birds, and mammals. In addition, off-site aquatic receptors residing in Lake Huron could

potentially come into contact with surface water contaminants of potential concern at the site.

Table 9: ERA – Radiological and Non-radiological Contaminants

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

The risk evaluation for ecological receptors identified the following:

- There are no adverse effects due to exposure to radiological contaminants.
- There are no effects from soil and surface water due to exposure to non-radiological contaminants for terrestrial plants and invertebrates, aquatic plants and invertebrates, fish, herpetofauna, and birds and mammals.
- Physical stressors including noise, bird strikes, and road kill pose no adverse effects to non-human biota.
- Risks to benthic invertebrates (e.g. insect larvae and mollusks) due to exposure to sediment were assessed based on the comparison of sediment chemistry to the Toxicity Reference Values and a qualitative evaluation of benthic invertebrate field data. The conclusions related to the benthic invertebrates are:

    (a) Copper and zinc in the South Railway Ditch (a human-made environment) exceeded the sediment Toxicity Reference Values, and there is the potential for low to moderate effects to benthic invertebrates. However, it is difficult to distinguish whether the limited benthic invertebrate community in the drainage ditch, which consists primarily of pollution tolerant species, is strictly the product of the poor habitat quality the ditch provides or whether elevated metal concentrations are having an effect. The source of copper and zinc is not associated with WWMF operations. The ability to survive under low oxygen conditions during periods of low flow or no flow (stagnation) is probably the dominant factor governing the benthic invertebrate community in the ditch;

(b) In the Wetland, downstream of the South Railway Ditch, sediment concentrations were below the Toxicity Reference Values and adverse impacts to the benthic invertebrate community are not anticipated in the Wetland; and,

(c) Although silver in the West Ditch exceeds the sediment Toxicity Reference Value, only low potential for effects was identified. It should be noted that the West Ditch is not located within the WWMF, and the WWMF is not known to be a source of silver contamination to the West Ditch, therefore silver was not assessed further.

2.9.6 Future Plans for Improvement

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

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

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

- By December 31, 2016, WWMF will conduct a gap analysis and prepare an implementation plan for meeting the requirements of CSA Standard N288.3.4, *Performing Testing of Nuclear Air-Cleaning Systems at Nuclear Facilities*.
- By December 31, 2017, WWMF will conduct a gap analysis and prepare an implementation plan for meeting the requirements of CSA Standard N288.4, *Environmental Monitoring Program at Class I Nuclear Facilities and Uranium Mines and Mills*.
- By December 31, 2017, WWMF will conduct a gap analysis and prepare an implementation plan for meeting the requirements of CSA Standard N288.7, *Groundwater Protection Programs at Class I Nuclear Facilities and Uranium Mines and Mills*.

2.10 EMERGENCY MANAGEMENT AND FIRE PROTECTION

2.10.1 EMERGENCY MANAGEMENT

2.10.1.1 Emergency Management Program

OPG's key documents for the Emergency Management and Fire Protection SCA and the revision at the time of writing are listed in the table presented below, and will form the basis for future licence conditions.

Document Number	Title	Revision
Nuclear Waste Management	W-PROG-WM-0001	R013
Fire Protection	N-PROG-RA-0012	R011

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

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

2.10.1.2 Current Operations

(a) <u>Emergency Management</u>

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

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

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

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

(b) Response to Fukushima Event

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

For a complete summary of OPG's response to the Fukushima event, refer to Section 3.4. No significant gaps and no compensatory actions were identified during these reviews; however, some additional technical studies were identified such as beyond design basis seismic event analysis and flood hazard assessment for the WWMF. The technical studies identified the following opportunities to improve the response to design basis events and beyond design basis events:

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

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

2.10.1.3 Future Plans for Improvement

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

2.10.2 FIRE PROTECTION

2.10.2.1 Fire Protection Program

DNWM's goals for Fire Protection 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.

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

- The NFCC 2005;
- The NBCC 2005; and,
- The *Occupational Health and Safety Act* (OHSA).

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

DNWM governance is being reviewed to ensure effective alignment with OPGN's Fire Protection Program. The revision of DNWM's Nuclear Waste Management Division Impairment Manual and associated documentation is currently underway, to ensure it aligns with the OPG Nuclear impairment process.

Key Program Elements for WWMF

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

Fire drills are conducted in accordance with the NFCC. Annual emergency fire drills were performed at the WWMF, in accordance with the NFCC. Response from the Bruce Power Emergency and Protective Services organization was tested during this process. The interface between WWMF personnel and Bruce Power has been demonstrated as satisfactory. Findings from drills have been satisfactory with no major findings. Improvements to procedures and facilities have been recommended. These recommendations have been assessed and are being implemented as appropriate.

During the reporting period, independent third party reviews were completed biennially to confirm the WWMF fire systems have been operated, inspected, tested and maintained in accordance with the NFCC and the standards listed therein. The reports received indicate that WWMF is in general compliance with the NFCC requirements. Corrective actions resulting from the reviews have been completed. Examples of such actions included installing nameplates on systems, ensuring records are maintained, changing frequencies of inspection, maintenance and testing activities to reflect changed frequencies in the codes and standards and implementing additional work management tasks for hydrant and emergency lighting unit inspection, testing and maintenance. The results of the compliance reviews have been submitted to the CNSC as required by the licence.

2.10.2.2 Current Operations

(a) Fire Protection

Fire protection and detection systems at the WWMF are designed and constructed to comply with applicable fire and building codes (e.g. NFCC and NBCC). During the reporting period, these systems were required to comply with updated pressure boundary code requirements, such as CSA Standard N285.0-08, Update No. 2, *General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants*; CSA B51 (2009) and Update No. 1, *Boiler, Pressure Vessel, and Pressure Piping Code*; and ASME B31.1, *Power Piping Code*, 2010 Edition. OPG is complying with the updated pressure boundary code requirements, applying the additional rigour warranted for the maintenance of these non-nuclear / Class 6 pressure boundary systems with the exception of exempted systems and components documented in OPGN's Design Registration procedure.

All design modifications are reviewed for fire protection impact through the Engineering Change Control process described in OPGN's Modification Process procedure.

As discussed in Section 2.5.2, a project is in progress to replace beam detectors in LLSBs 1 to 11 with linear heat detection to improve the overall fire protection system reliability at the LLSBs. This project was initiated in the current operating window, with linear heat detection being installed in LLSB11 in 2015, and will continue into the next licence period.

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

- Replacing the wooden framing surrounding the WVRB incinerator stack with a non-combustible material (2013);
- Installing appropriate audible and visual alarms in certain locations at the WVRB (2013);
- Installing a manual station (pull station) at the exit door of the High Efficiency Particulate Air filter room of the WVRB (2015);
- Redesigning the incinerator solid waste and combustion system to prevent localized heating of the air duct (2015); and,
- Installing a properly sized relief valve in the CO_2 fire suppression system to meet American Society of Mechanical Engineers (ASME) B31.1 code requirements (2015).

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

Internal audits of the Nuclear Fire Protection Program are conducted to evaluate effectiveness of the program. An audit conducted in 2013 resulted in three (3) findings, namely: unclear DNWM Fire Protection program ownership, DNWM Fire Protection governance deficiencies, and WWMF fire predefines not consistently completed.

An organizational realignment to functionally move the ownership of the Fire Protection Program to one organization within OPG Nuclear has been implemented thereby addressing the audit finding on program ownership. This action resulted in OPGN's Fire Protection program becoming the governing program for the WWMF. This realignment will ensure programmatic consistency, implementation of actions to address past challenges regarding managed system controls plus a unified approach across OPGN with program ownership housed within a single programmatic document.

Predefine performance has improved. As a result, the 2015 audit did not have any findings in the DNWM Fire Protection area.

(b) Fire Protection Response

The fire protection systems are capable of responding to emergency situations based on test results.

With respect to operator actions, on July 11, 2013, the excess air duct located beneath the primary chamber of the incinerator at the WWMF experienced localized heating. Smoke was observed to be emanating from the surface. Operators responded by suspending the solid and liquid waste feeds, cooling the area and initiating a response by the Bruce Power Emergency Response Team. There was a repeat event in February 2014. At this time a root cause investigation was completed with measures, including a design modification of the incinerator, taken by OPG to prevent recurrence of a localized heating event of the incinerator air duct. Operations have procedures in place to address emergency situations.

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

2.10.2.3 Future Plan for Improvement

The project to install linear heat detection to replace beam detectors in the LLSBs 1 – 10 (LLSB 11 complete) will continue into the new licensing period.

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

By August 31, 2016, WWMF will conduct a gap analysis and prepare an implementation plan for meeting the requirements of CSA Standard N393-12, *Fire protection for facilities that process, handle, or store nuclear substances*. A transition plan based on identified gaps, e.g., completion of a Code Compliance Review and Fire Hazard Assessments, will then be executed.

When the licensed area is extended as proposed, assessments will be completed to ensure new buildings or those currently in existence within that area comply with the applicable fire codes and standards.

2.11 WASTE MANAGEMENT

2.11.1 Waste Management Program

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

L&ILW generation and storage is identified as a Significant Environmental Aspect in OPG's Environmental Management System, as described in Section 2.9.2

L&ILW is generated more significantly during nuclear power plant maintenance outages, but also arises from day-to-day operations. L&ILW produced is the volume of waste generated from nuclear operations that is shipped to the WWMF for processing and storage. L&ILW stored is the final volume of waste that is actually stored at the WWMF following review, acceptance, processing and storage of the produced waste from the same time period.

OPG's key documents for the Waste Management SCA and the revision at the time of writing are presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Radiation Protection	N-PROG-RA-0013	R009
Decommissioning Program	W-PROG-WM-0003	R001

2.11.2 Current Operations

OPG Nuclear Waste Management Facilities have taken the lead in establishing an OPGN 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.

As discussed in Section 1.3.1 regarding generation of waste at the stations, employees at WWMF ensure that radioactive LLW generated at the facility is segregated properly. Waste receptacles are located throughout the WWMF for likely clean and routine incinerable waste (Figure 36). Compactable and non-processible waste is collected in the staging area and the Transportation Package Maintenance Building only. Each waste staging area has various storage waste bins such as one each for likely clean, incinerable, and compactable.

(a) Integrated Waste Tracking System

OPG continues to maintain its waste inventory using electronic records using the Integrated Waste Tracking System.

(b) Pilot Projects

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

The pilot project itself is now complete. OPG will continue to send some waste to a licensed external provider for processing. OPG has sent legacy baled waste and some waste oil. OPG plans to continue sending these two waste streams and to continue with sorting waste in-house.

(c) Waste Segregation

In 2013, the WWMF instituted a "Likely Clean" waste segregation initiative to improve its own performance in the area of waste minimization. Specific waste collection stations were set up at the WWMF facilities. Through enhanced radioactive contamination monitoring and procedures, low-level waste that was once considered radioactive by default, is now thoroughly monitored and released if clean. As shown in Figure 37, the volume of waste generated decreased by about 40% since this initiative was implemented.

In 2014, targets were developed for the station waste generators specifically related to the non-processible waste stream. This enables focus to occur on waste reduction at the source. These indicators continue to be used across the fleet to increase awareness and drive improvement.

Likely Clean Metal

Contaminated LLW - incinerable

Contaminated LLW - compactable

Figure 36: Waste Receptacles

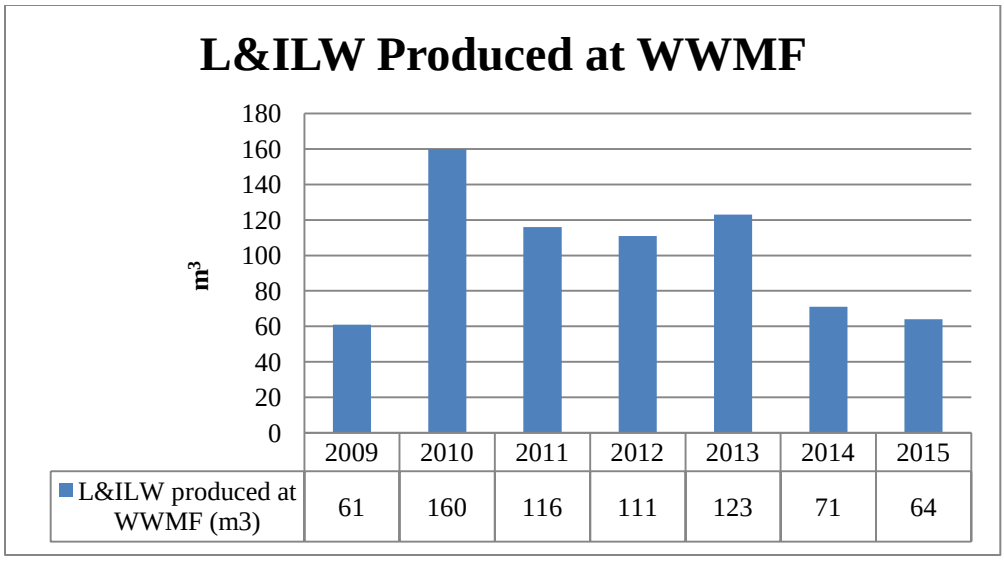


Figure 37: L&ILW Produced at WWMF

(d) Waste Sorting

In 2014, the WWMF began a waste sorting pilot project. Bins of stored non-processible LLSB wastes and new non-processible waste arising are opened and physically sorted into various streams as shown in Figure 38. Incinerable and compactable materials are segregated for further processing at the WWMF. Metals are segregated and either surveyed, decontaminated and free released or if not able to be decontaminated they are stored for future processing or interim storage.

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

Figure 38: Waste Sorting Pilot Project

2.11.3 Future Plans for Improvement

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

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

- Ongoing fleet-wide communication campaigns;
- Reviewing and improving waste sorting practices;
- By August 31, 2016, WWMF will conduct a gap analysis and prepare an implementation plan for meeting the requirements of CSA Standards N292.0-14, *General principles for the management of radioactive waste and irradiated fuel*; 292.2-13, *Interim dry storage of irradiated fuel*; and 292.3-14, *Management of low-and-intermediate-level radioactive waste;* and,
- A focused Steering Committee to oversee Darlington Refurbishment waste issues to ensure minimization is implemented appropriately through the execution of the project.

2.11.4 Decommissioning

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

OPG's strategy for decommissioning its nuclear waste facilities, including WWMF, is to dismantle the facilities once all the waste is removed and the facility is no longer required. Since all the wastes will be removed from the facility prior to decommissioning, little residual radioactivity is expected to be present at WWMF and as such there will be no need for any deferment of decommissioning. In some cases however, decommissioning activities may be deferred to align with other related activities on site. At this time, OPG plans to place L&ILW in the DGR expected to be located in Kincardine. Under the Nuclear Waste Management Organization's Adaptive Phased Management program established by the federal government, the long term disposal facility for used fuel is expected to be in service no earlier than 2035, at which time used fuel will start to be transferred from the interim storage location at WWMF to the Adaptive Phased Management facility.

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

update to regulatory requirements, and industry best practices. These updates will add clarity and detail to the decommissioning of the OPG fleet of nuclear facilities.

The WWMF Preliminary Decommissioning Plan was provided to the CNSC in support of the 2013 to 2017 Financial Guarantee submission (discussed also in Section 3.5). The requirements of CSA N294-09 as well as any relevant domestic and international experience obtained in the previous five years were incorporated into this revision. The next revision of the Preliminary Decommissioning Plan will be submitted to the CNSC by January 31, 2017 as part of the 2018 to 2022 Financial Guarantee submission and updated revisions submitted every 5 years after or when required by the Commission. Following the submission of the Preliminary Decommissioning Plans and respective cost estimates, OPG will also provide the necessary financial guarantee arrangements using G-206 *Financial Guarantees for the Decommissioning of Licensed Activities* as a guide.

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.

2.12 SECURITY

2.12.1 Security Program

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

WWMF is in compliance with RD-363, *Nuclear Security Officer Medical, Physical and Psychological Fitness* and REGDOC 2.12.2, *Site Access Security Clearance*.

The OPG physical security program for the WWMF is implemented through contracted security services provided by Bruce Power Security. Bruce Power Security implements OPG's Security Program at WWMF in accordance with OPG's policies and procedures. Bruce Site Security Program has been rated as satisfactory or fully satisfactory in all CNSC Annual Reports on Nuclear Power Plant Performance.

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.

OPG's key document for the Security SCA and the revision at the time of writing is presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Nuclear Security	N-PROG-RA-0011	R006

2.12.2 Current Operations

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

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

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

OPG has 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 we are in compliance with the requirements of this Regulatory Document. Sealed sources are not included in the WWMF Operating

Licence, but are separately licensed under a Nuclear Substance and Radiation Device Licence (Consolidated Uses of Nuclear Substances (B15), Licence No. 12861-2-20.3). OPG does not have any category 1, 2 or 3 sealed sources at the WWMF. OPG does have lower activity category 4 and 5 sealed sources at WWMF.

2.12.3 Future Plans for Improvement

OPG plans to upgrade its security search equipment at the Western UFDSF replacing aging weapons detection, explosive detection and baggage x-ray devices with devices utilizing industry leading technology. These enhancements are scheduled for 2016.

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 stated in Nuclear Substances and Radiation Devices Licence 12861-2-20.3 , licence condition 16(b).

Construction of Additional Protected Area for Used Fuel

OPG is planning on building four additional storage buildings for used fuel in one of two potential locations (woodlot or construction laydown area), as shown in Figure 1 and summarized in section 1.7.1. Processing of the DSCs will continue to occur within the existing processing building, and the DSCs will be transferred to the new buildings for interim storage. Two storage buildings for used fuel are planned for completion in 2019.

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

The protected area of the additional UFDSFs will be enclosed by a barrier at its perimeter designed and constructed to inhibit unauthorized entry into the protected area. The barrier will be comprised of a chain link fence with a minimum height of 2.4 meters made of wire not smaller than number 11 gauge, having openings whose sides do not exceed 6 cm in length and topped with three strands of barbed wire. All gates or doors that provide entry or exit to the protected area will be constructed so that they can be closed and locked.

This barrier will be equipped with two independent detection systems designed to detect intrusion into the protected area and detect any tampering that may cause the devices to malfunction. Intrusion and tamper attempts will set off a continuous alarm in a security monitoring room that may only be stopped by a nuclear security officer. A combination of fixed and pan zoom cameras will be installed to provide immediate assessment of the cause of alarms.

Detection and assessment devices will be powered by an uninterruptable power supply designed to power these devices for a period sufficient to allow for an alternative power supply to be implemented.

The protected area will be surrounded by an unobstructed area located on both sides of the protected area barrier that extends at least five meters away from every point of the barrier. The unobstructed area will be free of any structure, equipment or other

obstruction that could be used to penetrate or surmount the barrier or to restrict observation of the unobstructed area and will be continuously illuminated at an intensity and uniformity sufficient to permit clear observation of persons within the unobstructed area.

The perimeter boundary design will include measures to prevent forced vehicle penetration into the protected area by a vehicle as described in the Design Basis Threat and include a vehicle search portal at the vehicle access point.

The entrance to the Protected Area will be constructed to facilitate the search of persons and packages for weapons and explosives upon access and for nuclear material upon egress by nuclear security officers equipped with devices capable of detecting this material.

2.13 SAFEGUARDS

WWMF, under its current WFOL, is required to have in place a program that ensures all obligations arising from the Canada / International Atomic Energy Agency Safeguards agreement are met.

2.13.1 Safeguards Program

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 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.

In 2014, the ownership for Safeguards programs in OPGN moved from the Director, Regulatory Affairs, to the Chief Nuclear Engineer.

OPG's key document for the Safeguard SCA and the revision at the time of writing is presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Safeguards	N-PROG-RA-0015	R007

2.13.2 Current Operations

As of March 1, 2007, in accordance with the IAEA requirements, OPG has adopted the integrated safeguards protocol. Under the integrated safeguards protocol, all safeguards commitments were met at the WWMF for the licensed period (2007-2015).

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

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

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

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

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

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

- Complying with the Safeguards Agreement and the Additional Protocol;
- Providing services and assistance for IAEA staff tasks and equipment operation;
- Disclosing any records to the IAEA upon request;
- Installing, servicing and operating Safeguards equipment;
- Not interfering in any way with Safeguards equipment, samples or seals;
- Making no changes to operations, equipment or procedures that would affect Safeguards implementation without prior written CNSC approval; and,

- Preparing and submitting nuclear inventory reports per CNSC Regulatory Document RD-336, *Accounting and Reporting of Nuclear Material.*

WWMF staff completes an annual Physical Inventory Taking as part of licence conditions pursuant to the implementation of safeguards by the IAEA. A Physical Inventory Taking is a snapshot of the fuel physical inventory at any given time. Canadian facilities are selected at random by the IAEA for a Physical Inventory Verification that follows the Physical Inventory Taking. If a facility is not chosen for Physical Inventory Verification then CNSC Safeguards Staff performs limited confirmation activities following the annual Physical Inventory Taking process. The IAEA completed a Physical Inventory Verification at WWMF in July 2014.

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

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

As of June 28, 2012, WWMF has been in full compliance with the CNSC Regulatory Document, RD-336, *Accounting and Reporting of Nuclear* Material. CNSC Guidance Document, GD-336, *Guidance for Accounting and Reporting of Nuclear Material* is also used. This includes updating to the *Nuclear Fuel Location and Storage History* (NuFLASH) program to support RD-336 reporting requirements.

OPGN management 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 39 shows DSCs in storage with their IAEA wire seals in place.

Figure 39: DSCs in Storage with IAEA Wire Seals

2.13.3 Future Plans for Improvement

- OPG will maintain the safeguards program at the WWMF in compliance with WFOL Condition 7 and CNSC regulatory document RD-336, *Accounting and Reporting of Nuclear Material* as applicable.
- WWMF will continue to perform annual self-assessments to ensure OPG adherence to the safeguards program. Any findings needing attention will be addressed.
- Safeguards personnel will continue to be trained to OPG qualification requirements for safeguards. Safeguards governance will be updated, as required, to reflect any new regulatory standards or guides related to implementation of safeguards measures.
- The *Design Information Questionnaire* (DIQ), which provides a detailed account of facility design information to the IAEA is updated, as required, based on changes to WWMF.

Laser Mapping Container Verification System

WWMF's UFDSF has begun field trials for a new IAEA technology intended to become a new seal verification system. The Laser Mapping Container Verification (LMCV) system (Figure 40), 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's Dry Storage Facilities have been working closely with the CNSC International Safeguards Division and the IAEA on applying this technology to the Dry Storage Container.

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

Figure 40: Laser Mapping Container Verification System

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

2.14 PACKAGING AND TRANSPORT

2.14.1 Packaging and Transport Program

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

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

OPG's key documents for the Packaging and Transport SCA and the revision at the time of writing are presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Radioactive Materials Transportation	W-PROG-WM-0002	R010
Radiation Protection	N-PROG-RA-0013	R009

2.14.2 Current Operations

OPG has been safely transporting radioactive materials for over 45 years, and has never had an accident resulting in a radioactive release or serious personal injury. There have been no dangerous occurrences, accidental releases or imminent accidental releases reportable under the *Packaging and Transport of Nuclear Substances Regulations* and *Transportation of Dangerous Goods Act* during the reporting period. OPG drivers transporting radioactive materials have an excellent safety record on the roads.

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

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

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

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

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

2.14.2 Package Design and Maintenance

Packages used to transport higher risk radioactive materials require certification and registration by the CNSC. While packages designed for the transport of low risk radioactive materials do not require certification by the CNSC, these packages are still required to comply with the *Packaging and Transport of Nuclear Substances Regulations*. OPG retains documentation demonstrating all of its packages are in

compliance with the regulations. OPGN's Radioactive Material Transportation Program specifies requirements for training, preparation for shipment, loading and unloading, and maintenance and design requirements for waste packages.

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

2.14.3 Future Plans for Improvement

The Radioactive Material Transportation Program includes a strategic equipment replacement plan to ensure that radioactive material transportation packages and their trailers are replaced or supplemented as required. Aging management studies will continue to be conducted on the components most vulnerable to aging, to calibrate the equipment replacement plan on an ongoing basis, and is described in Section 2.6.4.1 Aging Management.

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

Program improvements include:

- Procurement and integration into the Radioactive Materials Transport fleet by 2018 of:
    - Two Type B(U) Multi-Purpose Transportation Packages (MPTP) for transporting tritiated heavy water; and,
    - Two Type B(U) Multi-Purpose Transportation Packages for Shielded Flask (MPTP-SF) for transporting radioactive filters and components.
- The above packages will supplement and eventually replace, respectively:
    - Two Tritiated Deuterium Oxide Packages (TDO) for transporting tritiated heavy water; and,
    - Two Radioactive Filter Transportation Packages (RFTPs) for transporting radioactive filters and components.
- Trailers for several radioactive materials transportation packages have been replaced or refurbished as required.
- Six new Type A ISO-40 and three ISO-20 packages are planned for construction to augment the existing fleet of seven Type A ISO packages. These are expected to be in service in 2017.
- Additionally, the existing Work Management System is being adopted to better integrate and coordinate workgroups that are closely tied to the Radioactive Materials Transport activities. This improvement project will consolidate the existing logistics and planning systems previously used to manage the Radioactive Materials Transport activities.

3.0 OTHER MATTERS OF REGULATORY INTEREST

3.1 ENVIRONMENTAL ASSESSMENTS

3.1.1 Studies under the Canadian Environmental Assessment Act

3.1.1.1 Additional Low Level Storage Buildings

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

3.1.1.2 Refurbishment Waste Storage Project

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

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

- Atmospheric Environment: air quality with respect to non-radiological parameters, including noise, meteorology and climatic conditions;
- Hydrology and Surface Water Quality: surface water quantity and quality;
- Aquatic Environment: aquatic biota and habitat;
- Terrestrial Environment: terrestrial biota and habitat;
- Geology, Hydrogeology and Seismicity: geological and hydrogeological conditions (including groundwater quality) and seismic potential;
- Radiation and Radioactivity: environmental radiation and radioactivity, including radionuclide emissions and doses to humans and non-human biota;
- Land Use and transportation;
- Physical and Cultural Heritage Resources: historical, cultural and archaeological resources as well as landscape and visual setting;
- Socio-Economic Conditions: population and economy, community infrastructure, community services, municipal finance and administration, residents and communities.
- Aboriginal Interests: use of lands and other important issues for aboriginal peoples.

Each environmental component is further divided into sub-components that represent a potential pathway or mechanism for the transfer of an effect to a Valued Ecosystem Component.

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

The Environmental Assessment follow-up and monitoring activities associated with the Refurbishment Waste Storage Environmental Assessment included stormwater and sediment, groundwater, and soil sampling, and identification of active crayfish borrows. Similar to earlier follow-up monitoring results, these sampling results demonstrated that there were no significant adverse environment effects on hydrogeology, ground water, sediment or surface water quality. The crayfish were found to be burrowing chimney crayfish, and present in reasonable numbers in Bruce County including the Bruce nuclear site.

3.1.1.3 Deep Geologic Repository Project for Low and Intermediate Level Waste

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

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

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

The assessment of effects of the DGR Project due to normal project development and operation focused on potential interactions of the proposed project with Valued Ecosystem Components – features of the environment which are valued or sensitive and have the potential to be affected by the project.

Valued Ecosystem Components were identified in the draft Environmental Assessment Guidelines, and finalized through a consultative process with the proponent, members of the public, scientists and the regulator. The assessment of effects was completed for a number of different components of the environment, including the physical, cultural and socio-economic.

The assessment followed a source-pathway-receptor approach for screening potential interactions between the DGR Project and Valued Ecosystem Components. The DGR project works and activities represented the source, while a measurable change to the

environment represented a pathway and the Valued Ecosystem Components represented the receptor. Any potential effect with a measurable change was advanced for further assessment, including the cumulative effects assessment.

Thirty-one projects or activities, including WWMF upgrades, expansion and current operations, were identified in the cumulative effects assessment. The objective was to determine whether effects from these projects could overlap in terms of type of effects, in time and in space. Overlaps were identified in areas of aquatic environment, air quality, noise levels, and radiation and radioactivity between the DGR project and WWMF. Their effects were assessed, and it was determined there were no residual adverse cumulative effects.

The Joint Review Panel held many public hearing sessions in 2013 and 2014 in Kincardine and Port Elgin, Ontario. During the review, the Joint Review Panel received written submissions and oral presentations from the proponent and participants including Aboriginal peoples, federal and provincial government agencies, local governments, environmental groups, individuals and organizations. In May 2015, the Joint Review Panel submitted its Environmental Assessment Report to the federal Minister of the Environment and Climate Change. The Joint Review Panel recommended acceptance of the Environmental Assessment on May 6, 2015, citing that there would be no measurable effects on the environment with mitigating measures in place. In February 2016, the federal Minister of the Environment and Climate Change directed OPG to conduct additional studies.

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

3.1.2.1 Predictive Effects Assessment (2016)

OPG conducted a Predictive Effects Assessment to determine the impact of the proposed new activities described in Section 1.7 on human health and on non-human biota.

Human Health Risk Assessment

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

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

For non-radiological emissions, of all the environmental media considered (including the atmospheric environment [air quality and noise], surface water, sediment, soil, and groundwater), the only non-radiological contaminant which was estimated to exceed the assessment criteria was airborne particulate at the Bruce nuclear site boundary, during the construction period only. However, the concentrations were estimated based on conservative assumptions and the adverse effect is immediately reversible with cessation of emission-generating activities. In addition, the frequency of

occurrence is low. For example, the exceedances of Ambient Air Quality Criteria at the Bruce nuclear site boundary occur less than 1% of the time while construction activities are taking place. Furthermore, the concentrations of these indicators at all specific human receptor locations are below the Ambient Air Quality Criteria values. Therefore, it is concluded that there are likely no adverse effects to human health due to the elevated airborne particulate concentrations.

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

Ecological Risk Assessment

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

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

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

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

to the biological integrity of the aquatic systems within the South Railway Ditch is expected.

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

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

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

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

Mitigation measures and follow-up actions will be provided in the Predictive Effects Assessment which will be submitted to the CNSC separately.

3.2 INDIGENOUS COMMUNITY ENGAGEMENT

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

OPG has remained committed to engaging with Indigenous communities about WWMF's nuclear waste operations and future projects. OPG's demonstration of this commitment is directed by a corporate-wide policy that provides a framework for engaging with Indigenous peoples and supporting community programs and community initiatives.

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

In the fall of 2015, OPG was independently recognized for the work we do with Aboriginal communities. The Canadian Council for Aboriginal Business awarded OPG a silver recognition. 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.

3.2.1 Nuclear Waste Management Indigenous Relations Program

Annually, an Indigenous relationship work plan is developed and executed.

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

OPG has regularly met with Indigenous communities who have an interest in the current regulatory licensing processes to help inform them of the process; determine their interest in being engaged in the licensing process; current and future facility operations; opportunities for engagement and employment; and identify interests and concerns.

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

- Saugeen Ojibway Nations;
- Williams Treaty First Nations representatives (Chippewa Nations: Georgina Island, Christian Island (Beausoleil), Rama, Mississauga Nations: Scugog, Hiawatha, Curve Lake, Alderville);
- Métis Nation of Ontario –Region 7: including the Métis Councils of Georgian Bay, Moon River and Great Lakes; and,
- Historic Saugeen Métis.

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

- Métis Nation of Ontario – Region 6 and Region 8;
- Mississauga of New Credit First Nation;
- Mohawks of Akwesasne First Nation;
- Mohawks of the Bay of Quinte;
- Six Nations Hereditary Chiefs represented by Haudenosaunee Development Institute (HDI);
- Aamjiwnaang First Nation; and
- Communities on Manitoulin Island.

3.2.2 Indigenous WWMF Licence Renewal Program

In support of the licence renewal, OPG has developed a specific engagement program to:

- Communicate and inform Indigenous communities of the future site operations proposed for the licence period to determine level of interest and concern;
- Take appropriate steps for Indigenous engagement and consultation; and,
- Address and manage concerns as appropriate.

3.2.2.1 Identification and Engagement

Based on existing relationships and traditional territories as well as work undertaken with past Environmental Assessments, licence review processes, DGR project consultation, and Indigenous engagement, OPG believes the following communities have an Aboriginal interest and/or right with respect to OPG's waste operations at the WWMF:

- Saugeen First Nation (Joint council Saugeen First Nation and the Chippewas of Nawash Unceded First Nation);
- Métis Nation of Ontario – (represented by Regional Consultation Committee Region 7); and,
- Historic Saugeen Métis.

Additionally, on-going information sharing on current operations, events of significance and the licence renewal process for WWMF, including the transportation of waste to the facility, will continue with a number of Indigenous communities based on existing relationships with OPG and at the request of any interested community.

OPG has undertaken early engagement with appropriate Indigenous communities beginning in early 2015, to raise awareness of the process; discuss potential timing of the licensing process; determination of a community's level of desired engagement and interest; what level of engagement is required; and identification of potential capacity requirements. Preliminary information on the nature and scope of the proposed activities over the licence period and how best communities would like to be engaged throughout the licence period have been on-going since early 2015.

Through the course of these early discussions, OPG has committed to fully inform and engage with the identified communities and provide financial capacity to assist them in the ability to learn, understand and participate in the review process. OPG has also committed to continue to strengthen the relationships and maintain open and transparent communication over the life of the next licensing period.

OPG is currently working to formalize these commitments through the development of agreed upon engagement work plans supported with participation agreements to ensure appropriate resources are in place. OPG has also committed to the sharing and review of the Licence Application, Environmental Risk Assessment, Predicted Effects Assessment and future Commission Member Documents with communities. Many communities have identified the need for additional technical resources and support to fully review the documentation. OPG continues to work at finalizing

participation agreements define the engagement plan and to provide necessary capacity in addition to potential funding provided by the CNSC through the Participant Funding Program.

Engagement with communities during the licence renewal process will include timely and frequent communication through electronic correspondence, phone calls, regular face-to-face meetings, community information sessions and presentations. Additionally a number of site visits and tours of the WWMF have been conducted over the past year and more are planned over the course of licence renewal process for community members and citizens to better understand and see first-hand, the current waste operations and proposed licensed activities. Engagement work plans are being finalized and OPG will identify potential opportunities for the CNSC to participate during appropriate information sharing sessions.

3.2.3 Future Plans for Improvement

OPG has worked hard to build strong respectful and mutually-beneficial relationships with Aboriginal communities in proximity to our operations. The relationships continue to mature and build trust and understanding. A number of agreements and Memorandums of Understanding are in place and are reviewed periodically to ensure a framework is in place to enable OPG and the communities to continue to remain informed and engaged in the future and that issues are discussed and resolved in the right forum to allow both parties to continue to work toward common goals.

OPG received a number of suggestions and insights on how to improve our Aboriginal Relations by the Canadian Council for Aboriginal Business. 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.

OPG will provide CNSC staff with interim status updates on the progress of the Aboriginal engagement plan on a regular basis during the regulatory review process leading up to the licensing hearing. If over the course of engagement with communities there are material changes then OPG will provide an update to the engagement report to the CNSC, in a timely manner. And finally OPG plans to provide a summary of engagement activities in their licensing hearing Commission Member Document in accordance with REGDOC-3.2.2 Aboriginal Engagement, section 4.4.

3.3 COMMUNITY RELATIONS & PUBLIC INFORMATION PROGRAM

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

OPG's key document for the Public Information and Disclosure SCA and the revision at the time of writing is listed in the table presented below, and will form the basis for future licence conditions.

Document Title	Document Number	Revision #
Nuclear Public Information Disclosure	N-STD-AS-0013	R00

3.3.1 Community Consultation Program

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

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

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

3.3.2 Current Operations

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

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

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

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

3.3.2.1 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 OPGN's Nuclear Public Information and Disclosure Standard and the development and public posting of an OPG *Nuclear Information Disclosure and*

Transparency Protocol. While the guidance is directed at Class IA facilities, all of OPG's nuclear waste operations at the nuclear stations and operations at the WWMF adhere to OPGN's Nuclear Public Information and Disclosure Standard and the *Nuclear Information Disclosure and Transparency Protocol*.

3.3.2.2 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 DGR. OPG continues to respond to and support requests for information or briefings. In the past three years briefings and information sharing efforts have substantially increased as a result of interest in the DGR project. OPG has worked to respond to all of these requests and proactively reached out to communities to share information in both Canada and the United States.

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

To increase the understanding of nuclear waste operations, tours are provided to key stakeholder groups, media and interested groups. At the WWMF, a total of 173 tours were conducted from 2007 to the end of 2015.

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

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

- 22 newsletters to a combined audience of 260,000 households; and
- Over 17,000 visitors in 2015 to OPG's waste and DGR websites.

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. In 2015, 17,451 visitors accessed OPG's waste management and DGR websites for information.

Social media continues to increase in popularity and use. OPG actively monitors and responds to activity through Tweets, Facebook, and other social media platforms. OPG maintains a Facebook account, a Twitter account with 5,200 followers, and Tweets on relevant nuclear activities and information.

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

The WWMF hosted a variety of environmental education and recreational programs geared to students to demonstrate that OPG shares the values of family, safety and environmental stewardship. The WWMF site supports Science Career Paths sessions, The Bluewater Science Fair, Water Works and the Girls Science Club reaching over 5,200 students.

3.3.2.3 Community Engagement for WWMF Licence Renewal

During the licence renewal process OPG will develop and undertake 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.

3.3.3 Future Plans for Improvement

OPG plans to:

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

3.4 OPG'S RESPONSE TO THE FUKUSHIMA INCIDENT IN 2011

As discussed in Section 2.4, in response to the event on March 11, 2011, a magnitude 9.0 earthquake, followed by a devastating tsunami in Japan that caused a severe nuclear accident at the Fukushima Daiichi nuclear power plant, 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.

Pursuant to its authority, the 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 DNWM nominated an executive team lead and a supporting work force to manage the extensive work load and tight time lines. This work force consisted of specially assembled teams, which included an overall DNWM coordination team, and specific assessment teams in Used Fuel Operations, L&ILW Operations, and Nuclear Waste Engineering.

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

A. Safety Cases for Design Basis Events

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

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

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

OPG did not find any significant gaps during the review of the safety cases for OPG's WWMF. However, some possible improvements and enhancements were identified during this assessment (Table 10). Following the schedule

proposed by the CNSC Management Response guidance for implementing recommendations, OPG has completed the implementation.

B. Safety Cases for Beyond Design Basis Events

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

a. Emergency Response Capability

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

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

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

b. Technical Studies

The undertakings in this category which required further evaluation include the assessment of various waste management systems and structures under post-event conditions.

A flood hazard assessment was completed for the WWMF site concluded that:

- A 1-hour probable maximum precipitation event could result in flood levels generally between 0.15 and 0.5 metres, but up to 2 metres in localized areas; and,
- A flooding potential from the lake is insignificant compared to the probable maximum precipitation flood levels.

A public dose assessment as a result of the probable maximum precipitation flood indicated that potential doses to the public would be significantly below the regulatory dose limit.

Flood water modelling was performed to evaluate whether the waste storage structures at WWMF would be “fit for service” following a beyond design basis probable maximum precipitation flood event at WWMF. It was found that all storage structures and buildings would retain their structural integrity during and after a beyond design basis flood event, and would therefore be fit for service.

Flood hazard mitigation for the carbon dioxide fire suppression rooms supporting the LLSBs was considered, and the radiological dose to the public as a result of using water to fight an LLSB fire has been estimated to be below regulatory dose limits. Furthermore, fighting fire with water would not pose an unreasonable risk to the environment.

A seismic assessment of the DSC Processing Building was completed to determine the impact of the building collapsing while an unclamped and non-welded DSC is located inside a weld bay. The analysis assumed the DSC Processing Building collapses and the heaviest roof truss falls on an unclamped and non-welded DSC. It was determined that the lid would be displaced, but not fully removed and the used fuel in the DSC would not be exposed. The assessment concluded that the DSC is sufficiently robust to withstand design basis, and beyond design basis events without a loss of shielding and/or containment integrity.

In the event of an emergency, the OPG emergency preparedness and response procedure includes radiological surveys after the event to confirm that the shielding integrity of the DSCs has not been compromised.

A dose rate assessment was conducted in order to determine the magnitude of the potential public dose at the site boundaries, if all the waste storage buildings at the WWMF were to collapse as a result of a beyond design basis seismic event. Conservatively, rubble was not credited with providing any radiation shielding.

Based on the maximum potential occupancy at the site boundary (24 hours/day, 365 days/year), the dose over the course of a year to a member of the public located at the site boundaries of the WWMF was found to be well below the CNSC annual dose limit of 1 mSv for a member of the public. This value is also used by OPG as the acceptance criterion for abnormal operating events at the WWMF.

Table 10: Possible Improvements and Enhancements with OPG's Actions Taken

Item	Possible Improvements and Enhancements	Actions Taken
1	Purchase satellite phones and associated contracts for all facilities, to ensure DNWM 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 DNWM employees being stranded at work for up to seven days.	Three Globalstar CST·1700 satellite phones were purchased and these phones can be charged by a computer, an electrical outlet, or a car, which provides flexibility in keeping the phones charged in the event that some of these power sources are impacted by a severe weather event. Also, a contract has been established with Globalstar for access to the satellite and usage. The phone number for the WWMF was provided to the CNSC.
2	Update the OPG document "Environmental Emergency Plan – Propane" to identify the evacuation area of employees in the event of a potential propane tank explosion caused by severe weather event.	A copy of "Environmental Emergency Plan – Propane" was provided to the CNSC. OPG provided the CNSC with information to clarify the roles and expectations of the Propane Emergency Response and the evacuation plan to expediently evacuate all personnel and members of the general public within a 1600 m radius.
3	The DNWM operating procedure for the LLSB did not instruct OPG operations staff to manually activate the LLSB fire suppression system.	The DNWM operating procedure for LLSBs was updated to include instructions for the manual activation of the LLSB fire suppression system. In addition, a procedure for a fire watch following a post-event fire system impairment was created.
4	Assess the carbon dioxide fire suppression system's availability in the event of a loss of Class IV electrical power.	A manual transfer switch that would allow back-up power to be provided to the carbon dioxide fire suppression system supporting LLSBs 11 to 14 was installed. The same change was previously installed for the fire suppression system supporting LLSBs 1 to 10.
5	Investigate if a procedure to lower a suspended DSC in the event of a crane failure, as a result of a beyond design basis event is required.	An OPG review of the postulated suspended DSC event determined that no procedure was required, as the DSC lift height would be lower than the maximum height for a drop within the existing safety envelope, as analysed in the Safety Report.

Item	Possible Improvements and Enhancements	Actions Taken
6	Develop a procedure for the safe shutdown of the nuclear waste management facilities in the event of a beyond design basis event.	A "NWMD Emergency Preparedness and Response" procedure was developed and issued. It includes actions to be taken by staff during and after a beyond design basis event. The procedure includes facility specific checklists for all sites, which comprises the list of components that need to be checked, to ensure the facility is in a safe state.
7	It was identified that the WWMF did not have defined radiation emergency response support in the Bruce Site Services Agreement.	A mutual Aid Agreement for nuclear emergency support was developed, agreed to by Bruce Power, Ontario Power Generation, Hydro Quebec, New Brunswick Power, and Atomic Energy of Canada Limited, and was placed into effect November 30, 2012. In addition, Bruce Power updated their seismic event procedure to include notifications to the WWMF.
8	Review the adequacy of the OPG Transportation Emergency Response Plan to ensure that no significant gaps exist for a response in the event of a significant event at the nuclear stations, coincident with a Radioactive Materials Transportation event. The Transportation Emergency Response Plan response may be slow, or assigned lower priority compared to station responses.	The Radioactive Materials Transportation Emergency Response Plan has been included in OPG's prioritization guide for OPG Nuclear station coincident events.
9	There is no designated portable standby generator dedicated to fixed radiation monitoring at the WWMF WVRB, in the event of a seven day power outage.	WWMF maintains several small diesel generators. An assessment performed by the OPG Nuclear Waste Engineering Department, concluded it is acceptable to power a radiation monitor using a small diesel generator.
10	Assess whether undertaking additional measures to provide food, water etc. is required in the event of a severe weather emergency.	Results of the assessment concluded that additional food, water, and other provisions would be required for this event. OPG procured the required additional items.

Item	Possible Improvements and Enhancements	Actions Taken
11	Investigate the adequacy of the existing Mutual Aid Agreements, and whether additional mutual aid contracts would be required in the event of a severe weather emergency.	Results of the assessment concluded that no additional mutual aid agreements would be needed.
12	Assess whether additional fire response capability would be required in the event of a severe weather emergency at the WWMF.	Results of the assessment concluded that no additional fire response capability would be needed.
13	Investigate whether an alternate fire water supply is required in the event of a severe weather emergency at the WWMF.	Results of the assessment concluded that no additional fire water supply would be needed.

3.5 FINANCIAL GUARANTEE

Preliminary decommissioning planning forms the basis for establishing the cost estimate of decommissioning work which in turn is used to calculate the OPG long term financial obligation, segregated funds and financial guarantee requirements.

3.5.1 Cost Estimates

Cost estimates are prepared based on the facility Preliminary Decommissioning Plan to determine the liability to be incurred during decommissioning. In 2011, OPG completed a comprehensive review and update of the Ontario Nuclear Funds Agreement Reference Plan and associated lifecycle cost estimate for nuclear waste management and stations and waste facilities decommissioning as part of the five-year update cycle as required by Ontario Nuclear Funds Agreement. The updated Ontario Nuclear Funds Agreement Reference Plan was approved by Ontario Minister of Finance effective January 1, 2012. The updated and approved cost estimates form the basis of OPG's proposed 2013-2017 CNSC Consolidated Financial Guarantee requirement submission that was accepted by the CNSC in December 2012. OPG is currently working on an update to the currently approved Ontario Nuclear Funds Agreement Reference Plan which is expected to be approved by the Ontario Minister of Finance by end of 2016. The updated and approved cost estimates will form the basis of OPG's 2018-2022 CNSC Consolidated Financial Guarantee submission.

3.5.2 Financial Guarantee

OPG is required to provide and maintain a consolidated financial guarantee for all costs of implementing proposed decommissioning plans for all its Ontario based Class 1 and Waste Nuclear Substance licence facilities. In December 2012 the CNSC accepted OPG's proposed 2013-2017 Consolidated Financial Guarantee. The sources to satisfy the consolidated financial guarantee requirement are the Ontario Nuclear Funds Agreement segregated funds augmented by a Provincial Guarantee. CNSC access to these funds is provided by the *CNSC Financial Security* and *Ontario Nuclear Funds Agreement Access Agreement* between the CNSC, OPG and the Provincial of Ontario, and the Provincial Guarantee Agreement between the CNSC and the Province of Ontario. The WWMF is included within this consolidated financial guarantee scope. The consolidated financial guarantee is normally updated on a five-year cycle using the guidance set out in CNSC regulatory documents G-219 and G-206. Specific to WWMF, this requirement is embedded in the WWMF WFOL-W4-314.03/2017 which contains Licence Condition 10.2 which requires OPG to maintain a financial guarantee acceptable to the Commission, and references the accepted documentation supporting the financial guarantee.

3.5.3 Financial Guarantee Reporting

In addition to the 5 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.

3.5.4 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.

3.6 NUCLEAR LIABILITY INSURANCE

OPG continues to maintain Nuclear Liability Insurance for its WWMF consistent with the requirements of the *Nuclear Liability Act (1976),* and will make any required changes to comply with *Nuclear Liability and Compensation Act* when its associated regulations are brought into force. A copy of the most current certificate is attached as Appendix A, confirming that the appropriate insurance is in place. Insurance inspections are conducted at WWMF at the request of the nuclear property or conventional insurers.

3.7 COST RECOVERY

OPG has provided timely payments during the licensing period, 2007 to 2016, to the CNSC on a quarterly basis based on 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.

3.8 ADDITIONAL INFORMATION REQUESTED BY CNSC

3.8.1 Other Relevant Regulations, Obligations and Permits

Table 11 provides the list of other regulations, obligations that WWMF must abide by, and permits, certificates and licences issued by authorities other than the CNSC.

Table 11: Other Legislation (Non-CNSC) That WWMF Abides By

Regulatory Agencies	Legislation	Legislative Instrument	Reporting Requirements
FEDERAL			
Environment 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 Canada	Canadian Environmental Protection Act	CEPA	Annual National Pollutant Release Inventory Report
Environment Canada	Environmental Emergency Regulation	CEPA	Emergency Plan for propane system associated with the incinerator
PROVINCIAL			
Ministry of Environment and Climate Change	Environmental Protection Act	Landfilling Sites, Reg. 232/98	Annual Landfill Report under ECA A272006
Ministry of Environment and Climate Change	Environmental Protection Act		Annual Written Summary report for Air and Noise under ECA 8047-8GLPAM
Ministry of Environment and Climate Change	Environmental Protection Act		Annual Update of the Emission Summary and Dispersion modelling for ECA 8047-8GLPAM

Regulatory Agencies	Legislation	Legislative Instrument	Reporting Requirements
Ministry of Environment and Climate Change	Environmental Protection Act		Source Test Report associated with ECA 8047-8GLPAM
Ministry of Environment and Climate Change	Environmental Protection Act		Annual Industrial Sewage Works Performance Report under ECA 5167-4TYKED for
Ministry of Environment and Climate Change	Environmental Protection Act		Storm water Report under ECA 5381-8ZCP75
MUNICIPAL			
Saugeen Valley Conservation Authorization			SVCA Permit No. 13-015 expired in Apr 2014, as all construction was undertaken prior to expiry.
OTHER			
Technical Standards and Safety Authority	Ontario Technical Standards and Safety Act	Boilers and Pressure Vessels Regulation	Certificate of Authorization (expires April 15, 2017).
Technical Standards and Safety Authority	Ontario Technical Standards and Safety Act	Private Fuel Outlet	Registration # 76600774

3.8.2 Open Action Items Discussed in CNSC Hearings and Meetings

There are no open action items remaining from the 2007 CNSC Hearing on WWMF Licence renewal, and the interim status consolidated meetings held in 2010 and 2015.

4.0 ACRONYMS

ALARA	As Low As Reasonably Achievable
CANDU	CANada Deuterium Uranium
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DGR	Deep Geologic Repository
DNWM	Decommissioning and Nuclear Waste Management Division
DSC	Dry Storage Container
HEPA	High-Efficiency Particulate Air
HX	Heat Exchanger
IAEA	International Atomic Energy Agency
IC	In-Ground Storage Container
ILW	Intermediate Level Waste
ISO	International Organization for Standardization
L&ILW	Low and Intermediate Level Radioactive Waste
LLSB	Low Level Storage Building
LLW	Low Level Radioactive Waste
MCNP	Monte Carlo N-Particle
MPTP	Multi-Purpose Transportation Package
MPTP-SF	Shielded Flask Multi-Purpose Transportation Package
NBCC	National Building Code of Canada
NFCC	National Fire Code of Canada
NGS	Nuclear Generating Station
NWMO	Nuclear Waste Management Organization
OPG	Ontario Power Generation
OPGN	Ontario Power Generation – Nuclear
RCSB	Retube Component Storage Building
RFTP	Radioactive Filter Transportation Package
SGSB	Steam Generator Storage Building
TDO	Tritiated Deuterium Oxide Package
UFDSB	Used Fuel Dry Storage Building

UFDSF	Used Fuel Dry Storage Facility
WFOL	Waste Facility Operating Licence
WVRB	Waste Volume Reduction Building
WWMF	Western Waste Management Facility

5.0 REFERENCES

[R1] OPG Letter, K.E. Nash to G. Riverin, “Environmental Study Report - Western Waste Management Facility Refurbishment Waste Storage Project” (Report #01098-REP-07701-00002 R01)”, October 21, 2005, CD# W-CORR-00531-00210.

[R2] OPG Letter, K.E. Nash to Ben Belfadhel, “Draft Environmental Assessment Study Report for OPG’s Proposed Additional Low Level Storage Buildings at the Western Waste Management Facility”, November 28, 2008, CD# 01098-CORR-00531-00253.

[R3] OPG Letter, K.E. Nash to K. Klassen, “Bruce Radioactive Waste Operating Site 2 (RWOS 2) – Submission of Environmental Assessment for Additional Storage of Low and Intermediate Level Wastes”, September 14, 2000, CD# 0125-CORR-00531-00081.

[R4] OPG Letter, K.E. Nash to D. Howard, “Bruce Used Fuel Dry Storage Project Updated Environmental Assessment Submission”, December 15, 1997, CD# 01098-00531-SAD-P.

[R5] OPG Letter, L. Swami to S. Oue, “Environmental Risk Assessment for the Western Waste Management Facility (WWMF),” April 18, 2016, CD# W-CORR-00531-01121.

APPENDIX A

INSURANCE CERTIFICATE

MARSH

Certificate of Insurance

No.: **2016-2** Dated: **January 21, 2016**

This document supersedes any certificate previously issued under this number

This is to certify that the Policy(ies) of insurance listed below ("Policy" or "Policies") have been issued to the Named Insured identified below for the policy period(s) indicated. This certificate is issued as a matter of information only and confers no rights upon the Certificate Holder named below other than those provided by the Policy(ies).

Notwithstanding any requirement, term, or condition of any contract or any other document with respect to which this certificate may be issued or may pertain, the insurance afforded by the Policy(ies) is subject to all the terms, conditions, and exclusions of such Policy(ies). This certificate does not amend, extend, or alter the coverage afforded by the Policy(ies). Limits shown are intended to address contractual obligations of the Named Insured.

Limits may have been reduced since Policy effective date(s) as a result of a claim or claims.

Certificate Holder:	Named Insured and Address:
Canadian Nuclear Safety Commission **Headquarters** **280 Slater Street P.O. Box 1046** **Station B** **Ottawa, ON K1P 5S9**	**Ontario Power Generation Inc.** **700 University Avenue, H18-J18** **Toronto, ON M5G 1X6**

This certificate is issued regarding:
Western Waste Management Facility

Type(s) of Insurance	Insurer(s)	Policy Number(s)	Effective/ Expiry Dates	Sums Insured Or Limits of Liability	
NUCLEAR LIABILITY • Western Waste Management Facility • Terrorism	Euro Liab. Ins for the Nuc. Ind. (ELINI)	EL036CA16	Jan 01, 2016 to Jan 01, 2017	Limit of Liability	$ 6,000,000

Notice of cancellation:
The insurer(s) affording coverage under the policies described herein will not notify the certificate holder named herein of the cancellation of such coverage.

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Marsh Canada Limited

By: _____
Diane Flynn