ONTARIO POWER GENERATION

DARLINGTON
NUCLEAR GENERATING STATION

APPLICATION FOR LICENCE RENEWAL

December 2013

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1.0 OVERVIEW

1.1 Introduction

Ontario Power Generation (OPG) is an Ontario-based electricity generation company whose principal business is the generation and sale of electricity in Ontario. OPG was established under the *Business Corporations Act* (Ontario) and is owned by the Province of Ontario (the "Province").

As of December 31, 2012, OPG's electricity generating portfolio had an in-service capacity of 19,051 megawatts (MW) from over 70 generating stations. OPG operates two nuclear generating stations, five thermal generating stations, 65 hydroelectric generating stations, and two wind power turbines. In addition, OPG, in partnership with other companies co-owns two gas-fired combined cycle generating stations. OPG also owns two other nuclear generating stations, which are leased on a long-term basis to Bruce Power.

OPG's mission is to be the Province's low-cost generator of electricity. Today, OPG produces about 60 per cent of the electricity used by Ontarians to power their homes, businesses and institutions. OPG's focus is on the efficient production and sale of electricity while operating in a safe, open and environmentally responsible manner.

Safety, Integrity, Excellence, People and Citizenship are OPG's core values, and are the fundamental truths about OPG that do not change. These values clarify what is important in the organization, guide behaviour and decision-making, and point the way to business conduct that results in successful individuals and a successful company.

1.2 Darlington Nuclear Generating Station (NGS)

Darlington NGS has four units that are Canadian Deuterium Uranium (CANDU) pressurized heavy water reactors with a net generating capacity of 881 MW providing a combined capacity of 3,524 MW. Over the past 20 years, Darlington NGS has become a top performing station in the nuclear industry and is an important part of Ontario's energy supply:

- Darlington NGS provides a significant amount of the Provincial energy supply, approximately 20 per cent, which is enough to power 2 million homes.
- Darlington NGS is well situated in the provincial electricity system. It is close to load centres. Continued operation maintains system stability.
- Darlington NGS energy production is clean. 99.99% of the power produced at Darlington NGS is free from greenhouse gas emissions.
- Darlington NGS contributes significantly to Ontario's economy. There are 2,600 workers at site (60% of whom live in Durham Region). Annual spending is $400 M.
- Darlington NGS, as a source of low cost energy, helps moderate the cost of power in Ontario.

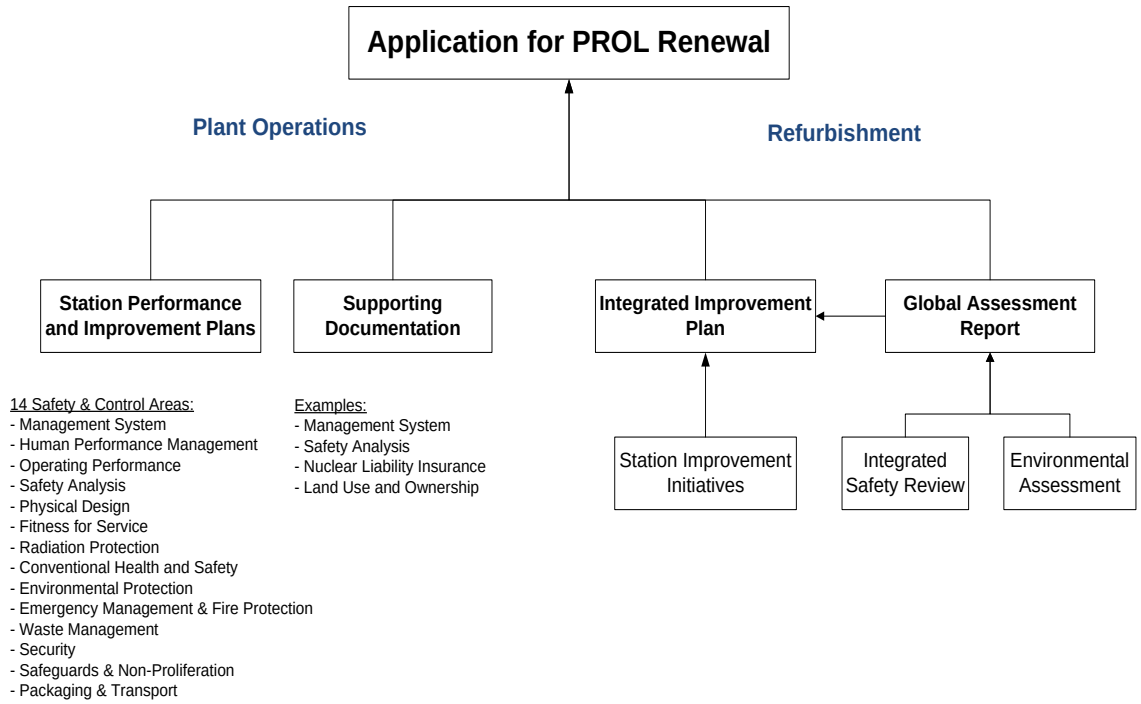
OPG is proceeding with the mid-life refurbishment of the four Darlington NGS reactors, which will allow for an additional 30 years of operation.

Application for Licence Renewal

The Darlington NGS Power Reactor Operating Licence (PROL) 13.00/2014, issued by the Canadian Nuclear Safety Commission (CNSC), will expire on December 31, 2014. This application for licence renewal has been prepared in accordance with the requirements of the Nuclear Safety and Control Act (NSCA) and its associated Regulations, and provides the basis for renewal of the Darlington NGS operating licence, including the changes in the information that was previously submitted from References 1 and 2. The application encompasses the continued safe operation of each unit up to its refurbishment outage; the refurbishment of each unit; and the return to full power operation of all four refurbished units.

This application forms one part of the overall package for OPG's licence renewal request. The following figure (Figure 1) illustrates the relationship between the various key elements of this application.

Figure 1- Licence Renewal Key Elements



This section of the application, Section 1.2, provides an overview of the current station performance, highlights numerous achievements, and discusses improvement initiatives.

Section 1.3 provides an overview of refurbishment, including the regulatory process, the Refurbishment Program and timelines.

Section 1.4 describes OPG's future plans for periodic safety reviews and updates to the Integrated Implementation Plan.

Sections 2 to 15 describe, for each CNSC Safety and Control Area (SCA), the station's performance and improvement plans, and the measures and programs that will be in place during refurbishment outages.

Section 16 describes performance of, and future plans for, the Tritium Removal Facility.

Section 17 describes the Darlington site infrastructure improvements that are being undertaken to support the current and future needs of the Darlington site including refurbishment.

Section 18 summarizes the status of the Fukushima Action Plan.

Section 19 outlines OPG's community relations and public information program for Darlington NGS and for Nuclear Refurbishment, including engagement of First Nations and Métis communities.

Finally, Sections 20 to 22 and the appendices provide the remaining information required by the NSCA and Regulations.

Station Performance

OPG's objective for current operations at Darlington NGS is maintaining high performance while positioning the station for refurbishment and continued operation to approximately 2055. In 2011, three of the Darlington reactors were ranked in the top five performing CANDU reactors world-wide. In 2012, Darlington NGS received its best ever assessment during an international industry peer evaluation and was recognized as being one of the top performing stations in the world.

Last year, Darlington NGS operated at high power with minimal unplanned losses and the station ended the year with a forced loss rate of just over 2%. The reactor trip rate continues to be consistent with the industry benchmark of 0.5 reactor trips per 7,000 hours of operation.

In CNSC staff's most recent assessment of Canadian Nuclear Power Plants (NPP) and for the fifth year in a row, Darlington NGS received an overall integrated station rating of Fully Satisfactory. CNSC staff regulatory inspections continue to confirm OPG is making adequate provision for the safety of the public and environment.

Safety and Safety Improvements

Safety is both a core value and a cornerstone of OPG's operations at its nuclear stations. OPG is proud of its safety record and works hard to maintain a safe work environment for its employees. OPG is recognized as a leader in promoting safety in the workplace. OPG became the first employer in Ontario to receive the ZeroQuest® platinum award from the Infrastructure Health and Safety Association in 2012. The award considered OPG's safety performance, safety management systems and safety culture.

OPG's priority is to continue to safely operate its nuclear facilities in a manner that poses minimal risk to the public, to employees and to the environment. OPG reactors and waste storage facilities are designed, operated and maintained in such a way to

ensure accidents do not happen. OPG maintains a rigorous program of safety reviews, assessments and analysis and works with municipal, provincial and federal authorities to ensure that the highest standard of emergency response capability is always available. OPG has continued to take a leadership role in Canada, by leading in developing Canadian Standards Association (CSA) standards for nuclear emergency management, providing ongoing support for Durham Region's Emergency Management response capabilities, and in facilitating rigorous training across the sector.

At Darlington NGS between 2008 and 2012, staff worked almost thirteen million hours without a Lost Time Injury (LTI). As of the date of submission, staff continue to work safely, with a total of 3.8 million hours recorded without a LTI. Although the conventional safety performance at Darlington NGS is very good, OPG's target is to achieve zero injuries. To that end, minor issues are tracked and trended to put pre-emptive actions in place to avoid more serious events.

During the licensing period, there were no radiation exposures at Darlington NGS that exceeded regulatory limits and external and internal dose performance at Darlington NGS continues to be among the best in the CANDU industry. The dose to the public has been a fraction of 1% of regulatory limits for the entire licensing period and this takes into account the impact from all licensed facilities at site. The radiological emissions from Darlington NGS have been well below regulatory limits and station action levels.

OPG's commitment to continuous improvements in nuclear safety is illustrated during the last three years by significant accomplishments at Darlington NGS including:

- The transition to CNSC Standard S-294, *Probabilistic Safety Assessments (PSA) for Nuclear Power Plants,* which involved the development of new methodologies for carrying out risk assessments at nuclear power stations, and the completion of the associated analysis. The current Darlington Risk Assessment (DARA) is world class and is used to assist in the operational decision making process;
- The work required to meet the new requirements of the updated fire protection standard, CSA Standard N293, *Fire Protection for Canadian Nuclear Power Plants,* which included re-analyses and assessments that resulted in station improvements; and,
- The completion of the environmental qualification reconstitution program, including equipment upgrades.

OPG's 2014 focus areas for continuing improvement at Darlington NGS include:

- Equipment reliability (includes an initiative to address timely completion of preventive and corrective critical maintenance activities);
- Leadership behaviours, including communication and supervisory effectiveness; and,
- Vacuum Building Outage (VBO) preparation and execution prior to refurbishment.

Improvement plans are in place at Darlington NGS to continue the drive for excellence in safe, reliable and cost-effective generation.

OPG has also been recognized for its achievements in operational and management excellence in its response to the Fukushima Daiichi accident.

Following the events at the Fukushima Daiichi plant, OPG immediately completed field walk downs to confirm the ability of its nuclear facilities to withstand severe flooding events. OPG has taken the key lessons learned from this tragic event and have incorporated changes that further enhanced the safety of OPG's nuclear facilities. The majority of actions from the CNSC's Fukushima Action Plan have been completed. The remaining actions are either in the process of being completed or are scheduled for future outages.

Community Support

OPG enjoys strong community support throughout Durham Region. OPG is committed to making a difference in the community and the environment by operating its facilities in an accountable, transparent, and socially responsible manner.

OPG routinely shares information about the safety and environmental performance of its facilities. OPG regularly and proactively provides information to the public on on-going activities; public and environmental impacts; transportation programs, and consults with key stakeholders and the public on future planned activities.

OPG respects the relationship it has with its host communities and recognizes that public confidence is something that has to be earned. This is done by safely and efficiently operating OPG nuclear stations and waste facilities, by maintaining open and transparent communications, and by being a socially responsible contributor to the community fabric.

1.3 Refurbishment

The CANDU stations require a mid-life refurbishment that replaces key reactor components like the fuel channels.

In June 2006, the Government of Ontario directed OPG to begin technical feasibility studies on refurbishing its existing nuclear units.

Refurbishment is a multi-year, multi-phase program for Darlington NGS to enable the replacement of life-limiting critical components, the completion of upgrades to meet current regulatory requirements and rehabilitation of components.

Refurbishment, when completed, will allow Darlington NGS to continue safe and reliable operation for at least an additional 30 years. A refurbished Darlington NGS will continue to provide a significant portion of the Provincial energy supply, thereby helping to maintain system stability, moderate the overall cost of electricity and sustain the province's economic competitiveness. The investment in refurbishment will also off set the production of greenhouse gases, as electricity production at Darlington NGS will displace carbon dioxide emissions from other energy sources.

Refurbishment will help create jobs and contribute to the province's economic competitiveness. During refurbishment, over 2,000 direct jobs and many thousands of indirect and induced jobs will be created across Durham Region and the Province.

Refurbishment Planning Process

The Nuclear Refurbishment Program was formally established in 2008 and in October 2010, OPG and the CNSC signed an OPG - CNSC Protocol (Reference 3). The protocol sets out the administrative process to be used between OPG and CNSC staff to manage the regulatory interaction for the assessments and licensing submissions required to support life extension as described by CNSC Regulatory Document RD-360, *Life Extension of Nuclear Power Plants,* February 2008.

RD-360 requires a licensee to prepare an Integrated Implementation Plan and a Global Assessment. The Integrated Implementation Plan describes the scope of refurbishment from the Environmental Assessment and Integrated Safety Review. The Global Assessment provides an overall risk judgement of the acceptability of continued plant operation. Each of these is described in the following sections.

Environmental Assessment

OPG undertook an Environmental Assessment (EA) under the Canadian Environmental Assessment Act to assess the effects of the refurbishment of the four Darlington reactors and the operation of the reactors for approximately 30 years following refurbishment.

The EA concluded that refurbishment and continued operation of Darlington NGS, taking into account mitigation measures, is not likely to cause significant adverse environmental effects. This conclusion was confirmed through the CNSC public hearing process in 2012 and documented in the Record of Proceedings, including Reasons for Decision issued by the Commission (Reference 4).

An EA follow-up program was developed which will verify the accuracy of the EA and determine the effectiveness of the mitigation measures (Reference 5). This includes four design enhancements which will further increase safety margins and reduce plant risk. The actions to implement the program are contained in the Integrated Implementation Plan.

Integrated Safety Review

An Integrated Safety Review (ISR) is a systematic assessment of plant design, condition and operation to determine the extent to which the nuclear power plant conforms to modern standards and practices, the licensing basis will remain valid over the extended operating life, and adequate arrangements are in place to maintain plant safety for long-term operation.

The ISR completed for Darlington NGS demonstrated that the current state of the plant and its operational performance complies closely with modern codes and standards and utilizes industry best practice. The ISR considered components that would limit safe, long-term operation (e.g. fuel channels). These components are scheduled for refurbishment or replacement and are contained within the Integrated Implementation Plan, along with other activities to enhance the condition of the station.

CNSC staff concluded that the Darlington ISR met the applicable requirements of CNSC RD-360 (Reference 6).

Integrated Implementation Plan

The Darlington Integrated Implementation Plan (IIP) contains the safety improvements resulting from the EA and ISR, including:

- Replacement of fuel channels, feeders, Calandria Tubes (CTs), and end fittings;
- Replacement of liquid relief valves on the Heat Transport System (HTS);
- Implementation of safety-related recommendations from component condition assessments, including refurbishment or replacement of components;
- Implementation of changes to safety analysis to comply with CNSC Regulatory Document RD-310 *Safety Analysis for Nuclear Power Plants*;
- Completion of the implementation of Severe Accident Management Guidelines;
- Design and installation of a Containment Filtered Venting System (CFVS);
- Provision of Shield Tank Overpressure Protection (STOP);
- Enhancements to the Powerhouse Steam Venting System (PSVS);
- Installation of a 3rd Emergency Power Generator (EPG3);
- Provision of an alternate, independent supply of water as an Emergency Heat Sink (EHS);
- Installation of diesel driven fire water pumps;
- Installation of two auxiliary shutdown cooling pumps; and,
- Completion of the EA follow up program.

Global Assessment

The Global Assessment (GA) determined that Darlington NGS has performed well throughout its operating life and noted it has been recognized by its peers as a top performer. This performance is the result of a robust design, solid engineering, operations and maintenance programs and processes that incorporate continuous improvement, and staff that is committed to nuclear safety as a core value and as a cornerstone for nuclear operations.

The GA included a detailed assessment of Darlington NGS's defence in depth against the defence in depth requirements for new NPP contained in CNSC Regulatory Document RD-337, *Design of New Nuclear Power Plants*. It was determined that these requirements are not only met at Darlington NGS but that the defence in depth barriers will be further strengthened as a result of the implementation of the IIP.

All aspects of RD-360 were evaluated and an adequate justification for continued operation is documented. The results demonstrate that Darlington NGS is a safe and reliable nuclear power plant today, that there are opportunities for further improvements and that implementation of these improvements, as documented within the IIP, will result in Darlington NGS being an even safer and more reliable supplier of clean electrical power to the Province of Ontario. The GA and IIP were submitted for CNSC staff review in Reference 7.

<u>Refurbishment Program</u>

OPG established a separate refurbishment management organization that is distinct from the station to better enable both organizations to focus on their areas of responsibility and expertise. The Nuclear Refurbishment organization will focus on the development, implementation, and assurance of the projects that will be performed during refurbishment.

The Nuclear Refurbishment organization and the Darlington NGS organization have established common goals and objectives, to ensure that there is alignment between the two organizations. A managed process is used to ensure control and accountability is clearly defined at all times, including:

- An interface agreement which clarifies roles and responsibilities and ensures that the objectives of the Refurbishment Program are met while minimizing the impact of refurbishment activities on plant operation;
- Department organizational transfer plans which identify, at a departmental level, the responsibilities and specific activities required to support transition of a unit from the station to the Nuclear Refurbishment organization, and back again; and,
- A higher level plan (in development) which integrates the department organizational transfer plans. This integrated transition plan will ensure that all station and refurbishment staff are aligned and have a clear understanding of the specific deliverables required to support transition of a unit from the station to the Nuclear Refurbishment organization, and back again.

Refurbishment Timeline

All regulatory scope reflected in the Integrated Implementation Plan will be completed before the end of the Darlington Life Extension Window. This is the window of time from the beginning of the first refurbishment outage (Unit 2 Refurbishment in 2016) through the first complete planned outage following the last refurbishment outage. Figure 2 Darlington Life Extension Model illustrates the various work windows for completion of the regulatory scope. The dates in the figure are based on current planning assumptions and are indicative only and, therefore, are subject to change.

The majority of the safety related work required for the Darlington Life Extension, as identified in the IIP, will be completed before or during the Refurbishment outages.

Prior to the first Refurbishment outage in 2016, several major modifications that enhance the response of Darlington NGS to severe accidents will be completed. These Safety Improvement Opportunities (SIOs) include the installation of a third Emergency Power Generator, a new alternate and independent supply of emergency cooling water and a new CFVS. They will further reduce the already low risk to the public from the continued operation of Darlington NGS.

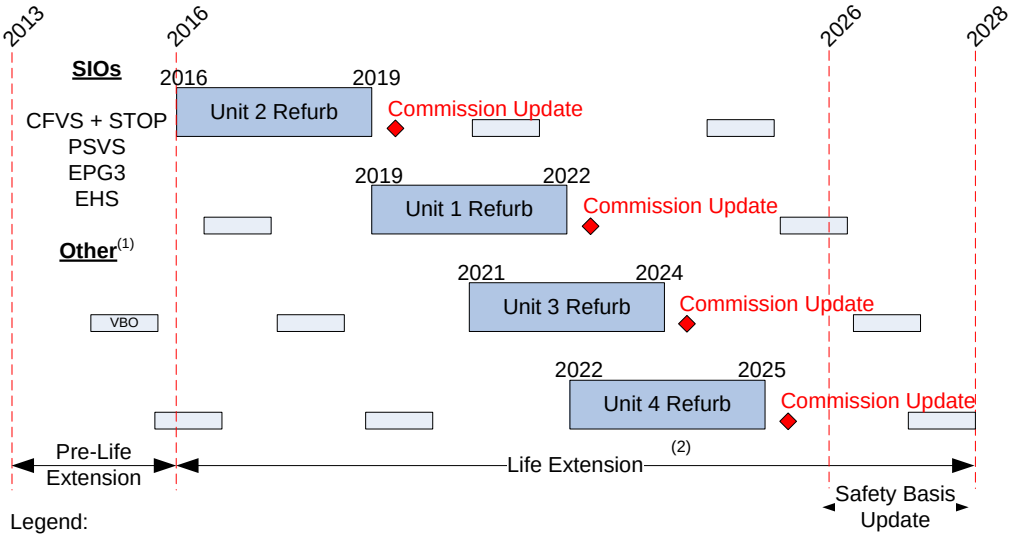
During the refurbishment outages on each unit, work will be undertaken to ensure that the credited safety related systems are ready for an additional 30 years of safe operation. The replacement of reactor components, including pressure tubes, calandria tubes, end fittings and feeders, is the primary refurbishment outage work. Enhancements to the shutdown cooling system to add two new pumps along with other safety related modifications and maintenance will also take place during the Refurbishment outages.

The balance of the safety related work will be executed during the planned unit maintenance outages and during normal operation as maintenance work within the Life Extension timeframe. Operational improvements in the IIP will also be implemented during the Life Extension Window. In some cases, such as completion of implementation of Severe Accident Management Guidelines (SAMG), program improvements are already in progress.

The completion of the safety related work in this manner provides the greatest enhancement to plant safety early in life extension. Completion of all of the identified work will ensure that Darlington NGS continues to operate in a safe and reliable fashion for an additional 30 years after refurbishment.

OPG commits to report to the Commission following the conclusion of each outage on the lessons learned and improvements to be made in the refurbishment outage performance. These have been nominally shown of the illustration of the Life Extension Window (Figure 2), and would, of course, be confirmed should the licence renewal request be granted.

Figure 2 - Darlington Life Extension Model *(Indicative)*



1.4 Post-Refurbishment Operation – Continuous Improvement

Also shown on the Life Extension Window illustration (Figure 2) is OPG's commitment to updating the safety basis for the station. The completion of the assessments required by RD-360, together with this application, is the first step in transitioning to a licence based on periodic reviews of the safety of the nuclear facility. The periodic safety review is the established international practice by which nuclear facilities are judged to be in a condition and have the required programs necessary for continuing safe operation. CNSC staff have previously indicated that the Canadian nuclear framework would, over time, be brought into alignment with the international regulatory practice. Completion of periodic safety reviews is also an action in the CNSC's action plan for Fukushima.

OPG expects to update the Integrated Improvement Plan as the life extension activities are performed. In this manner, OPG will confirm the completion of the safety enhancements that are the basis for the Global Assessment determination that Darlington NGS will be safe to operate for an additional 30 years after refurbishment. As noted above, OPG will also be performing the Environmental Assessment follow-up

monitoring that will confirm the effectiveness of the enhancements that are being made in protecting the environment and the public.

OPG also expects to undertake activities during the life extension window as may be needed to address any operational experience that is gained. This would include any safety enhancements that arise from revision of the codes and standards that form the basis for confirming the safety of the design. These activities are part of OPG's continuous improvement which ensures that safety always comes first. As a result, re-performance of the ISR would not be required as the information would be available through the assessments and transition plans that are prepared with each code update.

As new commitments are made, these will be incorporated into the Integrated Improvement Plan, or such other document as comes to replace it. OPG considers it an important feature of the licensing process to have a consolidated listing of the safety enhancements that it is committed to make and to demonstrate to the CNSC and to the public that it is fulfilling its commitments.

Following return to service of the last refurbished unit, a safety review will be undertaken to reconfirm that the station remains consistent with modern codes and standards and that, holistically, on the basis of the monitoring and results achieved and the committed enhancements, OPG is well positioned to continue to safely operate Darlington NGS.

References:

1. OPG letter, S. Seedhouse to M. Leblanc, "Darlington NGS 'A' – Application for Renewal of Darlington Nuclear Generating Station Power Reactor Operating Licence", June 28, 2011, CD# NK38-CORR-00531-15556.

2. OPG letter, B. Duncan to M. Leblanc, "Darlington NGS 'A' – Additional Information in Support of Application for Renewal of Darlington Nuclear Generating Station Power Reactor Operating Licence", March 29, 2012, CD# NK38-CORR-00531-15849.

3. CNSC Letter, G. Rzentkowski to D. Reiner, "Revision of OPGN-CNSC Protocol for the Conduct of the ISR Through to the Integrated Implementation Plan (IIP) for the Refurbishment of Darlington NGS 'A', August 20, 2012, e-Doc# 3992020, CD# NK38-CORR-00531-00656.

4. CNSC letter, L. Levert to D. Reiner, "Record of Proceedings-Environmental Assessment on the Refurbishment and Continued Operation of the Darlington Nuclear Generating Station", March 14, 2013, e-Doc # 4105440, CD# NK38-CORR-00531-16265.

5. OPG letter, D. Reiner and B. Duncan to F. Rinfret, "OPG Submission of the DNGS Environmental Assessment Follow-up Program (Revision 001)", October 2, 2013, CD# NK38-CORR-00531-16500.

6. CNSC letter, F. Rinfret to D. Reiner, "Darlington NGS 'A'-CNSC Staff Assessment of Integrated Safety Review", July 5, 2013, e-Doc # 4154507, CD# NK38-CORR-00531-16396.

7. OPG letter, D. Reiner and B. Duncan to F. Rinfret, “Request for Acceptance of the Darlington NGS Global Assessment Report (GAR) and Integrated Implementation Plan (IIP)”, December 2, 2013, CD# NK38-CORR-00531-16568.

2.0 MANAGEMENT SYSTEM

Darlington NGS, under its current PROL is required to have in place a management system that is in compliance with CSA N286-05, *Management System Requirements for Nuclear Power Plants*.

OPG's key documents for the Management System SCAs are listed in the table presented below. These documents are in the current Licence Condition Handbook (LCH).

Document Title	Document Number	Revision #
Management System		
Nuclear Management System	N-CHAR-AS-0002	R017
Managed Systems	N-PROG-AS-0001	R015
Records and Document Control	N-PROG-AS-0006	R010
Organization		
Nuclear Management Systems Organizations	N-STD-AS-0020	R012
Organizational Change Control	N-PROC-AS-0068	R006
Persons Authorized to Act on Behalf of OPG in Dealing with the CNSC	N-CORR-00531-06321	N/A
Plant Management (including Safety Culture)		
Nuclear Safety Policy	N-POL-0001	R002
Nuclear Safety Oversight	N-STD-AS-0023	R006
Health and Safety Management System Program	OPG-PROG-0010	R002
Nuclear Safety Culture Assessment	N-PROC-AS-0077	R005
Self Assessment and Benchmarking	N-PROC-RA-0097	R007
Independent Assessment	N-PROG-RA-0010	R012
Nuclear Pandemic Plan	N-PROG-RA-0018	R003
Guideline for Maintaining Staff in Key Positions When Normal Station Access is Impeded	N-GUID-09100-10000	R000

2.1 Current Operations

Over the last three years, CNSC staff have consistently assessed the Management System SCA as meeting all regulatory requirements and expectations. Given OPG's robust processes that are in place, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

2.1.1 Business Planning

OPG's goal is for the Darlington NGS to be the best performing nuclear power plant in the world. Darlington's near term objective for the 2014 to 2016 business plan is to continue the station's Journey of Excellence program while positioning the station for refurbishment and beyond.

The Journey of Excellence program focuses on OPG's Cornerstones, using the Values and Behaviours that will drive the Darlington station towards excellence in safe, reliable and cost-effective generation.

The business plan is updated every year to set challenging goals that drive continuing improvement in the operation of Darlington NGS

Performance Metrics (2014 to 2016)

As Darlington continues on its multi-year journey to achieve top quartile performance through its business plan, Table 1 highlights the Darlington's report card targets by cornerstone for the 2014 to 2016 business plan period.

Table 1 – Report Card Metrics Annual Target

Report Card Metrics - Annual Targets	2014	2015	2016
Safety			
All Injury Rate (#/200k workhours)	0.89	0.89	0.89
Collective Radiation Exposure (person rem/unit)	56.00	73.80	55.00
Airborne Tritium Emissions (curies)	4000	4000	4000
Environmental Infractions (#)	8.0	8.0	8.0
Environment Index (%)	80.0	80.0	80.0
Reliability			
Net Electrical Production (TWh)	28.13	25.57	26.03
Forced Loss Rate (%)	1.25	1.00	1.00
Unit Capability Factor (%)	93.2	85.0	92.0
BP-Planned Outage Performance (days)	81.4	206.6	97.0
Nuclear Performance Index (%)	95.7	93.2	97.4
On-line Deficient Maintenance Backlog (work orders/unit)	190	180	175
On-line Corrective Maintenance Backlog (work orders/unit)	29	25	25
Plant Reliability List (# of work orders completed)	200	200	200
Equipment Reliability Index (%)	83	85	88
Dry Storage Containers (#)	60	60	60
Chemistry Performance Indicator (Annual YTD)	1.01	1.01	1.01
Value for Money			
Thermal Performance Indicator (%)	99.5	99.5	99.5
Human Performance			
Training Index (%)	80	80	80
Corrective Action Program - Quality of Significance Level 1&2 Eval's (Out of 3)	2.22	2.22	2.22
Event-Free Day Resets (#)	2	2	2

*DER - Design Electrical Rating

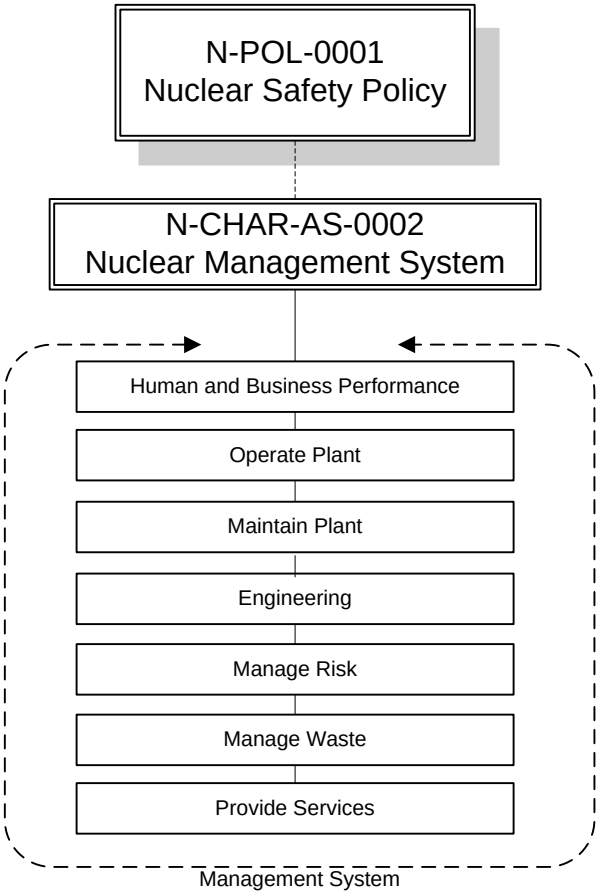
2.1.2 Management System

OPG's charter document, N-CHAR-AS-0002, *Nuclear Management System* provides the direction and references the documents which establish the Management System. The Nuclear Management System are the principles and the supporting documentation required to ensure safe and reliable NPPs, as defined by CSA N286-05, *Management System Requirements for Nuclear Power Plants.*

The Nuclear Management System will be followed during refurbishment, subject to necessary changes described in this application. The objective of the management

system is to ensure OPG Nuclear facilities are operated and maintained using sound nuclear safety and defence-in-depth practices to ensure radiological risks to workers, the public, and environment are As Low As Reasonably Achievable (ALARA), and in keeping with the OPG Nuclear Safety Policy and the best practices of the international nuclear community. Nuclear Safety is the overriding priority and basis for the management system as depicted in Figure 3.

Figure 3 – Nuclear Management System



Every employee in the organization is responsible and held accountable for complying with the expectations of N-CHAR-AS-0002 and referenced programs, and for ensuring their actions are deliberate and consistent with protecting worker health and safety, the health and safety of the public, and the environment.

The OPG Nuclear Management System effectiveness is reviewed by the Nuclear Executive Committee as part of ongoing oversight. Each program area provides annual reports on a standardized set of performance criteria and are assessed in the areas of management and leadership, performance execution and continual improvement.

The Nuclear Management System will be evolving over the next two years to support the OPG business model by transferring several of the nuclear programs to the centre-

led business units. This involves careful review and oversight of the changes by the Chief Nuclear Officer (CNO) and the Nuclear Executive Committee to ensure that the roles and accountabilites in meeting the CSA N286 requirements are understood and captured in the centre-led program owner's governance and management systems.

Ownership, oversight and accountability for the program will reside with the centre-led program owner but the CNO will remain accountable for the effectiveness of the implementation of these programs at the nuclear facilities, and in meeting the requirements of CSA N-286. Program health and effectiveness review of these interfacing programs will continue to be part of the Nuclear Management System.

As part of this alignment to the OPG Business Model, OPG Nuclear will take the opportunity to transition N-CHAR-AS-0002, *Nuclear Management System* to reflect the CSA N286-12 requirements.

Transition Plan for CSA Standard N286-12, *Management System Requirements for Nuclear Power Plants*

OPG has recently completed a gap analysis from CSA Standard N286-05 to CSA Standard N286-12. Planning is currently underway to assess the results of that gap analysis in order to determine the final transition date to CSA N286-12. The compliance date will be provided to CNSC staff before May 2014.

2.1.3 Nuclear Safety Policy

N-POL-0001, *Nuclear Safety Policy*, establishes guiding principles for OPG nuclear 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. The requirements of the policy are set out below.

Everyone shall demonstrate respect for nuclear safety by:

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

Everyone shall conduct themselves in a manner consistent with the traits of a healthy nuclear safety culture. The following traits have been incorporated into the policy: Personal Accountability, Questioning Attitude, Safety Communication, Leadership Accountability, Decision-Making, Respectful Work Environment, Continuous Learning, Problem Identification and Resolution, Environment for Raising Concerns and Work Processes. These traits are promoted and discussed daily and applied by staff in all work performed at the site.

2.1.4 Nuclear Safety Culture

In June 2012, OPG conducted at Darlington NGS, a station wide assessment of its Nuclear Safety Culture. OPG will continue to conduct these station wide assessments periodically as per N-PROC-AS-0077, *Nuclear Safety Culture Assessment.*

Darlington NGS was assessed as having a healthy nuclear safety culture, a strong respect for nuclear safety, and that nuclear safety is not compromised by production priorities. Station personnel feel they can challenge any decision if needed, without fear of retaliation.

In January 2013, OPG implemented an industry document, Nuclear Energy Institute's NEI-09-07, *Fostering a Strong Nuclear Safety Culture*. NEI-09-07 provides a framework to monitor nuclear safety culture. As a result, a Nuclear Safety Culture Monitoring Panel has been established to monitor the process inputs that are indicative of the health of the organization's nuclear safety culture. In doing so, strengths and potential concerns that merit additional attention by the organization are identified and acted upon.

2.1.5 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, management self-assessments and other third party reviews. 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 N-CHAR-AS-0002, *Nuclear Management System* and related activities are performed by the Nuclear Oversight organization in accordance with N-PROG-RA-0010, *Independent Assessment.* Managed processes are subject to audits once every three years, unless otherwise specified.

Industry peer reviews are performed periodically; the most recent peer review was completed in February 2012 with Darlington receiving its highest rating ever, recognized by its peers as being one of the top performing stations in the world.

During this process strengths and areas for improvement are identified, so that Darlington NGS can maintain its excellent performance through continuous improvement.

2.1.6 Self Assessment and Benchmarking

OPG procedure, N-PROC-RA-0097, *Self Assessment and Benchmarking,* ensures 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 other utilities, and participation in assessments. Similarly, peers from other utilities visit Darlington NGS to gain insights. These relationships are important to ensure OPG continues to gain insight on industry best practice in all areas.

2.1.7 Organization

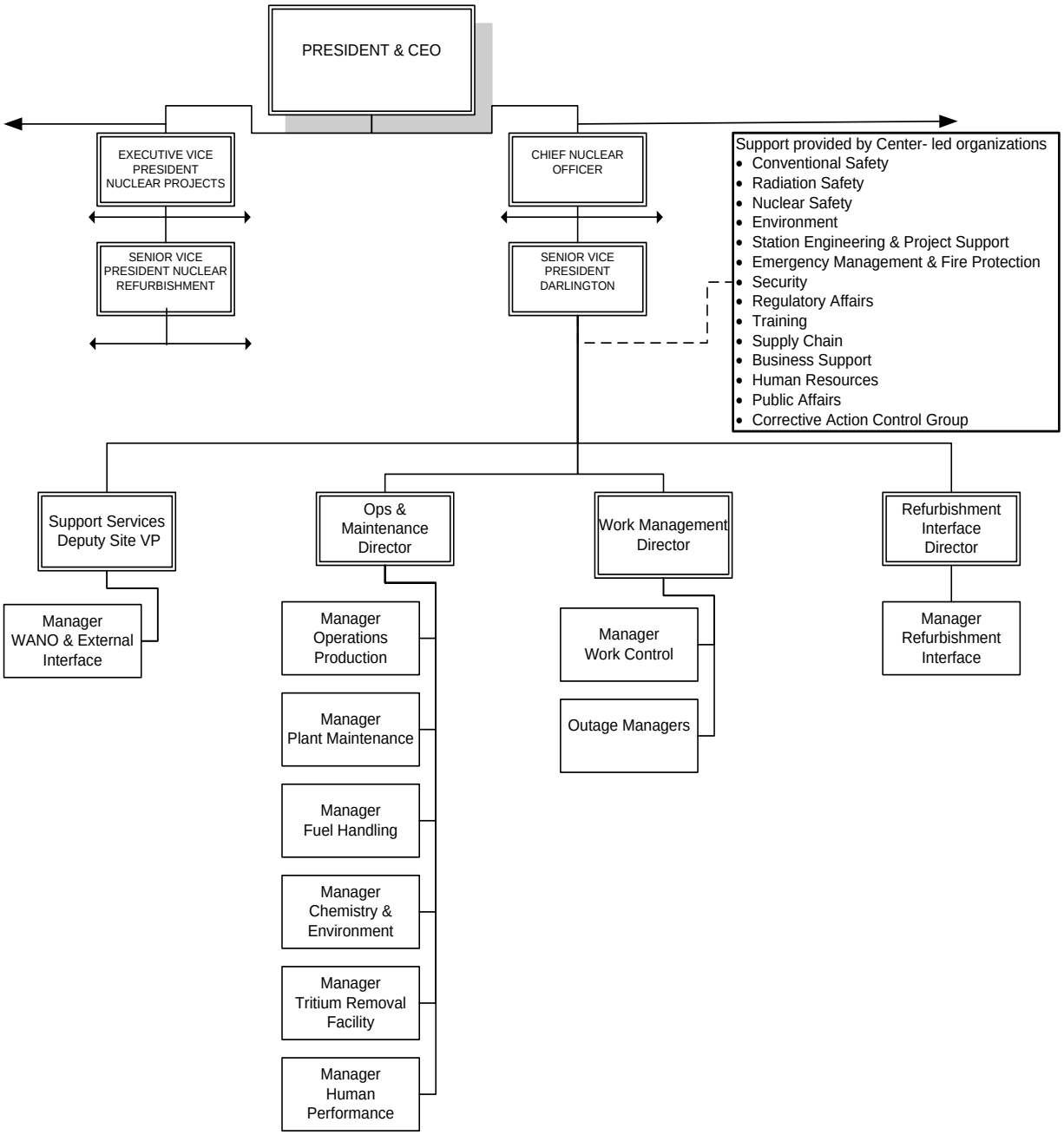
OPG has adopted an integrated organizational model. Under this structure, there are two types of functional organizations: those accountable for delivering fleet-wide support; and those accountable for operations. The Nuclear organization is defined in N-STD-AS-0020, Nuclear Organization.

Support functions establish one point of accountability for an entire function, to deliver functional support across all business units. This new structure requires “integration” of a function and avoids duplication of work. Examples include Human Resources, Supply Chain, Finance, Law, Environment and Corporate Relations and Communications. Previously, for some functions (e.g. supply chain) OPG had a separate department within each operations group.

Figure 4 provides the current organization chart for Darlington NGS with the support structure represented by a dotted line organization.

Organizational changes are managed following N-PROC-AS-0068, Organizational Change Control and CNSC staff are provided updates annually. The most recent update was provided in Reference 1.

Figure 4 – Darlington NGS Organization



2.2 Refurbishment

2.2.1 Nuclear Management System

As noted above, Nuclear Refurbishment is subject to the OPG *Nuclear Management System,* N-CHAR-AS-0002 and all governance under that system.

In addition, the Nuclear Refurbishment organization is developing Program Management Plans (NK38-PLAN-09701-10067) to describe how refurbishment meets the Nuclear Management System and identifies any supplemental guidance/direction specific to undertaking the refurbishment of the units. These plans will be submitted to CNSC staff for information.

The Refurbishment Program complies with OPG program, N-PROG-AS-0007, *Project Management Program*. This program, describes the key project management principles to support the safe, consistent, and effective execution of nuclear projects at OPG. N-PROG-AS-0007 is implemented through standards on project management, contract management, project oversight and field engineering and supplemented with a procedure on the technical contractor management process.

Contractor Quality Management

OPG will use Engineer, Procure, and Construct (EPC) contractors to perform the majority of the refurbishment work.

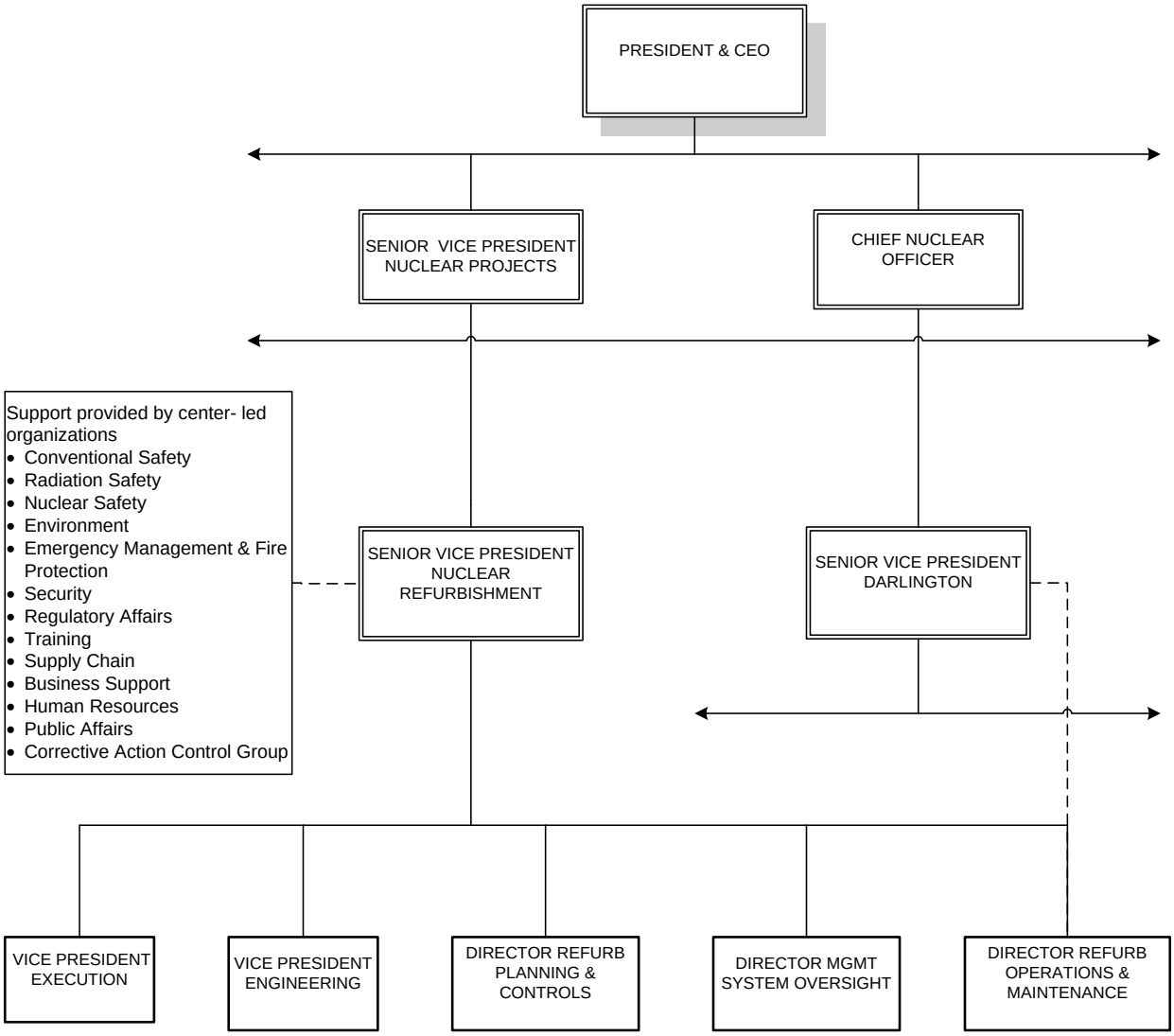
Contractors are qualified by OPG Supply Chain Quality Services under a process that ensures that the contractor has developed and implemented a management system that meets the applicable requirements outlined in the CSA Standard N286-05. Combining this with the fact that many of the EPC contractors have a long history of working in the nuclear industry and with OPG in particular, provides confidence that the results of their work activities will satisfy all applicable standards.

EPC contractors will use sub-contractors in the execution of some of their work. OPG has established the requirement that the sub-contractors must work under the EPC contractor's quality program.

2.2.2 Organization

The Nuclear Refurbishment organization is comprised of project teams and functional organizations supported by embedded staff from central OPG and OPGN organizations. The current Nuclear Refurbishment organization is shown in Figure 5.

Figure 5 – Nuclear Refurbishment Organization



2.2.3 Nuclear Safety Culture

Ensuring a healthy safety culture exists within the construction environment during refurbishment will be achieved through active leadership from the responsible management teams from OPG and contractors starting with alignment around, “Safety is our core value”.

Nuclear Refurbishment and contractor’s management teams will:

- Set and maintain high standards and common expectations, through a focused management program that will be in place prior to commencement of refurbishment activities.
- Be aligned on common priorities and goals for quality and safety.

- Establish and conduct strong and agreed upon oversight and assessment activities for quality and safety.

Established approaches to maintaining a healthy nuclear safety culture will be used based on industry experience and actual refurbishment performance. A key element is communication and reinforcement of the Safety Culture message by leadership of Nuclear Refurbishment and the contractors along with extensive field supervisory and worker training and reinforcement to engrain and uphold safety culture.

2.2.4 Nuclear Refurbishment Program Oversight

OPG's Nuclear Standard on N-STD-AS-0030, *Project Oversight* will be followed during refurbishment. The Management System's Oversight functional organization is accountable to ensure consistent oversight across the entire program and to co-ordinate all external reviews and evaluations.

The OPG Project Managers are accountable to plan and conduct oversight of their contractors and to communicate and document the results. Project oversight of contractors is an assessment of the contractor's products and services to determine if they are delivering the contracted products and services safely, to the specified quality, on time and on budget.

2.2.5 Self-Assessment and Benchmarking

The Nuclear Refurbishment organization develops an annual self-assessment schedule to confirm that the objectives of safety, scope, quality, cost, and schedule are being maintained. The annual self-assessment schedule is approved by the Senior Vice President, Nuclear Refurbishment.

References:

1. OPG letter, Brian Duncan to F. Rinfret, "Darlington NGS 'A' – Organizational Changes – Annual Update Report for 2012", January 24, 2013, CD# NK38-CORR-00531-16188.

3.0 HUMAN PERFORMANCE MANAGEMENT

Darlington NGS, under its current PROL is required to implement and maintain Human Performance, Minimum Shift Complement and Training programs.

OPG's key documents for the Human Performance Management SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Human Performance		
Limits of Hours of Work	N-PROC-HR-0002	R004
Human Performance	N-PROG-AS-0002	R014
Procedural Use and Adherence	N-STD-AS-0002	R013
Communications	N-STD-OP-0002	R002
Self-Check	N-STD-OP-0004	R003
Conservative Decision Making	N-STD-OP-0012	R004
Observation and Coaching	N-STD-OP-0015	R015
Second Party Verification	N-STD-RA-0014	R005
Pre-Job Briefing and Post-Job Debriefing	N-PROC-OP-0005	R012
Continuous Behaviour Observation Program (CBOP) – Participants Materials – Workbook Components	N-CMT-62808-00001	R001
Leadership and Management Training and Qualification Description	N-TQD-601-00001	R016
Minimum Shift Complement		
Station Shift Complement	D-PROC-OP-0009	R012
Duty Crew Minimum Complement Assurance	D-INS-09260-10001	R005
Training, Certification and Examination Program		
Training	N-PROG-TR-0005	R015
Systematic Approach to Training	N-PROC-TR-0008	R018
Written and Oral Initial Certification Examination for Shift Personnel	N-INS-08920-10004	R004
Simulator-Based Initial Certification Examinations for Shift Personnel	N-INS-08920-10002	R006
Requalification Testing of Certified Shift Personnel	N-INS-08920-10001	R004
Responsible Health Physicist	N-MAN-08131-10000-CNSC-031	R001
Shift Manager, Darlington Nuclear	N-MAN-08131-10000-CNSC-006	R000
Control Room Shift Supervisor	N-MAN-08131-10000-CNSC-008	R000
Authorized Nuclear Operators	N-MAN-08131-10000-CNSC-010	R001
Unit 0 Control Room Operator	N-MAN-08131-10000-CNSC-025	R001

3.1 Current Operations

Over the last three years, CNSC staff have consistently assessed the Human Performance SCA as meeting all regulatory requirements and expectations. Given OPG's robust processes that are in place, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

3.1.1 Human Performance Program

The Human Performance Program at Darlington is defined by the program document N-PROG-AS-0002, *Human Performance.* The objective of OPG's Human Performance program is to reduce human performance events and errors by managing defences in pursuit of zero events of consequence.

The Darlington NGS Human Performance Strategic Plan starts with awareness, understanding, and commitment by all levels of the organization. It involves driving line ownership and accountability regarding human performance best practices. The strategic plan involves multi-faceted initiatives from individual to leadership level.

The Human Performance Program integrates site-wide proactive (prevention) and reactive (detection and correction) human performance initiatives.

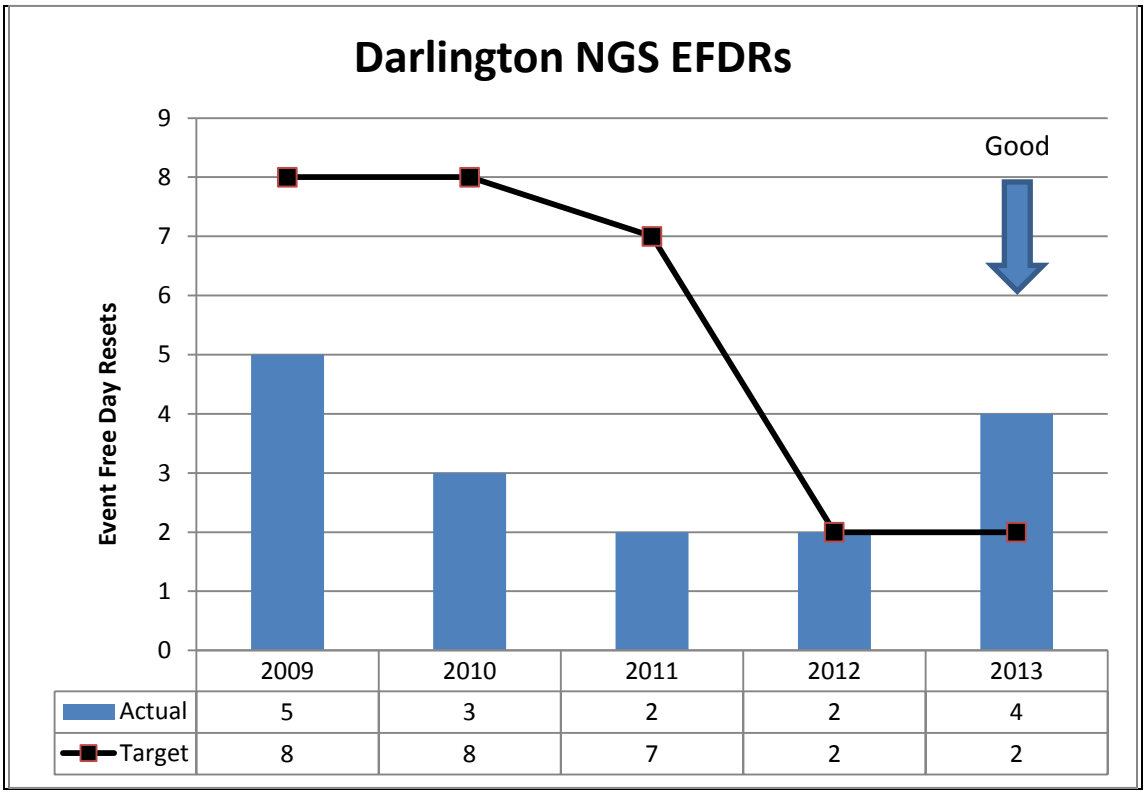
The site strategic plan provides guidance to the leadership team on the requirements for the development and implementation of an integrated site and department human performance strategic plan. Department managers and supervisors develop a human performance plan that sets clear direction and priorities to achieve the common goals.

Performance

Strategic measures provide insight into how well the human performance culture is performing and are used to evaluate the reliability and robustness of the Human Performance Strategic Plan.

Figure 6 shows how performance at Darlington NGS has improved during the last five years to be in-line with industry best performance. In 2012 and 2013 Darlington NGS had set a target of two Event Free Day Resets (EFDR) for 2013, which is consistent with industry best performance of 0.5 EFDR / unit. In 2011 and 2012 Darlington's performance was at two EFDR each year.

Figure 6 – Darlington NGS EFDRs



Currently in 2013, Darlington has experienced four EFDRs. As a result Darlington line organizations are working to increase situational awareness and to improve the use of error prevention tools.

Two major initiatives in the station are:

- Operations has completed a series of Human Performance workshops to assist in understanding the drivers behind the behaviors and
- Maintenance is performing a Dynamic Learning activity with all staff focusing on error prevention tools.

The situational awareness campaign is being communicated to all staff across the fleet emphasizing the importance of knowing your surroundings while executing your work activity and taking a two minute job site drill before any work is performed to familiarize the employees with their work location and potential hazards that may exist. Darlington leadership will continue to set the EFDR targets at the top industry quartile metrics to drive excellence in Human Performance.

3.1.2 Minimum Shift Complement

The Minimum Shift Complement is defined in order to ensure that the minimum number of qualified workers are always present to support the safe operation of Darlington NGS, respond to all credible events and to ensure adequate emergency response capability.

The minimum shift complement for Darlington NGS is detailed in the station procedure, D-PROC-OP-0009, *Station Shift Complement.* This procedure meets the requirements of and is in compliance with the CNSC Guidelines G-278, *Human Factors Verification and Validation Plans* and G-323, *Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement*.

Darlington's duty crew minimum complement assurance program is in place to ensure compliance with the requirements and to maintain historical auditable data.

Days Based Maintenance Initiative

The purpose of implementing a Days Based Maintenance (DBM) organization is to improve Human Performance and efficiencies. Reducing handoffs and turnovers between shift crews not only reduces the likelihood of errors, it also improves productivity, increases ownership and allows for developing equipment expertise. Speciality crews can then focus on specific pieces of equipment.

During the current licensing period, some Maintenance resources are being transitioned from a shift schedule to a predominately days-based structure in a staged approach. Analysis and validation that the fire response capability is not affected by this change has been completed.

In addition, automated gamma monitors for source term and near boundary monitoring have been installed which reduces the need for staff performing manual radiation surveys.

3.1.3 Limits of Hours of Work

OPG has in place hours of work requirements that are documented in N-PROC-HR-0002, *Limits of Hours of Work*. This procedure sets limits for the number of hours within a specified time period that station staff can work. The limits, which are in place to guard against fatigue in the workplace, are very strict in comparison to other industries.

The Darlington management team are ensuring staff are aware of the procedural requirements of N-PROC-HR-0002. This involves discussions with First Line Managers and staff on their shared accountability to understand and achieve the procedural requirements.

An internal assessment was conducted on the hours of work program in 2013 and concluded that limits are being effectively monitored at OPG facilities.

As part of OPG's fitness for duty program, OPG has in place a Continuous Behaviour Observation Program which trains supervisors and managers to monitor workers for signs of fatigue or other factors which could adversely impact worker performance. This has been proven effective as there has been no instance where these factors have been identified as a cause of station events.

3.1.4 Training, Certification and Examination Program

A 10 year estimated projection of certified staff levels is in place which addresses the certified staff needs for Darlington including refurbishment. This projection takes into consideration the current staff levels as well as forecasted resource requirements. The projection also takes into account hire date, earliest retirement date and job family for all certified staff in Operations at Darlington. A rate of 67% for retirement in the year of eligibility is used in the forecast, and is based on experience at OPG. OPG uses this projection to determine the number of candidates to accept into the certification training program.

Training programs related to safe and reliable plant operation, health and safety of the public, and safety of plant personnel are developed, implemented and maintained to improve the necessary knowledge and skills of CNSC certified personnel to perform certain job functions. Through these training programs, station personnel possess the skills and knowledge commensurate with their individual positions within the organization and the responsibilities of those positions.

The training program is based on the Systematic Approach to Training (SAT) as required by CNSC Regulatory Document RD-204, *Certification of Persons Working at Nuclear Power Plants*.

Recent improvements in the training program for certified staff include the development and implementation of revised On-the-Job Training Programs. Considerable work has been completed for the most recent Control Room Shift Supervisor (CRSS) Supplemental program by updating all the mentor guides. Task list review, revision and revalidation for each program are ongoing and tracked, with formal issuance of the revised list on a two year cycle.

A new initial certification program selection and development process, which includes classroom and simulator training and evaluation, has been developed and implemented. This program is designed to improve candidate throughput in the initial training programs.

The continuing training program for certified staff is now at a mature stage. This training includes refresher training, update training as a result of design or engineering changes, infrequently performed test and evolution exercises, just in time training and formal evaluations (knowledge and performance) of certified staff.

Certified staff on average complete greater than 200 hours per year of simulator focused continuing training. Improvements to this program have included significantly increased focus on operator fundamentals and emergency responses, including response to beyond design basis events. In addition, other areas of essential training for certified staff are work protection, confined space, radiation protection, emergency preparedness re-qualification and environmental protection.

All required re-qualification testing programs are being executed as planned. This includes written tests and simulator based Comprehensive Simulator Tests and Diagnostic Simulator Tests for all certified staff. Table 2 shows the high success rate, during the licensing period, for certified staff when performing their re-qualification testing.

Table 2 - Re-qualification Tests Results

Year	Success Rate %	Number of Candidates	Number of Passes
2011	**100%**	**38**	**38**
2012	**96%**	**66**	**63 ***
2013	**100%**	**48**	**48**

* All unsuccessful candidates were successfully remediated

OPG will continue to demonstrate to CNSC staff its capability to self-administer the certified staff training and examinations and to ensure sufficient qualified staff are available to ensure safe and reliable operation of the Darlington station. This will include the requirement that sufficient trained and qualified staff will be available to deliver these training programs throughout the continued operation and refurbishment timeframe. Five-year initial training schedules exist for the Authorized Nuclear Operators (ANOs), U0 Control Room Operators and Shift Manager (SM)/CRSSs and these plans are updated on an annual basis. Continuing training is reviewed continuously to determine what training needs to be modified and adapted to station modifications planned as part of the Nuclear Refurbishment Program.

OPG is currently participating in discussions with CNSC staff on the development of a single certification for the SM and the CRSS positions. This is an important initiative as a single certification would better reflect OPG's current certified training program which is common to both the SM and CRSS positions. In addition, a single certification would allow for better alignment on interpretations for licence compliance on the issue of coverage for these two certified positions.

3.1.5 Personnel Training

OPG's training program, N-PROG-TR-0005, *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 programs, OPG personnel possess the skills and knowledge required to discharge the responsibilities of their positions within the organization.

Performance

The Health of Training reports, developed during the Training Performance Improvement Plan, continue to drive improvements to OPG's major training performance areas. The reports are used to assess against industry accreditation objectives and criteria on a quarterly basis. The reports are prepared by the training organization in co-operation with the applicable line organization and the training for each major job family is evaluated using the following objectives.

(1) Training for performance improvement – training is used as a strategic tool to provide highly skilled and knowledgeable personnel for safe, reliable operations and to support performance improvements.

(2) Management of training processes and resources – Management is committed to and accountable for developing and sustaining training programs that meet station needs.

(3) Initial training and qualification – the initial training program uses a SAT to provide personnel with the necessary knowledge and skills to perform their job assignments independently.

(4) Continuing Training – Continuing training uses SAT to refresh and improve the application of knowledge and job-related skills and to meet management expectations for personnel and plant performance.

(5) Conduct of Training and Trainee Evaluation – Training is conducted using methods and settings that support trainee attainment of job-related knowledge and skills. Achievement of learning is confirmed with reliable and valid evaluation methods.

(6) Training effectiveness evaluation – Evaluation methods are used systematically to assess training effectiveness and modify training to improve personnel and plant performance.

The Health of Training reports successfully maintains a solid SAT foundation for OPG's Nuclear Training Programs upon which it continues to build and improve.

Future Plans

The Health of Training reports are contributing to the continual improvement of the training program and recent improvements at Darlington include the development of a technical certification training program for Operations Training Specialists who will be involved in the development and delivery of the Operations Training Programs, improvements to the Fuel Handling (FH) Training program including the introduction of simulators in the initial and continuing training programs, improvements to the welding skills training courses, and the implementation of enhanced continuing training in radiation protection. Further improvements are also being implemented for the training material in use for the Non-Licensed Operator training programs, and in the development of standardized task evaluations for supplemental workers.

<u>Continuing Training</u>

Operations, Maintenance and Engineering departments have a robust continuing training program, and continuing training plans are revised and reissued on a 5-year cycle. The following are examples of the improvements in the continuing training program.

For Operations, in 2013 the continuing training program included introductions to the Emergency Mitigating Equipment and SAMG equipment and procedures and Rod-Based Guaranteed Shutdown State.

In 2014, the Operator continuing training plans will include new Non-licensed Operators and Supervising Nuclear Operator (SNO) Professional Development sessions and work protection dynamic learning activities as well as the base component that is derived from tasks identified for continuing training. The continuing

training program includes higher learning outcomes with refresher training in Science Fundamentals and Equipment Principles.

For Maintenance personnel, training such as Human Performance Dynamic Learning Activity, welding, and correct component verification have been developed and delivered.

For Engineering personnel, the continuing training program consists of training to address changes, refresh on important topics, and review operating expertise and training to improve performance. Conduct of Engineering Workshops are held regularly and presentations are conducted by the senior engineering leadership team.

3.2 Refurbishment

3.2.1 Human Performance Program

Nuclear Refurbishment staff will be in compliance with N-PROG-AS-0002, "*Human Performance*" (with associated standards and procedures), and N-PROC-HR-0002, "*Limits of Hours of Work*". Contractors will be required to have equivalent human performance programs.

Expectations around behaviours of refurbishment staff and contractors will be confirmed utilizing a combination of defensive and people focused controls, including extensive field supervision, cultural and task specific training (human performance labs and mock-ups), job planning, rehearsal (mock-up), sound work procedures (comprehensive work packages), oversight, and the implementation of a continuous improvement program. Contractors will be required to have human performance programs that are equivalent to those established by OPG.

The Darlington Energy Centre will house a full scale replica of a Darlington reactor, its surrounding systems and structures. The replica will be used to provide training to staff prior to performing work in the field. Specialized tooling required for refurbishment work will also be tested and commissioned on this replica reactor. Staff will have the opportunity to use these tools as part of training before field use to minimize the potential for human performance events during refurbishment.

Elements of established human performance programs and procedures will be taught and emphasized in both the planning and the execution of the work.

Evaluating worker day-to-day fitness for duty will be a documented field supervisory responsibility. Contract staff hours of work will be monitored to ensure adequate rest, while complying with shift length and consecutive shifts worked requirements.

3.2.2 Personnel Training

NK38-PLAN-09701-10007, *Darlington Refurbishment - Project Training Work Plan* details activities and tasks necessary to fulfill training requirements of the entire Refurbishment Program, including the key elements and steps necessary for training various staff at various phases of the Refurbishment Program. It addresses the major areas of contractor on-boarding training, contractor project/job specific training, and OPG personnel training.

The Refurbishment Program training work plan also contains the assumptions, design, curricula and logistics elements along with the methods to evaluate training effectiveness, roles and responsibilities and contingency plans.

A training and qualification description will be established for all staff associated with the Refurbishment Program. This description will describe the training requirements for OPG refurbishment and station personnel, contractor personnel, and owner support services personnel.

There are two major components of the training program as follows: Islanding and Interface Training that will be completed prior to first unit breaker open, and Modifications and Return-to-Service Training, that will be completed prior to first unit breaker close.

Islanding and Interface Training

OPG refurbishment and contractor staff will receive islanding and interface training to ensure that expectations are clearly understood for accessing the refurbishment island and other satellite areas (eg., Unit 4 loading bay, Retube Feeder Replacement Annex, shops, scaffold storage areas). Training will also be provided to station staff, either as an update to the Nuclear General Employee Training or by completing the same islanding and interface training as refurbishment and contractor staff.

Modifications and Return to Service Training

Modifications and Return to Service (RTS) training will be incorporated into the existing training program for plant staff and will be determined on a modification-by-modification basis. Modifications and RTS training will be incremental to existing training programs and a training delivery schedule will be developed that incorporates it into additional continuing training cycles.

Contractor Training

Contractors will be required to train their personnel to be competent to perform the work they are assigned. They will also be accountable to provide Quality Assurance (QA) training to their staff. Evidence of QA training activities will be supplied to OPG.

Training for contractor staff will follow agreed to project specific contracts and contractor training qualifications in accordance with the contractors QA program. OPG will remain accountable for OPG specific qualifications, e.g., radiation protection, work protection, and islanding and interface training.

Contractors will maintain documented evidence of all training provided to their staff including exams, training attendance, assessments, certificates, course correspondence and objectives.

OPG will exercise due diligence regarding training through observation and review of contractor training delivery and materials as part of oversight function accountabilities. OPG Project Managers or delegate will provide oversight of training that the contractor is conducting through routine or strategic observation and audits of materials.

Training Provided by Contractors

For some equipment the contractor/vendor/manufacturer will provide the training materials and deliver training to OPG staff. This is carried out in accordance with existing governance and provides the necessary information to facilitate the revision or development of training material for the operation and maintenance of that equipment. If information changes due to commissioning results, then just-in-time training will be provided prior to system available-for-service.

4.0 OPERATING PERFORMANCE

Darlington NGS, under its current PROL, is required to implement and maintain an Operations program.

OPG's key documents for the Operating Performance SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Operations Program	Revision #
Operations Program		
Operating Policies and Principles	NK38-OPP-03600	R028
Safe Operating Envelope	N-STD-MP-0016	R002
Operational Safety Requirements: Emergency Coolant Injection System	NK38-OSR-08131.02-10001	R001
Operational Safety Requirements: Emergency Water System	NK38-OSR-08131.02-10002	R002
Operational Safety Requirements: Fuel and Reactor Physics	NK38-OSR-08131.02-10003	R001
Operational Safety Requirements: Shutdown Systems	NK38 OSR-08131.02-10004	R001
Operational Safety Requirements: Main Steam Supply System	NK38 OSR-08131.02-10005	R001
Operational Safety Requirements: Containment	NK38 OSR-08131.02-10006	R001
Operational Safety Requirements: Steam Generator Emergency Cooling System	NK38 OSR-08131.02-10007	R003
Operational Safety Requirements: Moderator System	NK38 OSR-08131.02-10008	R001
Operational Safety Requirements: Powerhouse Steam Venting System	NK38 OSR-08131.02-10009	R001
Operational Safety Requirements: Reactor Regulating System	NK38 OSR-08131.02-10010	R001
Operational Safety Requirements: Group 1 Service Water Systems	NK38 OSR-08131.02-10011	R002
Operational Safety Requirements: Emergency Power Supply System	NK38 OSR-08131.02-10012	R001
Operational Safety Requirements: Feedwater System	NK38 OSR-08131.02-10013	R002
Operational Safety Requirements: Shutdown Cooling System	NK38 OSR-08131.02-10014	R002
Operational Safety Requirements: Heat Transport System	NK38 OSR-08131.02-10015	R002
Operational Safety Requirements: Group 1 Electrical Power Systems	NK38 OSR-08131.02-10016	R002
Operational Safety Requirements: Darlington NGS Toxic Gas Monitoring and MCR Breathing Air	NK38 OSR-08131.02-10017	R001
Operational Safety Requirements: Fuel Handling System and Irradiated Fuel Bays	NK38 OSR-08131.02-10018	R001

Document Title	Operations Program	Revision #
Operational Safety Requirements: Powerhouse Steam and Flooding Protective Provisions	NK38 OSR-08131.02-10019	R001
Operational Safety Requirements: Annulus Gas System	NK38 OSR-08131.02-10020	R001
Operational Safety Requirements: Critical Safety Parameter Monitoring Instrumentation	NK38 OSR-08131.02-10021	R002
Operational Safety Requirements: Shield Cooling System	NK38 OSR-08131.02-10022	R001
Nuclear Operations	N-PROG-OP-0001	R004
Chemistry	N-PROG-OP-0004	R006
Conservative Decision Making	N-STD-OP-0012	R004
Operational Decision Making	N-STD-OP-0036	R008
Severe Accident Management	N-STD-MP-0019	R000
Operations Performance Monitoring	N-STD-OP-0011	R008
Operating Experience Process	N-PROC-RA-0035	R017
Processing Station Conditions Records	N-PROC-RA-0022	R031
Corrective Action	N-PROG-RA-0003	R009
Response to Transients	N-STD-OP-0017	R007
Reactor Safety Program	N-PROG-MP-0014	R004
Reactivity Management	N-STD-OP-0009	R008
Control of Fuelling Operations	N-STD-OP-0021	R002
Written Reporting to Regulatory Agencies	N-PROC-RA-0005	R014
Preliminary Event Notification	N-PROC-RA-0020	R017

4.1 Current Operations

Over the last three years, CNSC staff have consistently assessed the Operations SCA as exceeding regulatory requirements and expectations. Given the robust processes in place within OPG, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licensing period.

4.1.1 Safe Operating Envelope

The objective of the Safe Operating Envelope (SOE) program is to specify the information required to ensure plant operation is in conformance with Safety Analysis upon which the plant is licensed to operate. OPG Nuclear Standard N-STD-MP-0016, *Safe Operating Envelope* defines the processes, organizational responsibilities and key program elements to ensure that the SOE is defined and documented in a correct, complete and consistent manner and reflected as required in the station operating documentation.

Performance

Significant work on the SOE program has progressed through 2012 and is on-going in 2013. OPG's governance, N-STD-MP-0016, *Safe Operating Envelope* was revised to be fully consistent with the requirements of CSA Standard N290.15, *Requirements for the safe operating envelope for nuclear power plants.*

The SOE program is fully implemented fleet wide. A process has also been implemented for continuous review of station SOE documentation (Operational Safety Requirements, Compliance Tables, Instrument Uncertainty Calculations etc.). The review will compare existing Document Change Requests and Engineering Changes against a predetermined set of criteria which may trigger an update to an SOE document.

The SOE documents are considered living documents which may require revision when new analysis is completed and system/component modifications are installed in the plant. The Engineering Change Control (ECC) process has controls in place to ensure the need for SOE documentation revisions are flagged and tracked.

There is an on-going self-assessment on the SOE implementation which will conclude by the end of 2013. Also as part of the self-assessment OPG will be benchmarking against industry best practice on SOE.

4.1.2 Operations Program

The Nuclear Operations Program implements a series of standards and procedures to ensure safety of public, environment, plant personnel, and plant equipment. This program establishes safe, uniform, and efficient operating practices and processes within nuclear facilities that provide nuclear professionals the ability to ensure facilities are operated in such a manner that the PROL, Operating Policies and Principles (OP&Ps), and other applicable regulations and standards are followed.

Operations have several initiatives to enhance performance in areas identified during internal and external assessments. The areas targeted are: Management and Leadership, Human Performance/Operator Fundamentals and Work Protection.

Management and Leadership

The objective of Operations Management and Leadership is to establish safe, uniform, and efficient operating practices within Darlington NGS, to ensure safety of the public, the environment, as well as the safety of the plant personnel and plant equipment.

Operations staff are expected to take a leadership role at the station. By setting the highest standards and leading by example Operations staff demonstrate leadership through ownership, and maintain credibility by leading and/or supporting teams to address emergent issues.

Human Performance/Operator Fundamentals

Operator Fundamentals are defined as the essential knowledge, behaviours, and practices that operating crews need to apply to operate the plant safely and effectively.

Continuous improvement is being driven through a plan which has three primary elements:

(1) Developing operational leadership (high standards, accountability, succession planning).
(2) Operator Fundamentals (focused on risk awareness and event free operation).

(3) Operator training (Supervising Nuclear Operator leadership, Work Protection and certified staff throughput).

Work Protection

Work Protection establishes safe conditions for work by creating a Safe Work Area to ensure complete isolation and de-energization of isolated equipment. Operations Managers own the Work Protection Program at the site and provide oversight through the following measures:

- Nuclear Work Protection Review Board - This Board reviews and provides oversight of the work protection performance in OPG Nuclear. This includes monitoring significant trends or events and their associated corrective action plans.
- Fleet strategic initiatives for work protection – these initiatives focus mainly on improving behaviours around human performance and work group fundamentals.
- Local Work Protection Review Boards (LWPRB) – these provide oversight of the work protection performance at the site. The LWPRB reviews and provides oversight and analysis of recent events at all sites, corrective actions of events, Operating Experience (OPEX) and work protection training issues.
- Darlington Journey for Excellence - Work protection safety was highlighted in the 2013 Journey for Excellence. Monthly oversight meetings review the status and performance of work protection improvement initiatives. This forum allows all departments to review and challenge members of the LWPRB on these work protection improvements.

Reactivity Management

Effective reactivity management is critical to the continued safe operation of any reactor. This includes close monitoring of independent indications of reactivity at all times. Proper control and management of reactivity helps to ensure that:

- Fuel integrity is assured.
- Limits that are laid out in the safety report and the operating licenses are complied with.
- Bulk and spatial control is maintained.
- Operational challenges are minimized.
- Deratings are minimized.
- Fuel burnup is maximized.

All plant operations and maintenance activities with potential to impact on core reactivity must be performed in a safe, controlled, conservative manner, following approved procedures. Planned changes in core reactivity are not executed until the expected response is understood and any deviations from this response must immediately be investigated.

Darlington NGS documents, characterizes and trends all reactivity management events and near misses, and takes actions to prevent recurrence. One major improvement initiative is the FH Equipment Reliability (ER) Improvement Project.

A Reactivity Management Oversight Committee meets regularly to review station performance, to confirm appropriate disposition of any reactivity management related

events, to review and monitor selected corrective action plans and to ensure trends are identified and addressed. Current trends have resulted in additional focus on human performance, equipment reliability and shutdown system computers.

Plant Status Control

Plant Status Control (PSC) is the control of Structures, Systems and Components (SSCs) in a nuclear facility. It forms part of Darlington's managed process to operate the plant safely and within the approved design basis. A misposition event is declared when a component is found in a state that is different from the approved state.

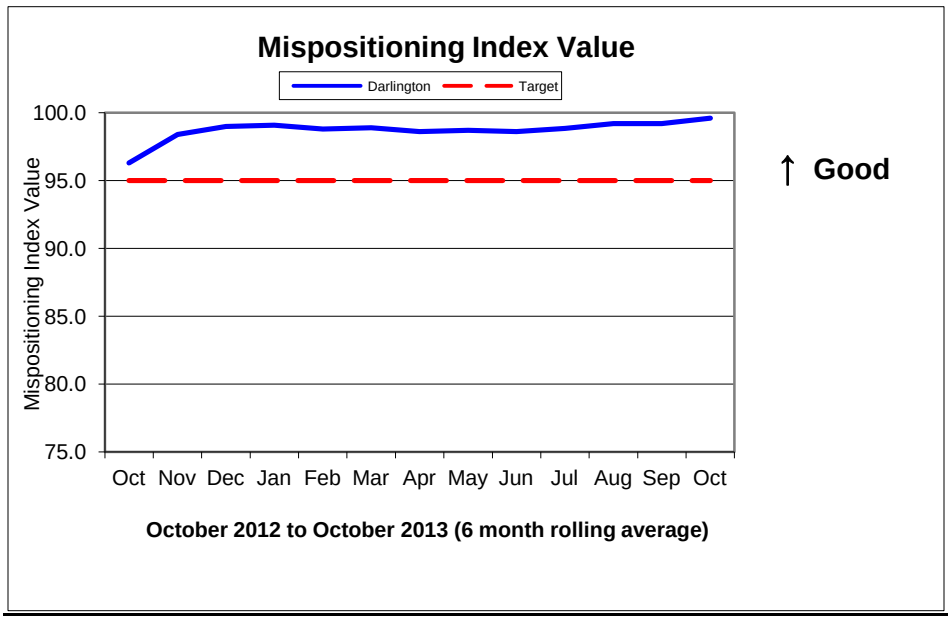
Increased staff awareness, supervisory oversight, training initiatives and human performance awareness are key contributors to a reduction in misposition events.

Over the licensing period, the following initiatives were carried out:

- Darlington developed a process to identify, track and correct all component precursor and actual misposition events.
- Operations Support with the Operations Manager categorizes and reviews all misposition occurrences, identifies trends, and reviews corrective action plans to ensure that adequate corrective actions are taken to prevent recurrences.
- There is an increased focus on misposition events at forums such as the Shift Manager Station Brief daily meetings and Crew Management Review Board meetings.
- Supervisors have been trained on the importance of discussing the critical steps of a job and the consequences of mis-aligning equipment during pre-job briefings.

Figure 7 shows Darlington's excellent performance in the last year, in maintaining a low number of mispositioning events.

Figure 7 – Mispositioning Index Value 2012 to 2013



Part of the Excellence Plan success is to see a reduction in the number of mispositioning events by driving supervisory reinforcement of expectations around procedure use and adherence and placekeeping when manipulating the plant.

Prompt investigations are used as a process for immediate follow-up to misposition events to gain an understanding of the Human Performance errors that contributed to the event and establish compensatory actions to prevent reoccurrence. The Human Performance Lessons Learned process is then used to share the underlying contributors to the event to prevent other occurrences.

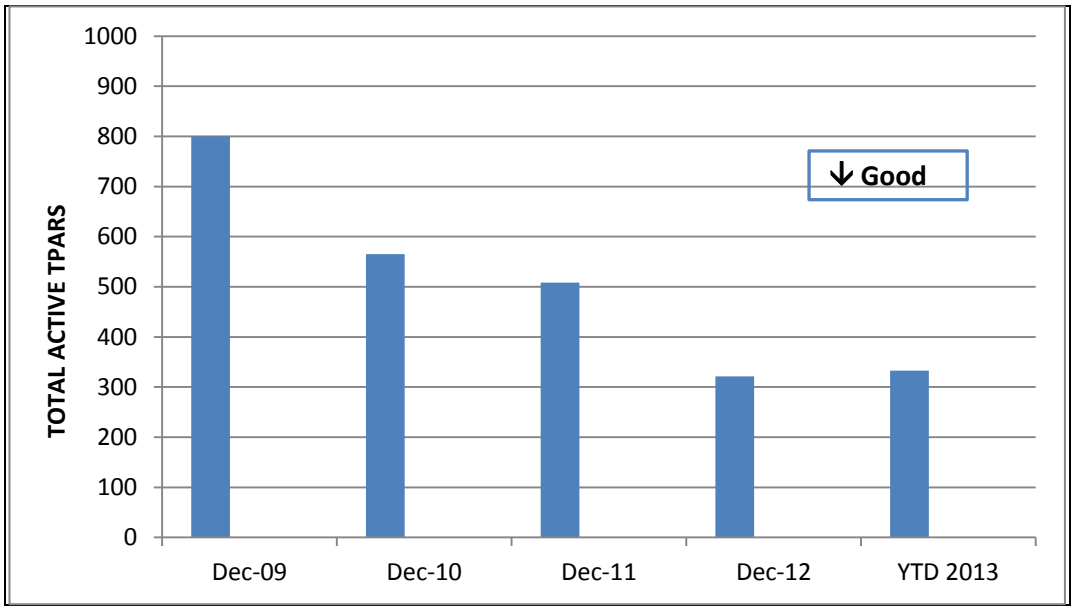
Operations Procedures

The timely issuance of quality operations procedures is essential for maintaining safe and reliable plant operation. High priority has been placed on timely response to the backlog of Operation's Technical Procedural Action Requests (TPARs) which are filed to correct or enhance technical procedures. The backlog is predominantly related to administrative changes and enhancements to further improve the procedure quality. Intent changes require a temporary change in the field (e.g. Operating Memo) until the procedure can be updated.

Performance

In 2012, over 1,000 Operation's TPARs were completed and procedures updated. This high number of TPARs that have been proactively initiated and completed is a reflection of staff engagement and ownership of operations procedures, including the drive for procedure use and adherence improvements. There is a high level of rigour applied during the procedure change control process to comply with the safety and design basis. Significant progress has been made over the past five years to reduce and to maintain a low Operation's TPAR backlog as shown in Figure 8.

Figure 8 – Total Operation's TPARs



4.1.3 Response to Transients

During the current licence period, there have been no serious process system failures.

Unit transients are minimized by ensuring that the required corrective and preventative maintenance is performed, such that the operation of the station is challenged as infrequently as possible by unanticipated failures of equipment.

For all unit transients, a robust multi-disciplinary review is held shortly after the unit condition is stabilized, in order that any lessons to be learned are documented and assessed. The review focuses not just on system/equipment response, but it also provides an opportunity to review the crew response for any improvements for the personnel involved, and the entire Darlington Operations team as a whole.

A Station Condition Record (SCR) is entered for every transient and follow up investigations are conducted to determine the root cause for the failure and implement corrective actions as required to prevent recurrence.

Table 3 shows the number of unplanned transients experienced at Darlington NGS for four operating units during the licensing period.

Table 3 - Number of Unplanned Transients

Year	Unplanned Reactor Trips	Step-backs	Setbacks
2011	1	1	3
2012	1	0	2
2013 (to end Q3)	2	0	0

In 2013 (up to the end of 3rd Quarter) there were two unplanned unit transients where shift operating crews needed to respond to conditions by manually tripping the unit. In both cases, the response of the shift operating crews was correct and timely, evidence of the success of the continuing training program in sustaining high levels of performance in transient situations. At no time was there any risk to station personnel, the public or the environment.

4.1.4 Chemistry Control

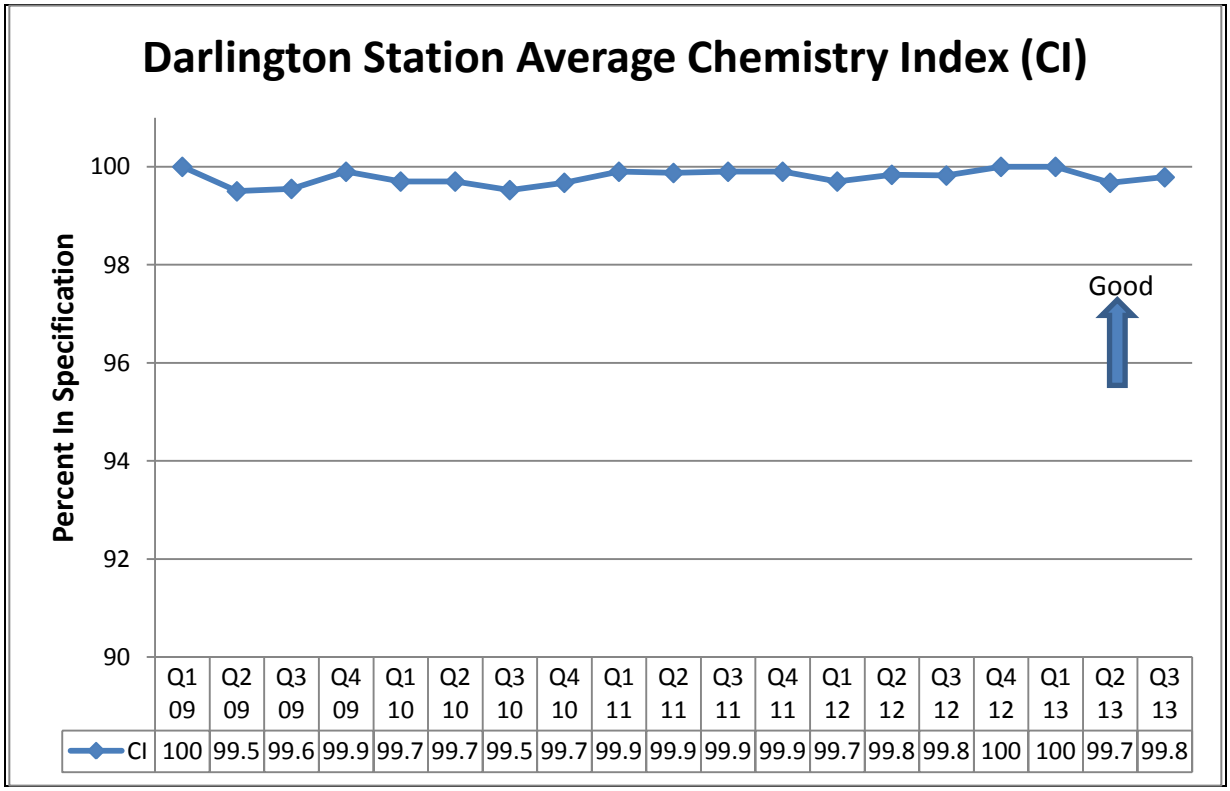
The primary chemistry objective is to meet or exceed the design life of station system equipment by minimizing degradation of system materials while ensuring safe operation. Control of chemistry is also required to meet public, worker and environment safety as well as licensing requirements. Corporate Chemistry Specifications and Rationale have been developed to provide direction in meeting these goals. Station implementation actions are documented in the Chemistry Control Operating Manual and the Chemistry and Environment Management program.

Performance

Several Indicators are used to measure chemistry performance and are tracked to provide feedback on the effectiveness of control actions and areas that require further improvement.

The Chemistry Performance Indicator is based on performance against a set of five industry benchmarks for boiler and feedwater chemistry parameters. OPG's performance at Darlington (1.01) is slightly above industry best performance (1.00). Performance at Darlington NGS has steadily improved since 2011. The improved performance is a result of implementing morpholine addition to improve pH control and cleaning condensers to remove corrosion products as well as flushing sample lines during outages. Also since implementing these actions quarterly, feedwater iron has been below the industry benchmark value.

Figure 9 - CNSC Chemistry Index



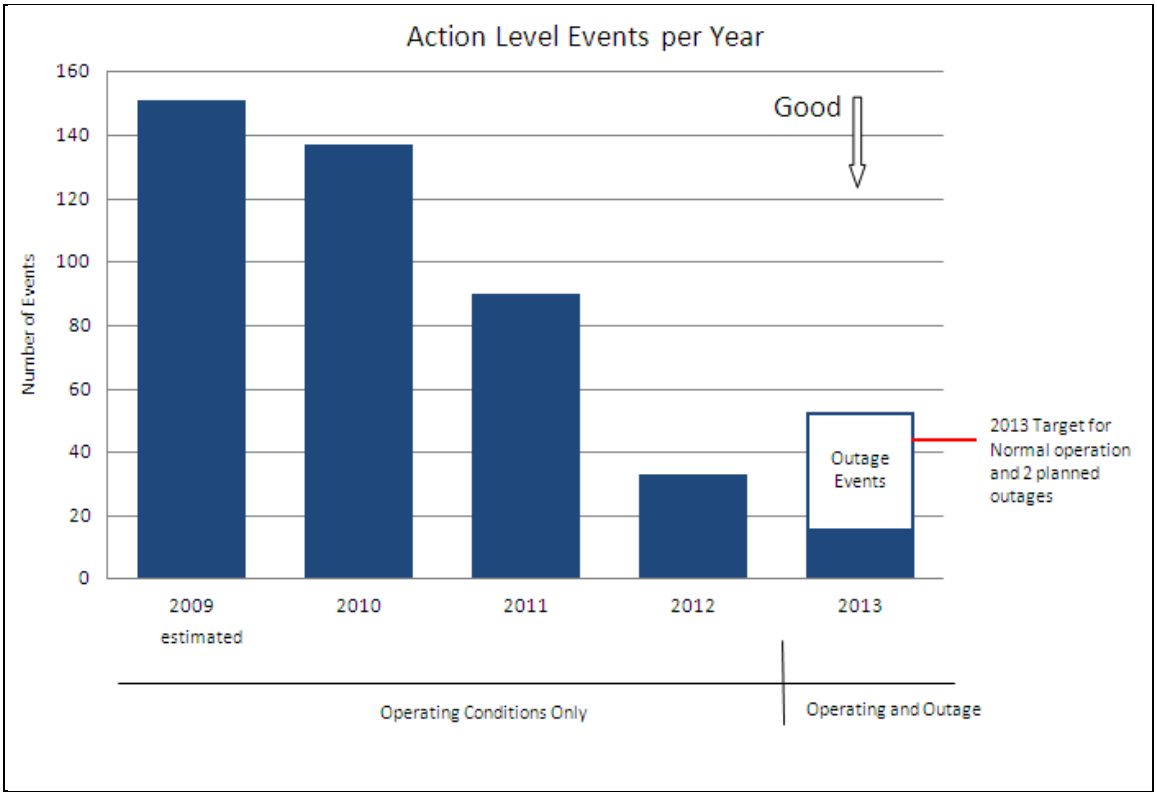
	Q1 09	Q2 09	Q3 09	Q4 09	Q1 10	Q2 10	Q3 10	Q4 10	Q1 11	Q2 11	Q3 11	Q4 11	Q1 12	Q2 12	Q3 12	Q4 12	Q1 13	Q2 13	Q3 13
CI	100	99.5	99.6	99.9	99.7	99.7	99.5	99.7	99.9	99.9	99.9	99.9	99.7	99.8	99.8	100	100	99.7	99.8

The CNSC Chemistry Index (CI) measures time within specification for 15 key primary and secondary parameters. This measure demonstrates the stations ability to prevent action level violations and respond when chemistry is outside specification. As shown in Figure 9, station performance has been excellent, and for 2012 the station average was 99.8% within specification. This excellent performance has continued in 2013.

In Chemistry, Action Level events (where system analyte concentrations are outside corporate limits) are tracked to identify conditions that may cause future out of specification conditions and to minimise their impact. An aggressive target has been set to reduce action level occurrences for 2013 as shown in Figure 10. Prior to 2013

only events from high power operation were included. In 2013 Darlington included action level events from all operating states, including outages. Each year the events are reviewed to determine the effectiveness of previous corrective actions and ensure recurring issues are identified.

Figure 10 – Chemistry Action Level Events



Future Plans

There are plans to replace instrumentation and equipment to further improve reliability and chemistry control.

To help reduce the accumulation of corrosion products in the steam generators, equipment is being installed to allow filtration of condensate during start-up and the use of chemical additives is planned to reduce corrosion product formation.

Focus areas for the next several years will include: reductions in corrosion product transport to the steam generators; reduction in condenser cooling water in-leakage; optimisation of turbine hydraulic fluid chemistry; reduction in primary side dose through chemistry improvements; optimisation of feedwater chemistry control and preparation for chemistry control during extended lay-up.

Chemistry Laboratory

The chemistry laboratory focuses on providing timely accurate results to support station operation. To support accurate analysis laboratory staff participate in blind sample programs run by the CANDU Owners Group (COG) and the Canadian Association for Laboratory Accreditation as well as an internal program.

Chemistry fundamentals were developed to document the behaviours expected of all staff to support the laboratory operation. Specific chemistry continuing training and a rotating weekly focus in pre-job briefings reinforces these expectations. Additional training has been developed to address areas of weakness identified through the curriculum review committee.

The laboratory is continually replacing old instrumentation to maximise availability and accuracy. Recent replacements include: liquid scintillation counters, gamma spectroscopy equipment and bench top ion chromatographs. Replacing instruments before they fail has resulted in avoiding operational challenges due to instrument unavailability.

4.1.5 Fuel Handling

Safe, reliable and predictable performance of the fuelling machines is necessary to maintain core reactivity and support outage activities. Online refuelling operations on a routine basis is required to ensure sufficient reactivity to maintain reactor operation at full power operation, and maintain average zone levels in the target range for optimum control.

Although unavailability of FH equipment can potentially have an economic impact by restricting unit power production, these occurrences do not represent a safety issue as operating in this state remains within the design basis of the plant.

The objectives of the FH program are to:

- ensure fuelling machines are available to maintain average zone levels across the four operating units and to support and execute outage activities,
- provide safe handling and storage of fuel,
- maintain fuel accounting.

Performance

Fuelling machine reliability has declined due to several issues including crud build up in the fuelling machine heads, equipment aging and parts obsolescence issues. A significant effort has been spent to focus on ensuring core reactivity is maintained, while at the same time ensuring sufficient focus is provided on maintaining the fuelling machine equipment and performing the required preventative maintenance to ensure long term equipment reliability.

Future Plans

In addition to an increased focus on planned work completion to maintain reliability of the fuel handing equipment, the following continual improvement initiatives are under way:

- continued operational focus by FH crews and authorized management,
- Improved scheduling of fuelling machine head and other major overhauls,
- reactivity management plan compliance with increased focus from licensed staff,
- PM optimization of work to increase efficiency,
- additional FH Panel Qualified Operators to support the Refurbishment Project.

The expected benefits of this initiative are expected to include:

- reduce unavailability of FH equipment thus increasing reliability and predictability of fuelling and maintenance windows,
- maintain Liquid Zone average zone levels to maintain core reactivity and have no power reductions due to FH equipment,
- increase fuelling capability and improve the reactivity management plan stability,
- minimize the risk to the refurbishment defueling campaign and the continued operation of the remaining three units with two trolleys,
- improve margins for handling functional failures by ensuring critical spares are available and the FH head refurbishment program stays ahead of usage.

Planning for refurbishment has resulted in an increased focus on FH equipment reliability as the reactor defueling window will be on critical path of the Life Extension window. To address this, a FH Equipment Reliability/Refurbishment Readiness Plan has been developed that integrates the priority equipment reliability initiatives and the refurbishment pre-requisites.

4.1.6 Fuel Reliability

Fuel reliability is a direct measure of the effectiveness of the first two of five physical barriers to the release of radioactivity. These five barriers are the ceramic fuel matrix, the fuel sheath, the primary heat transport boundary, containment and the exclusion zone.

Performance

Iodine levels remained well below station shutdown limits during the licensing period. Darlington has experienced thirteen fuel defects since 2010. The trend suggests a change has occurred at the station or at the manufacturing facility. Measures are being taken to mitigate this potential including slight adjustments in fuel manufacturing and close monitoring of bundles, bundle position, and channels that are more susceptible to fuel defects. Steps have been taken at both the manufacturing facilities and at the station to reduce contamination and foreign material during the fabrication and handling of the fuel bundles.

Post-discharge fuel inspections and post-irradiation hot cell examinations, of a sample of fuel discharged in the last five years of operation, indicate that the fuel condition remains within the design basis compliance envelope for wear and deformation.

In-core fuel operating conditions have been well controlled to within the CANDU design basis compliance envelope and licence operating limits. There were no abnormal operating conditions that degraded in-core fuel performance. Enhancements to fuel defect monitoring and location systems are ongoing. Both the gaseous fission product monitoring system and feeder scanner system are active projects to help identify and locate defective fuel for timely removal from the core.

4.1.7 System Availability

In accordance with S-98, *Reliability Requirement for Safety Systems*, Darlington indentified 14 Systems Important to Safety (SIS) for each unit (i.e. 56 systems total) and their associated system unavailability targets.

Availability of SIS systems remained high for all four units during the current licensing period. Safety system testing, along with a strong preventative maintenance program have contributed to low occurrences of events that have resulted in system unavailability.

During the current licensing period, all but one system met their unavailability targets in 2012 and all but three systems met their unavailability targets in 2013. These incidences were reported to CNSC staff per Regulatory Standard S-99. The causes of the unavailability have been identified in each case, and appropriate corrective actions have been taken to prevent reoccurrence.

In 2013, a design modification was completed to install new strainers on service water supply to the shutdown cooling pump motor coolers to allow for online cleaning of zebra mussels. The system was successfully installed and declared available for service on September 20, 2013. Similar strainers were also installed and declared available for service to prevent zebra mussel fouling of the Unit instrument air compressors. These modifications will resolve issues that have been encountered previously at Darlington due to zebra mussel fouling of equipment for which the chlorination system was not effective.

4.1.8 Corrective Action Program and OPEX

N-PROG-RA-0003, *Corrective Action Program* ensures deficiencies, non-conformances or conditions that adversely impact, or may adversely impact operations, personnel, nuclear safety, the environment, equipment and component reliability or production or other business deliverables, are promptly identified and corrected.

In order to develop effective corrective actions to eliminate or reduce the probability of recurrence of incidents in the future, N-STD-RA-0008, *Incident Investigation,* describes the evaluation process and managerial review and approval process to determine the cause of adverse conditions or events.

Trending analysis is conducted and the results of this analysis are documented in Quarterly SCR Trending and Performance Improvement Reports and adverse trends are initiated in the SCR database for evaluation and action implementation.

The Corrective Action Program also provides the processes to ensure in-house and external OPEX is evaluated, distributed to appropriate personnel, and applied to implement actions that improve plant safety and reliability. OPG has consistently contributed OPEX to the industry. Industry Performance metrics have been maintained at the highest level. No challenges are foreseen as these programs remain mature and updated through benchmarking industry best practices.

Performance

Personnel at Darlington NGS have a healthy SCR reporting culture with over 12,600 SCRs being generated in 2012. Employees identified a variety of adverse conditions that were promptly reviewed by their immediate supervisors to assign dispositions based on resolution category and significance. Significant issues that can impact on safety, regulatory compliance or economic performance are resolved with a corrective action plan. The other issues are dispositioned for tracking and trending in order to capture the lower impact issues, given their frequency.

The site managerial team reviews all of the dispositions in order to ensure the appropriate disposition is assigned to each SCR initiated. Approximately 88% of the SCRs generated at Darlington were low level events that were trended. Distribution of SCR population disposition categories: root cause evaluation, apparent cause evaluation and action taken/trend only, is closely aligned based on benchmarking with North American nuclear utilities.

Rigorous causal analysis techniques in alignment with industry best practices are utilized for significant events or recurring incidents to improve plant reliability and human performance at the station.

OPG consistently meets industry OPEX requirements, as assessed by a monthly score card that tracks the number of reports, timeliness of reporting, quality of reports, and average age of preliminary reports. OPG achieves a numerical ranking representative of a top performer in the industry.

4.1.9 Regulatory Reporting

OPG reports operating information to CNSC staff in accordance with PROL LC 4.3 and Regulatory Standard S-99, *Reporting Requirements for Operating Nuclear Plants*, covering both scheduled and unscheduled reports.

For unscheduled events, a Preliminary Event Report (PER) is submitted with reference to a SCR which is raised to document the event. Within 45 days after the issuance of the PER, a Detailed Event Report (DER) is submitted to CNSC staff. For reportable events, the nature of and status of completion of associated corrective actions are documented in the DER. In cases for events where the corrective action process has not been within the 45 days required to submit a DER, CNSC staff are notified (within a DER) that an Additional Report (AR) will be forthcoming.

Reportability of SCRs under S-99 is confirmed following review by a multi-disciplinary management team at Darlington Management Review Meetings (MRM), which are held daily (business days only). From initiation to review at MRM, an SCR generally takes five business days to complete the process. For significant unscheduled

reportable events – such as unit transients or on-site personal injuries (where reportable), the SCR is walked into MRM at the first available opportunity (once reportability and the applicable S-99 clause are confirmed). The PER is then issued that day. In the case of an immediately reportable event, the CNSC duty officer in Ottawa is contacted by telephone. Scheduled event reporting is done on a quarterly basis for both station operations and performance indicators as mandated in the S-99 standard.

Performance

From 2011 through Quarter 3 of 2013, Darlington has reported an average of 60 events annually related to the unscheduled reporting requirements of S-99. The breakdown is as follows: 60 events in 2011, 43 events in 2012 and 74 events in 2013 (through 3rd quarter).

The increase in unscheduled reportable events in 2013 appears to be due to three factors:

(1) human performance events related to fire code violations involving fire doors;
(2) relief valves lifting above set pressures; and
(3) events related to airlock breach of containment alarms. As this reportable event generally only occurs during scheduled reactor unit maintenance outages, this factor has been exacerbated by the occurrence of two scheduled unit shutdowns (Unit 4 and Unit 2) in 2013.

Corrective actions have been instituted to reduce the number of reportable events in these three areas. With respect to fire doors, staff have been coached on proper usage, signage has been installed and enhanced access control has been put in place. For relief valves, increased test frequencies have been implemented. To reduce the number of breach of containment alarms caused by improper usage of airlock doors (that occur during scheduled unit maintenance outages), OPG has implemented mitigating strategies including the posting of a sentry to control access in and out of the vault, as well as improved communication and training via the usage of signage and demonstration videos on entry protocols. Using the corrective action process, OPG will assess the effectiveness of these initiatives.

The number of quarterly reportable events has significantly decreased since 2011 due to a large reduction in events related to unapproved modifications. Darlington also maintains a very low backlog of ARs required for submission due to the effectiveness and timeliness of the corrective action program in assessing SCR's.

Each quarter, OPG publishes on its public website a list of non-security related events that have been reported to CNSC staff under S-99's unscheduled reporting requirement.

Since 2011, Darlington has submitted all Quarterly S-99 Operations and Performance Indicator reports within the period allocated, and has had one late PER (following a review of a previously interpreted non-reportable event).

Transition Plan for REGDOC-3.1.1 *Reporting Requirements for Operating Nuclear Power Plants*

Transitioning from S-99 to REGDOC-3.1.1 will involve some changes to scheduled and unscheduled event reporting. Darlington will establish and provide CNSC staff with a transition plan for REGDOC-3.1.1 compliance once this regulatory document has been issued by the CNSC.

4.2 Refurbishment

4.2.1 Operations Program

OPG will ensure that the refurbishment unit configurations and activities do not violate the SOE of the operating units.

Plant Status Control (PSC)

During refurbishment PSC will be managed to ensure:

(1) Status of SSC are known and controlled within bounds of analyzed conditions for safe operation and all phases of refurbishment.

(2) Changes to status of plant SSC are approved, documented, performed and verified by qualified personnel (unless the SSC is isolated by work permit).

(3) Changes in plant status that affect plant operation, during or following refurbishment, are incorporated into procedures, flowsheets, and other operating documentation.

PSC for the refurbishment unit will use a separate server for its electronic Equipment Status Monitoring Program. This will have a separate log-in to ensure the other units are not affected. All changes to plant status will be captured in Equipment Status Monitoring.

Nuclear Refurbishment and Darlington NGS staff will establish a plan to transfer responsibility for the PSC of a refurbishment unit. This will be documented in the Operations transfer plan. The exact status of the unit PSC will be captured prior to a unit entering refurbishment. Continuous PSC oversight will be performed by the Nuclear Refurbishment Operations and Maintenance PSC group.

To support the islanding of the refurbishment unit there will be boundary points and physical barriers in place to capture the partition between the operating station systems and the refurbishment systems. There will also be physical barriers to limit access to the refurbishment unit to appropriate personnel.

When an SSC is returned to service after maintenance or modification, a rigorous process will be used, with alignment checks and an approval process prior to declaring it available for service.

4.2.2 Safe Operating Envelope

The primary change to the SOE arising during the Refurbishment Program will involve revisions to the OP&Ps as contained in NK38-OPP-03600, *Operating Policies and Principles*.

The refurbishment outage will take place in several distinct stages. Each stage will require changes to the OP&Ps reflecting the unit and station configuration. For example, changes will be needed to reflect, i) a defueled core, and ii) isolated containment.

OPG is currently undertaking a detailed assessment of the required changes to the OP&Ps. In all cases, the changes to the OP&Ps will be supported by the appropriate safety assessment and analysis, documented, and subject to CNSC notification or approval as required in accordance with the Darlington LCH.

Operational Safety Requirements

For any temporary changes being implemented specifically to facilitate the refurbishment outage, it is anticipated that the changes to the OP&Ps described above will be sufficient and no changes to the Operating Safety Requirement (OSR) documentation will be required in the majority of cases. This assumption will be verified during the outage planning process as assessments and analyses progress. At this time, it has been identified that the Negative Pressure Containment OSR may require updating to account for a reduced containment volume and changes to parameter set points. Again, this will be verified through the proper assessment and analysis and CNSC staff will be notified or CNSC approval requested in accordance with established requirements.

With respect to permanent modifications, all modifications to the plant are controlled by the engineering change control process. This process includes a screening step to evaluate the impact of the modification on SOE margins.

Many of the permanent modifications planned for the refurbishment to date are explicitly designed to improve the safety of the plant and will have a positive impact on SOE margins. Such improvements to existing systems will not require an update to the OSR documentation (safety limits will be the same, margins to the limit will increase). However, the addition of new equipment which will be credited in Safety Analysis will need to be added to the OSR documentation in order to properly capture the safety limits and surveillance requirements of this new equipment. For example, modifications to enhance the reliability of the outage heat sink may require OSR updates. CNSC staff will be notified of any such impacts to OSR documentation as per the established requirements.

4.2.3 Chemistry Control

The particular chemistry specifications for systems that will be placed in a layup state are documented in a specification/rationale document and in a refurbishment chemistry control operating manual. There is also a chemistry requirements guide document that clarifies expectations and applicable OPG governance for contractors regarding the importance of maintaining proper chemistry during layup, controlling

chemicals and chemical products (e.g., adhesives, greases), and colour coding to prevent the introduction of chemicals that could potentially impact the integrity of system components.

OPG will perform oversight regarding chemical storage, labelling and usage by contractors, and approval of any new chemicals being brought on site.

4.2.4 Corrective Action Program

All contractors working during Refurbishment will have to demonstrate to OPG that either they have their own corrective action programs in place that satisfy the requirements of CSA N286 or commit to using OPG Nuclear's SCR process.

The general approach that OPG has adopted is described below.

For work performed by contractors under their own Management Systems, the contractors will utilize their own corrective action program(s) and associated databases. OPG will have access to contractors corrective action database information. Contractor non-conformances and in-process adverse conditions related to safety, quality, cost, and schedule will be managed through respective contractors' non-conformance and/or corrective action programs.

Nuclear Refurbishment Project teams, through their Project Oversight plans will provide both routine and strategic oversight of the contractor's corrective action programs. Examples of areas to be assessed include, but will not be limited to, the following:

- a documented process exists and is implemented for a) identifying, reporting, evaluating, and analyzing adverse conditions, and b) designing, prioritizing, and implementing timely corrective actions to prevent reoccurrence,
- staff understand the corrective action program and are adequately trained to execute their intended roles within the program, and
- results are communicated across the contractor's organization, as applicable.

To ensure proper oversight and follow-up of contractor's adverse conditions that may impact the station and/or adverse trends in contractor's corrective action programs observed through OPG's oversight activities, the following contractor adverse conditions will require use of OPG's SCR database in addition to use of contractor's own corrective action programs:

- an adverse trend or reoccurrence observed by OPG through oversight activities – the threshold of reporting will depend on the consequence(s) of the reoccurrence(s) on all business drivers (e.g. quality, safety, cost, schedule, environment, regulatory commitments),
- an adverse condition that may apply to other equipment or activities beyond the specific occurrence, where it may have a greater impact,
- an adverse condition that directly impacts the ability to safely operate and/or maintain the equipment or the plant, and/or
- an adverse condition that represents an actual or potential operability concern or that represents a condition reportable under the PROL.

These directions and expectations will be reviewed annually by OPG and revised, as required.

4.2.5 OPEX

The Nuclear Refurbishment Program benefits from the nuclear process outlined in N-PROC-RA-0035, *Operating Experience Process*.

Within this process, Nuclear Refurbishment identifies other sources of OPEX specific to Refurbishment Projects, including lessons learned reports, benchmarking visits to other stations, large projects around the world, and internal lessons learned from Nuclear Refurbishment project managers.

5.0 SAFETY ANALYSIS

Darlington NGS, under its current PROL, is required to have in place safety analysis that demonstrates the station satisfies public safety requirements.

OPG's key documents for the Safety Analysis SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Darlington NGS Safety Report: Part 1 and 2	NK38-SR-03500-10001	R003
DN 1-4 Safety Report: Part 3 – Accident Analysis	NK38-SR-03500-10002	R004
Darlington Analysis of Record	NK38-REP-00531.7-10001	R029
Safety Analysis Program		
Severe Accident Management	N-STD-MP-0019	R000
OPG Probabilistic Risk Assessment (PRA) Guide-Level 1 (At Power)	N-GUID-03611-10001 Volume 1	R003
OPG Outage Probabilistic Risk Assessment (PRA) Guide-Level 1	N-GUID-03611-10001 Volume 4	R001
OPG Probabilistic Risk Assessment (PRA) Guide-Volume 2 – Level 2 (At Power)	N-GUID-03611-10001 Volume 2	R002
OPG Probabilistic Risk Assessment (PRA) Guide – Internal Hazards Screening	N-GUID-03611-10001 Volume 9	R000
OPG Probabilistic Risk Assessment (PRA) Guide – Seismic	N-GUID-03611-10001 Volume 7	R001
OPG Probabilistic Risk Assessment (PRA) Guide – Internal Flood	N-GUID-03611-10001 Volume 6	R001
OPG Probabilistic Risk Assessment (PRA) Guide – Fire	N-GUID-03611-10001 Volume 5	R001
OPG Probabilistic Risk Assessment (PRA) Guide-External Hazards Screening	N-GUID-03611-10001 Volume 8	R002
OPG Probabilistic Risk Assessment Guide – High Wind Hazard	N-GUID-03611-10001 Volume 10	R000
Submission of OPG Probabilistic Risk Assessment (PRA) Computer Codes	N-CORR-00531-04548, 04761, 04961	N/A
Submission of OPG Accident Sequence Quantification (ASQ) Tool	N-CORR-00531-04858	N/A
Submission of OPG Sensitivity and Uncertainty MAAP4-CANDU Post-Processing and Input Generation and Analysis Scripts	N-CORR-00531-05159	N/A
Submission of MAAP4-CANDU Version 4.07C for CNSC Acceptance in Accordance with S294	N-CORR-00531-05596 V 4.07.D - 06093	N/A
Darlington NGS `A' – Methodology for a Reduced Scope Level 2 Outage Probabilistic Risk Assessment for Internal Events	N-CORR-00531-05495	N/A
External Hazards Screening Methodology – Outage Unit	N-CORR-00531-05491	N/A
Outage Probabilistic Risk Assessments (PRA) for Internal Fires, Seismic Events and Internal Floods	N-CORR-00531-05484	N/A

Document Title	Document Number	Revision #
Acceptance of Software Packages Used in OPG's Probabilistic Risk Assessments	N-CORR-00531-05492	N/A
Darlington NGS 'A' – Methodology for a Reduced Scope Level 2 Probabilistic risk Assessment (PRA) for Seismic Events	N-CORR-00531-05556	N/A
Internal Hazards Screening for an Outage Unit: Methodology and Application for Darlington NGS	N-CORR-00531-05505	N/A
Computer Codes and Software		
Software	N-PROG-MP-0006	R008

5.1 Current Operations

Over the last three years, CNSC staff have consistently assessed the Safety Analysis SCA as meeting all regulatory requirements and expectations. Given OPG's robust processes that are in place, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

5.1.1 Safety Analysis

The *Reactor Safety Program*, N-PROG-MP-0014 (document listed under SCA 4.0 in LCH) establishes the requirements and processes for the management of issues relating to the following key components:

- Safety Analysis Basis
- Safe Operating Envelope (see Section 4.1.1)
- Severe Accident Management (See Section 18.0)

The program and implementing procedures and standards govern management of issues related to Nuclear Safety Analysis and their impact on safe operation.

The *Risk and Reliability Program*, N-PROG-RA-0016 establishes a framework for the development and use of probabilistic risk assessment as a means to manage radiological risks and to contribute to safe operation of nuclear reactors.

RD-310 *Safety Analysis for Nuclear Power Plants* Implementation

As documented in the Darlington LCH, the Darlington Safety Report analyses will be updated in a staged manner between 2014 and 2021. RD-310 gap assessments and implementation plan have been developed with the objective of identifying the most practical sequence of upgrades for the Safety Report appendices through the development of a schedule of the key prerequisites and major activities. CNSC staff have reviewed the gap assessments and implementation plan and concluded that the planned sequence of upgrades is acceptable. Activities to evaluate the status of necessary prerequisites and plan the next stages of work are currently in progress and will support downstream analysis activities which are scheduled to begin in 2014.

Pilot analyses for "Loss of Reactivity Control" and "Loss of Moderator Heat Sink" have been completed and submitted to CNSC staff. OPG will continue to work with CNSC staff to address comments and eventually use these analyses to update the Safety

Report appendices. OPG continues to participate with Industry, in a COG Safety Analysis Improvement Task Team, to develop tools for performing these analyses. The most recent update communicating the progress on the safety analysis improvement project and the implementation activities for RD310 was provided to CNSC staff in October 2013 (Reference 1). Progress updates will be provided regularly until completion of implementation.

S-294 *Probabilistic Safety Assessment for Nuclear Power Plants* Compliance

The Level 2 Probabilistic Risk Assessment was performed in accordance with CNSC Standard S-294, *Probabilistic Safety Assessment (PSA) for Nuclear Power Plants* consisting of Level 1 and Level 2 at power internal events models, Level 1 outage internal events, at power fire, flood, seismic, and an external hazards assessment. Methodologies were submitted and accepted by CNSC staff and all model reports were submitted to CNSC staff by the end of 2011, in order to meet the requirements of Darlington's PROL. Over the next licensing period, OPG will continue to comply with S-294. This will require periodic updates to account for modifications completed before and during refurbishment.

The DARA model is utilized to quantify probabilistic risk for normal operation, as well as for outage configurations. It is used on a regular basis to risk inform maintenance schedules and proposed outage logic.

As a follow up from the 2012 Pickering licence renewal, OPG is participating in an industry working group on the development of the methodology for a site-wide PSA.

A site-wide PSA is not a requirement of S-294 nor is there an internationally recognized consensus methodology available for completing this assessment. Once a consensus methodology has been developed, OPG will apply it to assess the site-wide risk of the Darlington NGS.

5.1.2 Design and Analysis Computer Codes and Software

The objective of the Scientific, Engineering and Safety Analysis (SESA) Software program is to manage the quality of that the analytical tools used to support the design or maintenance of safety related systems with particular emphasis on requirements of CSA N286.7 *Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear Power Plants*.

Performance

All software in OPG is now classified through N-PROG-MP-0006, *Software*. SESA Software governance is extended to apply to all analytical software used within OPGN whose failure or misuse can lead to a safety (conventional, radiological or environmental), licensing or reliability impact on the facility.

N-PROG-MP-0009, *Design Management Program* requires that calculations are documented which in turn ensures that only qualified software is used in analysis. The N-PROG-MP-0014, *Reactor Safety Program* similarly ensures that only qualified software is used in safety analysis work.

Future Plans

Annual self assessments on the management and use of SESA software as well as active participation in related CSA Standards committee work will continue to ensure the SESA software program is effective in its implementation.

5.2 Refurbishment

5.2.1 Safety Analysis

Nuclear Refurbishment will carry out the reactor safety assessments and analysis in accordance with N-PROG-MP-0014, *Reactor Safety Program* and N-PROG-RA-0016, *Risk and Reliability Program* and their implementing procedures.

The scope and extent of the refurbishment outage represents a significant change to the configuration of the plant including defueling, containment isolation, and islanding of common systems. Each plant configuration will be assessed to ensure the continuing safety of operating units and the refurbishment unit during all outage states. Insights from the assessments above will be incorporated, as required, into the Operating Policies and Procedures.

All modifications to the plant are carried out in accordance with the OPG engineering change control process which includes several steps requiring assessment against reactor safety criteria, including explicit consideration of impact on safety analysis. Modifications which may impact or which will be credited in the safety analysis will then be handled in accordance with normal processes.

Modifications during refurbishment are expected to further enhance safety performance of the station. As such, the current safety analysis (and the updates being performed under transition to RD-310, *Safety Analysis for Nuclear Power Plants*) is expected to remain bounding.

Should this analysis, or other analysis performed in support of the refurbishment project require an update of Part 3 of the Safety Report or the Analysis of Record, then the update will proceed in accordance with established OPG processes and procedures.

New or modified systems or components which have been incorporated into the Safety Analysis will also result in updates of the Operational Safety Requirements documentation and, possibly, the operating policies and procedures.

Once all of the refurbished units are back on-line, the DARA will be updated to reflect the plant changes in all units.

The EA for Refurbishment and the ISR used the DARA to examine the SIOs associated with low probability, beyond design basis, accidents. Four SIOs were identified for implementation, and the status of the SIO implementation will be confirmed prior to the restart of each refurbished unit. After all units have been refurbished, the Darlington NGS PRA will be updated to reflect the detailed design and as-installed configuration. The EA Follow-up Program includes preparation of a report to compare the updated probabilistic risk assessment results from installed SIO equipment with the EA predicted

improvements, to confirm the actual reduction in accident probabilities and the corresponding increase in safety.

5.2.2 Hazard Analysis

The OPG ECC process includes several steps requiring assessment against reactor safety criteria, including consideration of impact on hazard analysis.

Modifications must be shown to either not impact the current assumptions contained in the Safety Report or the DARA or to incorporate mitigating measures, as appropriate within the SOE and in accordance with the Darlington LCH.

Hazards arising from space allocation and transient materials concerns including combustible material, tornado generated missiles, and impacts on the seismic route are addressed and controlled via application of established OPG programs and procedures. In addition to the consideration of hazards via the engineering change control process, Nuclear Safety assessments of temporary work areas and refurbishment specific lay-down areas will be performed. These assessments will aid in identifying if current governance is sufficient to control these types of hazards or if refurbishment-specific governance is required.

5.2.3 Design and Analysis Computer Codes and Software

In preparation for modifications to be installed during refurbishment, either performed in-house or as contracts to be issued to EPC contractors, Modification Definition Packages are prepared under OPG's QA program. These packages follow N-PROG-MP-0001, *Engineering Change Control*. Software is a mandatory item considered in the design scoping that links in the appropriate elements of the OPG software program, N-PROG-MP-0006, *Software*. This scoping determines the type, criticality and qualification requirements of the software and the appropriate cyber security considerations. The criticality assessment determines the quality program for the software which provides for appropriate confidence against coding errors. The OPG manual on how to conduct cyber security for real time process computing systems will be used to design against the introduction of viruses into these systems. For EPC contractors, agreements are in place to ensure the ECC and specified programs are followed.

References:

1. OPG letter, W.M. Elliott to M. Santini and F. Rinfret, "Progress Report on OPG Safety Analysis Improvement and RD-310 Implementation Activities – Action Item 2010OPG-05", October 7, 2013, CD# N-CORR-00531-06254.

6.0 PHYSICAL DESIGN

Darlington NGS, under its current PROL, is required to have in place a design program that ensures the ability of systems, structures and components to meet and maintain their design basis function.

OPG's key documents for the Physical Design SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Design Program		
Conduct of Engineering	N-PROG-MP-0007	R012
Engineering Change Control	N-PROG-MP-0001	R012
Configuration Management	N-PROG-MP-0005	R005
Design Management	N-PROG-MP-0009	R010
Fuel	N-PROG-MA-0016	R008
Software	N-PROG-MP-0006	R008
Pressure Boundary Program		
Pressure Boundary Program	N-PROG-MP-0004	R014
System and Item Classification	N-PROC-MP-0040	R008
Design Registration	N-PROC-MP-0082	R010
Pressure Boundary Program Manual	N-MAN-01913.11-10000	R014
Authorized Inspection Agency Service Agreement	N/A	N/A
Environmental Qualification Program		
Environmental Qualification	N-PROG-RA-0006	R007

6.1 Current Operations

Over the last three years, CNSC staff have consistently assessed the Physical Design SCA as meeting all regulatory requirements and expectations. Given OPG's robust processes that are in place, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

6.1.1 Design Management and Conduct of Engineering Programs

The Conduct of Engineering Program implements a series of programs, standards and procedures for performing engineering activities, including design activities, in a consistent manner across OPG Nuclear. The program establishes the following practices for engineering:

- Ensures each plant configuration is maintained in accordance with the design and licensing basis and operated within its SOE.
- Ensures essential plant equipment performs safely and reliably.
- Complies with relevant legal, statutory and regulatory requirements.
- Encourages continuous improvement in the conduct of engineering targeted at achieving safe, reliable and competitive operation of OPG Nuclear power generating stations.

Within the Conduct of Engineering Program, a series of design specific program elements control design related activities at OPG, and are described below.

The Design Management Program provides the framework for establishment of assurance that changes to facility design are controlled in a manner consistent with the plant design and licensing basis. This program provides assurance that the design basis, design outputs and design process documentation are prepared, reviewed or verified as applicable, approved and implemented in accordance with approved procedures and applicable regulatory requirements, standards and industry practices.

The ECC Program ensures all modifications to OPG Nuclear facility SSC's, including software and station engineered tooling, are planned, designed, installed, commissioned, decommissioned, placed into service, or removed from service within the SOE, design basis, and plant licensing conditions.

The Configuration Management program ensures OPG Nuclear facilities are operated, maintained and modified in accordance with their design and licensing basis. The program objectives assure the physical plant matches the configuration documentation, and that configuration information is accurate, consistent and readily available.

The primary objective of the Fuel program is to establish a formal and systematic process to ensure fuel performs safely and reliably over the life of the station and maintaining the fuel design and licensing basis. The Fuel program also integrates and reviews fuel channel data which may impact safety analysis in the safety report.

Performance

The health of the Design and ECC program is monitored using the ECC site index. The index incorporates metrics associated with modifications implemented in the field, the quality of Design ECC packages, ECC process compliance and the timely updating of records and closeout of modifications. Darlington performance in the ECC site index remained strong and steady through 2012 and 2013 although several fluctuations in the index have been observed over the noted period. These fluctuations are due to unapproved modifications and timeliness of EC close out activities.

Since the 2011 initiative to increase Darlington operations and maintenance staff awareness of the ECC process, the number of identified unapproved modifications has decreased significantly. Those identified are assessed and removed or documented as per ECC. None have been determined to pose a risk to the plant or staff. OPG has recently assigned dedicated resources to closeout activities and will track the closeout backlog reduction going forward.

OPG maintains a strong design program by means of ongoing ECC internal self assessments and internal OPG ECC audits. These assessments and audits, several of which were performed in 2012 and 2013, have consistently found an improving trend in overall design quality and generally good overall compliance with ECC requirements. Any deficiencies noted in the assessments and audits are documented and addressed through the Corrective Action Program to correct and prevent recurrence.

In 2012/2013, the Design Review Board (DRB) concept was introduced across OPG Nuclear. The DRB operates within the OPG design departments and meet regularly to review and critique selected design deliverables such as, Modification Outlines, Non-Identical Component Replacements, Modification Design Requirements and to provide constructive feedback to the package preparer, verifier and approver.

The first OPG design summit was held in 2011 for design staff across OPG. The purpose of the design summit is to provide a working level forum for exchanging design related work experiences and ideas and to recommend possible areas for enhancement or improvement to the ECC process.

The design qualification requirements were streamlined in 2013 resulting in a simpler, clearer system which promotes a better understanding of design qualification requirements.

The ECC program documents, which undergo cyclic review and revision, have recently been revised to allow for EPC activities by selected contractors within the ECC process as well as such enhancements as consideration of beyond design basis events (for example, those improvements driven by the post-Fukushima industry and OPG responses). In addition, the ECC program revisions included many suggestions for improvement from users.

Future Plans

OPG will continue to work to improve the ECC process and overall design quality through the initiatives, self assessments, internal audits and cyclic reviews described above.

OPG will continue to seek input and take action on suggestions for improvements from users, especially regarding clarifications and efficiency. OPG is planning to make greater use of the EPC process to drive modifications that will improve the plant. To ensure the EPC process is successful, OPG is continually working to better define the requirements of and level of oversight required for contracted work. This will ensure that expectations for quality are met.

Equipment obsolescence will continue to be a challenge where original equipment manufacturers and original equipment are no longer available in the market place. This will require sourcing replacement equipment from alternate suppliers and following a strict program of vendor qualification, equipment specification and equipment qualification and testing. OPG Supply Chain works with vendors and closely monitors vendor quality to ensure that the equipment procured meets design and quality requirements and that Darlington's expectation for quality are understood and met by suppliers.

Transition Plan for CSA Standard N289.1-08 *General Requirements for Seismic Design and Qualification of CANDU Nuclear Power Plants* and CSA Standard N291-08 *Requirements for Safety Related Structures for CANDU Nuclear Power Plants (update No.1 2011)*

OPG will comply with CSA Standard N289.1-08 and N291-08, as agreed in Reference 1. A transition plan is not required.

Transition Plan for CSA Standard N290.0-*11 General Requirements for Safety Systems of Nuclear Power Plants*

OPG is currently reviewing and will provide a transition plan by May 2014.

6.1.2 Pressure Boundary Program

The objective of the Pressure Boundary (PB) program is to manage the processes that control the quality of PB activities at OPG Nuclear. The program establishes the infrastructure and defines the activities necessary to maintain a sustainable managed process that allows OPG to perform activities associated with repairs, replacements, modifications and alterations to pressure retaining items, components, and systems including installation of new systems. The OPG PB Program ensures PB activities at Darlington NGS are in accordance with the Code and Standards required by the Darlington PROL. The PB program is a mature program that is compliant with the mandated codes and standards.

Performance

OPG is working on improvements to communications with the Authorized Inspection Agency (AIA), and the AIA inspectors. Regular quarterly meetings have been conducted with the AIA inspectors, and issues raised by the AIA or OPG are openly discussed and resolved in this forum.

During the licensing period, all legacy PB systems were incorporated in PB Program governance for modifications, repair and replacements in agreement with CNSC staff.

In addition, work has been completed to streamline procedures for classification, registration and reconciliation. Examples, instructions and explanations on how to complete the related forms have been removed from the procedures for classification, registration, and reconciliation; and the removed information has been incorporated in a separate guideline.

Future Plans

The Certificate of Authorizations (C of A's) for PB activities at OPG stations must be renewed every three years. This renewal is based on a satisfactory audit by the AIA. This audit is planned for the beginning of 2014. OPG has initiated a project to facilitate the preparation, readiness assessment, and the audit for the renewal of C of A's.

The current contract with the AIA expires at the end of 2014. The preparations for the new contract, which requires acceptance of CNSC staff, will start at the beginning of 2014.

To meet requirements for Code Effective Date (CED), OPG has implemented reconciliation processes that require long lead times to complete. There is an improvement plan to simplify the CED reconciliation processes in 2014 and 2015.

Transition Plan for CSA Standard N285.0-12 *General Requirements for Pressure – Retaining Systems and Components in CANDU Nuclear Power Plants*

Based on the agreement reached regarding engineering design-related code and standards effective dates for the Darlington Refurbishment Project (Reference 1), OPG has to comply with CSA N285.0-08 and Update No. 2 (includes Update No.1 and Annex M). OPG has implemented CSA N285.0-08 and Update No. 2 (includes Update No.1 and Annex M) as agreed, and the transition plans are already in the current LCH.

Recognizing a significant improvement in documenting regulatory requirements for PB in Update No. 1 of CSA N285.0-12, OPG will adopt Annex N of CSA N285.0-12 and Update No. 1. OPG will develop a PB Program document based on Annex N of CSA N285.0-12 and Update No. 1.

6.1.3 Environmental Qualification Program

The OPG equipment Environmental Qualification (EQ) program defines activities to ensure that essential safety-related equipment, required to mitigate the consequences of a design basis accident, will perform its intended function when exposed to harsh environmental conditions resulting from that accident, and to maintain this capability over the life of the stations. This program also includes programmatic controls necessary to maintain the qualified status of equipment over the life of the plants.

Since the previous licence application, Darlington NGS has worked to sustain the EQ program in accordance with CSA N290.13-05 with Update 1 (2009). Regular self assessments and/or internal audits are performed on an annual basis and Program Health Reports are issued semi-annually. The program is measured against metrics such as maintenance work order reviews, room condition monitoring, steam barriers, OPEX monitoring and document backlog.

6.2 Refurbishment

6.2.1 Design Management Program

Consistent with N-PROG-MP-0009, *Design Management* and N-PROG-MP-0001, *Engineering Change Control* all modifications implemented during refurbishment will be defined, planned, designed, installed, commissioned and placed in service within the SOE, design basis and licence conditions.

A significant portion of the plant modifications will be executed under the EPC contracting model, which will comply with OPG's ECC program and Design Management procedures.

OPG will monitor and assess design activities and ensure that appropriate interfaces and oversight are maintained throughout the modification process. The responsibilities of OPG and the Design Agencies during each phase of the modification process as well as the mandatory interface points and oversight requirements are outlined below:

- OPG will specify the requirements for the modification including the modification design requirements, conceptual design report and modification outline.
- Design Agency will prepare the detailed design including, drawings, change papers, calculations, reports, and any other documents required in accordance with governance.

- OPG has established mandatory interface hold points during the detailed design process. The OPG Design Authority authorizes design plans, engineering mobilization, constructability, operability, maintainability and safety declaration, design completion assurance verification review and engineering change release. All design modifications will be accepted by OPG Design Authority prior to being released for construction.
- OPG will conduct continuous oversight of the Design Agencies through routine communications, product monitoring and review of required documents confirming the quality of the deliverables. Periodic audits will also be performed to independently confirm that the Design Agencies are following the accepted management system. The Design Agencies will also be required to provide OPG with copies of their internal audits and any conditions and corrective actions that are identified during their performance of the design work.

6.2.2 Pressure Boundary

During refurbishment, EPC contractors will perform pressure boundary activities under their own C of A. OPG will issue a Letter of Authorization to the EPC contractor to prepare registration and reconciliation packages and to submit them to the AIA for registration on OPG's behalf. OPG will then receive the registration package.

The EPC contractor will also prepare Code Classification and Exemption evaluation packages. Should a variance or deviation from code be required, the EPC contractor will prepare and submit to the AIA the proposed resolution for evaluation on OPG's behalf.

OPG will be accountable for all communications with the CNSC related to the Code Class approvals and notifications regarding registrations and changes to pressure boundary documentation.

Studies are in progress to confirm that Class 1 pressure boundary related components are good for the extended service life from the perspective of the design basis Service Limits A to D and environmental fatigue. As required, the components Design Reports are being updated and the components re-registered with the AIA. As well, certified pressure vessels are being assessed to determine whether they need repair or replacement for extended operation. A fatigue monitoring program will be implemented at Darlington NGS through the Integrated Implementation Plan.

6.2.3 Equipment Qualification

EPC modifications will comply with the OPG ECC and EQ programs. The ECC program and supporting procedures will ensure proper reviews and approvals are achieved before modifications are implemented. The scope of these reviews includes EQ in accordance with N-PROG-RA-0006, *Environmental Qualification*.

The Darlington design guide was updated in 2012 to account for the changes in the CSA standards, industry initiatives regarding the probability based hazard assessments, as well as, to align with OPG's Risk and Reliability governance, recently completed Seismic Probabilistic Risk Assessment, and the current more rigorous ECC and Procurement processes. The updated design guide incorporates requirements for the seismic qualification of both the modifications of the existing SSCs and the design

of new structures that are aligned with the CSA N289.1-08, *General requirements for seismic design and qualification of CANDU nuclear power plants* requirements. This update will be applicable for modifications associated with the refurbishment program.

Reference:

1. CNSC letter, P.A. Webster and M. Santini to W.M. Elliott, “Design Code and Standards Effective Dates for OPG Nuclear Fleet”, June 22, 2012, E-DOC # 3947068, CD# N-CORR-00531-05758.

7.0 FITNESS FOR SERVICE

Darlington NGS, under its current PROL, is required to have in place a fitness for service program in accordance with the CNSC Regulatory Documents and CSA Standards as specified in the PROL.

OPG's key documents for the Fitness for Service SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Maintenance and Outages		
Conduct of Maintenance	N-PROG-MA-0004	R010
Component and Equipment Surveillance	N-PROG-MA-0017	R006
Production Work Management	N-PROG-MA-0019	R007
Integrated Aging Management	N-PROG-MP-0008	R005
Planned Outage Management	N-PROC-MA-0013	R015
Forced Outage Maintenance	N-PROC-MA-0049	R004
Equipment Reliability	N-PROG-MA-0026	R006
Risk and Reliability Program	N-PROG-RA-0016	R007
Reliability and Monitoring of Systems Important to Safety	N-STD-RA-0033	R002
List of Safety Related Systems and Functions	NK38-LIST-06937-10001	R000
2012-S-99-Annual Reliability Report **Table 1.1** List of Systems Important to Safety and Targets	NK38-REP-01500-10013	R000
Major Components		
Major Components	N-PROG-MA-0025	R001
Feeders Life Cycle Management Plan	N-PLAN-01060-10001	R015
Darlington Nuclear Unit 1 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	NK38-PIP-33160-10001	R000
Darlington Nuclear Unit 2 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	NK38-PIP-33160-10002	R000
Darlington Nuclear Unit 3 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	NK38-PIP-33160-10003	R000
Darlington Nuclear Unit 4 Fuel Channel Feeder Pipes Periodic Inspection Program Plan	NK38-PIP-33160-10004	R000
Steam Generators Life Cycle Management Plan	N-PLAN-33110-10009	R004
Darlington Units 1-4 Steam Generators Life Cycle Management Plan	NK38-PLAN-33110-00001	R006
Fuel Channels Life Cycle Management Plan	N-PLAN-01060-10002	R014
Darlington Nuclear 1-4, Unit 1 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	NK38-PIP-31100-10001	R002
Darlington Nuclear 1-4, Unit 2 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	NK38-PIP-31100-10002	R002
Darlington Nuclear 1-4, Unit 3 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	NK38-PIP-31100-10003	R002
Darlington Nuclear 1-4, Unit 4 Fuel Channel Pressure Tubes Periodic Inspection Program Plan	NK38-PIP-31100-10004	R002

Document Title	Document Number	Revision #
Reactor Components and Structures Life Cycle Management Plan	N-PLAN-01060-10003	R011
Darlington Nuclear Generating Station Periodic Inspection Plan For Unit 1	NK38-PIP-03641.2-10001	R002
Darlington Nuclear Generating Station Periodic Inspection Plan For Unit 2	NK38-PIP-03641.2-10002	R002
Darlington Nuclear Generating Station Periodic Inspection Plan For Unit 3	NK38-PIP-03641.2-10003	R002
Darlington Nuclear Generating Station Periodic Inspection Plan For Unit 4	NK38-PIP-03641.2-10004	R002
Containment		
Darlington Nuclear Generating Station - Periodic Inspection Program For Unit 0 and Units 1 To 4 Containment Components	NK38-PIP-03642.2-10001	R002
Darlington Nuclear - Unit 0 Containment Periodic Inspection Program	NK38-PIP-03643.2-10002	R002
Aging Management Plan for Containment Structures	N-PLAN-01060-10004	R001
Darlington Nuclear – Reactor Building Periodic Inspection Program	NK38-PIP-03643.2-10001	R002
Darlington Nuclear - Vacuum Building Periodic Inspection Program	NK38-PIP-03643.2-10003	R002
Inspection of Post Tensioning Tendons on DNGS Vacuum Building	NK38-TS-03643-10001	R001
Administrative Requirements for In-Service Examination and Testing for Concrete Containment Structures	N-PROC-MA-0066	R004

7.1 Current Operations

Over the last three years CNSC staff have consistently assessed the Fitness for Service SCA as exceeding regulatory requirements and expectations. Given the robust processes in place within OPG, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations during the next licensing period.

7.1.1 Maintenance

N-PROG-MA-0004, *Conduct of Maintenance* establishes processes to ensure the safety of the public and site personnel, the protection of the environment, and availability of plant equipment for safe and reliable operation through effective implementation and control of maintenance activities. This program also provides the requirements for managing identification and execution of preventive maintenance and repetitive task work activities using the predefined process, in support of operations, maintenance, and testing of equipment and facilities. The objectives of the program are primarily achieved by instituting effective maintenance processes and standards, sufficient resources, monitoring and assessing performance, and holding personnel accountable for their performance.

The intent of a maintenance program is to ensure that safety systems remain available to satisfy their design intent as described in the station's supporting safety analysis

and that equipment failures are minimized. This is accomplished by completion of corrective and preventative maintenance activities along with routine inspections on system components to ensure that they remain in good operating condition.

N-PROG-MA-0019, *Production Work Management Program* specifies the requirements for identifying, prioritizing, planning, scheduling, and executing work in support of the operation, maintenance and modification of the plant. The program also establishes safe, uniform and efficient work control practices in the station.

Performance

As discussed in Sections 4.1.3 and 4.1.7, the occurrences of equipment failures leading to unit transients and safety system unavailability are low at Darlington.

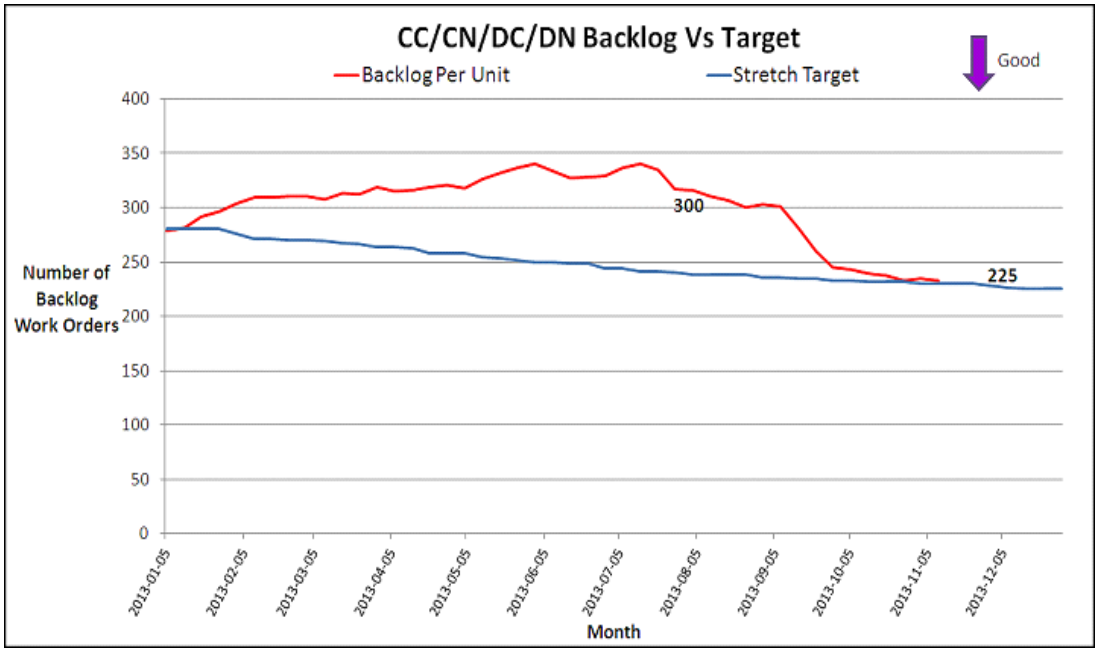
Backlogs

Darlington's goal is to ensure that Corrective Critical (CC), Corrective Normal (CN), Deficient Critical (DC) and Deficient Normal (DN) backlogs levels are in line or better than industry benchmark targets. As shown in Figure 11, the volume of these combined maintenance backlogs has been reduced in 2013 and are expected to satisfy the station target by year end.

In order to decrease the Darlington station backlog and meet end of year targets, several initiatives are in place through the online Fix It Now (FIN) process, including:

- Increased FIN resources to achieve the weekly effectiveness target of 65%. Increased FIN work order execution to reduce carry over to backlog.
- Established a backlog reduction team of Operations, Engineering and Maintenance to ensure existing backlog work is completed and validated.
- Hold Removal Team meeting weekly to focus on hold removal.
- Additional backlog work scheduled beyond 2013 is being brought forward through scope addition and a contingency work list approach.
- A scoping review process is in progress to ensure the scope contains the required number of CC, CN, DC and DN work orders to achieve the year end backlog target.
- A review of work execution (15 weeks prior) is in progress to ensure that work on the schedule will be ready to be executed as scheduled.

Figure 11 – Corrective Critical/ Corrective Normal/Deficient Critical/Deficient Normal Backlogs



Procedures

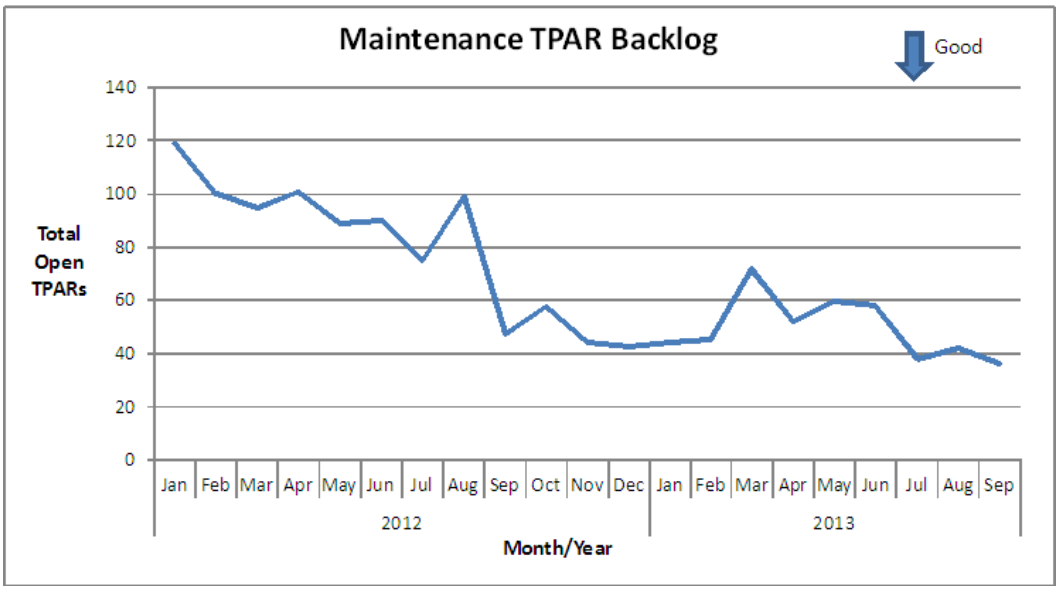
The objective of maintenance procedures is to provide Maintenance staff with a consistent and systematic approach for maintaining station equipment.

At OPG, there has been an increased focus on Procedural Use and Adherence (PU&A) as an error prevention tool to ensure a high level of human performance. In the event that work cannot be performed in accordance with the procedure, the associated work activity must not proceed.

One of the initiatives implemented to reinforce PU&A is the introduction of Dynamic Learning Activities. This comprises interactive practical exercises which have been performed by all Maintenance staff to reinforce the importance by applying procedure usage in a practical way. Training was developed around PU&A that has been completed by all Maintenance staff.

In addition, procedural quality is essential for maintaining safe and reliable plant operation and staff is encouraged to identify when maintenance procedure revisions are required by issuing a T-PAR. The number of outstanding T-PAR revisions is tracked as shown in Figure 12. An increased focus on technical procedure backlogs has resulted in a steady decrease in this area. This improves the Maintenance Department's ability to supply current and updated procedures to staff to enable them to perform quality work in the field.

Figure 12 – Maintenance TPAR Backlog



Preventive Maintenance Work Orders

PM work orders are scheduled for a specified start date (start of grace period) and are required to be completed before a specified late date (end of grace period) to ensure the equipment is maintained in a reliable state. To minimize the risk of PM work not being completed on time, it is preferable to not have PM work completed during the second half of the grace period.

Efforts taken to date to ensure the PM work is completed before its late date include: increased oversight of the PM scheduling and deferrals, increased resources to execute PMs on or before its scheduled start date, backlog work, as well as a PM review to ensure accuracy of the work coding. These efforts have resulted in a reduction of PMs completed during the second half of the grace period from 449 per Unit in Quarter 1 2013 to 316 per Unit for Quarter 3 2013. Continued efforts through additional resources, as well as PM reductions through the PM review initiative, are expected to decrease this count further.

Proactive Reporting

Maintenance has initiated an increased focus on the need for identifying issues/concerns proactively over the past year. Data indicates that when this is done, actual safety related events decrease as a result of the increased proactive reporting. As part of the proactive SCR reporting program, Maintenance consistently surpasses established station and stretch targets to identify and remove potential hazards before they can impact worker safety.

Future Plans

A program has been initiated to allow for pre-authorization of low criticality work, providing a reduction in preparation and increased efficiency in work order execution. A team consisting of Operations, Maintenance and Work Control was established to oversee the pre-authorization process. A program is in place that has Maintenance apply the appropriate pre-authorization code to work orders on the schedule plan three weeks prior to execution, and hand off to Operations for concurrence and additional code inputs. Progress will be monitored to determine the effectiveness of the pre-authorization implementation.

Darlington is transitioning to a DBM (see also Section 3.1.2) approach to scheduling maintenance activities in order to align with industry best practices. The purpose of this is to allow for the scheduling of the majority of maintenance work during days and to take non-essential maintenance personnel and activities off shift. The potential benefits of DBM include the formation of specialized maintenance teams, less fatigue due to rotating shifts, fewer turnovers, and reduced potential for error.

Maintenance First Line Managers are currently conducting regular field tours as part of their job site oversight. To supplement this, additional field observations to ensure standards are being maintained at high levels are being provided by the Manager in the Field program, Paired Observation and Coaching, and increased outage oversight through the Rapid Trending expectations program.

A new Darlington Maintenance Facility is being constructed that will allow for improved shop facilities to support Darlington well into the future. Availability of the new Maintenance Facility will alleviate congestion in the Central Service Area of the station and modernize tooling and work space to increase efficiencies in work preparations and execution. The facility became available in December 2013.

Transition Plan for CNSC RD/GD 210, *Maintenance Programs for Nuclear Power Plants*

The Darlington Maintenance program is in compliance with CNSC RD/GD-210, *Maintenance Programs for Nuclear Power Plants* which has replaced S-210 currently identified in the Darlington PROL. As the requirements set out in RD/GD-210 remain unchanged from S-210, no transition plan is required for Darlington to comply with the requirements of the new document.

7.1.2 Outages

The objective of the outage management program is to ensure that inspections, testing, maintenance and modifications activities are correctly identified and safely completed while the reactor is in the shutdown state.

Outages are carefully planned and managed to ensure safe, cost effective and efficient outages. The Outage Management processes for preparation and execution of planned and forced nuclear unit outages within OPG Nuclear receive authority from N-PROG-MA-0019, *Production Work Management*. Governance associated with planned outages is in accordance with N-PROC-MA-0013, *Planned Outage*

Management. Governance associated with forced outages is in accordance with N-PROC-MA-0049, *Forced Outage Management*.

Performance

Planned Outages

Routine planned maintenance outages occur every three years. Planned outage durations for Darlington units are typically dictated by inspections of fuel channels and feeders. These components are critical to determine how long the units can safely run and produce electricity. There have been two planned outages completed since the previous licensing submission (Unit 3, 2012 (D1231) and Unit 4, 2013 (D1341)) and one currently in progress at the time of this application (Unit 2, 2013 D1321).

During D1231 the highest number of tasks that Darlington had ever successfully executed during a planned outage were completed. Major work programs include inspections of the feeders and fuel channels, boiler inspections and turbine/generator overhaul.

Conventional safety performance improved with the execution of D1341 (no lost time accidents or high Maximum Reasonable Potential for Harm events). Low level reporting of safety issues increased, showing an improved awareness and willingness to identify issues proactively. Tritium emissions were at an all time low, as was the overall internal dose uptake, as a result of Darlington's proactive efforts to minimize dose. During D1341, even more work was completed than for D1231. Major work programs include inspections of the feeders and fuel channels, boiler inspections and turbine/generator overhaul.

One of the major indicators of good outage performance is total dose accumulated for a planned outage. For both D1231 and D1341, dose savings of 5 rem internal dose and 20 rem whole body dose were realized due to recent dose mitigation initiatives. (See Section 8 Radiation Protection).

Planned outage scope variance measures the deviation of outage scope completed versus target since scope is frozen (12 months prior to outage start). Scope variance includes both scope additions and scope rejections once the scope is frozen. This is an important indicator as it measures how much additional effort is put into a planned outage prior to execution. Every time scope is either added or removed, it challenges the outage schedule. Scope variance has been decreasing for the past three planned outages due to rigorous scope reviews.

A process intended to capture lessons learned from previous outages is conducted for each outage. The intent is that each department evaluate their own performance, making use of all available inputs (SCRs, coordinators notes, suggestion cards, feedback questionnaires etc.) to identify improvement opportunities. These evaluations are recorded in the station Self Assessment Data Base with all identified corrective actions. A summary of lessons learned are also included in the final outage report, which is issued for every planned outage.

Forced Outages

On occasion, unit forced outages occur when either the unit is automatically or manually shutdown due to unexpected reasons. There have been three forced outages at Darlington NGS in the current licensing period. The work completed to return the units to service was executed safely with no impact to other units. Lessons learned from these outages were incorporated into future outage plans to prevent re-occurrence.

Darlington maintains ready-to-execute forced outage plans to be completed in the event a forced outage occurs. The purpose of the plans are to ensure that appropriate reviews are incorporated into these plans. There are regularly scheduled meetings between the Outage department and the SMs, CRSSs and ANOs to ensure that the correct work is identified on the forced outage plans when a unit shuts down.

In addition there is mandatory scope to be completed in a forced outage such as routine items required for readiness for service criteria, routine start-up and shutdown inspections/testing and regulatory commitments.

Future Plans

In the second quarter of 2015, the Vacuum Building and Common Containment Structure is scheduled for an outage to allow inspections and testing. This outage, called the VBO, requires all four units to be shutdown to allow work on equipment that cannot be otherwise taken out of service or tested. Most of this equipment is associated with Unit 0 (common to all four units).

One of the key activities during the VBO will be a pressure test of the vacuum building and containment structures. The last Darlington VBO was in 2009 which confirmed the integrity and leak tightness requirements.

During the next licensing period, prior to a unit entering its refurbishment phase, regular planned outages will continue to be planned at three year intervals to ensure regulatory testing; planned maintenance and inspections are completed as required.

7.1.3 Reliability

Overall Darlington's ER is stable and there has been a reduction in functional failures of critical equipment. The challenge is to ensure non-critical equipment is maintained such that there is minimal or no impact on station performance. One of the major contributors is aging and obsolescence of equipment and parts.

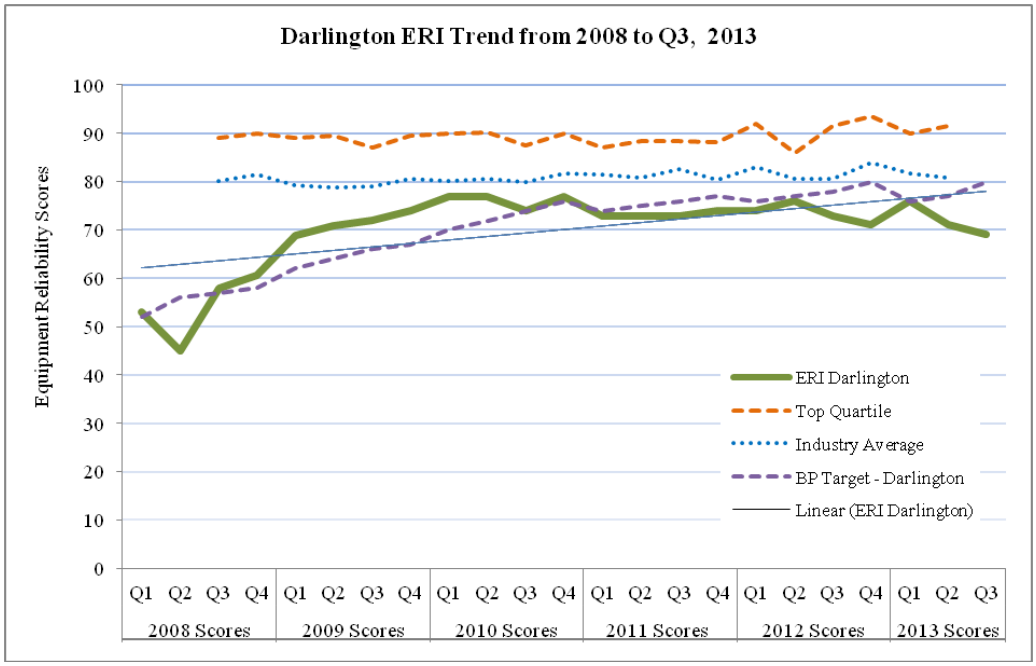
In 2012, a self assessment was performed on Darlington's ER Program. The findings indicated general compliance with the ER Program requirements of *Equipment Reliability*, N-PROG-MA-0026 as well as the implementation process. The major elements of the ER process are established with improvement opportunities identified in each area.

The main indicator for reliability is the Equipment Reliability Index (ERI). The ERI contains 18 metrics from all disciplines of Operation, Maintenance, Engineering, Work Control and Long Range Planning. Each metric is scored and colour coded depending

on the station performance against set targets and thresholds which are unique to each metric, as compared to the Industry Standards. Additionally, an overall ER score is calculated.

The trend in Figure 13 depicts the ER score from 2008 to 2013 Q3 for Darlington NGS in comparison with industry-best-practice scores. The ERI score for Darlington is 70 which is slightly lower than the second quartile score. The goal is to reach the industries top quartile performance in this area by 2016.

Figure 13 – ERI Trend from 2008 to Q3 2013



Review of the ERI allows OPG to identify trends and to take appropriate mitigating actions.

7.1.4 Major Components

The Major Components Program establishes a formal and systematic process in OPG Nuclear for managing information related to four major component areas: feeders, steam generators, fuel channels, and reactor components and structures. This program provides a framework for integrating and reporting of the component performance, condition, and compliance with design basis documents. The objective is to ensure the four major components perform safely and reliably over the life of the station, maintaining the design and licensing basis.

To ensure the integrity of the pressure boundary and fitness for service of nuclear plant systems and components, OPG has implemented Periodic Inspection Program (PIP) Plans for fuel channels, feeders, steam generators, containment components and concrete containment components. Elements of PIP are required to satisfy CSA Standards.

CSA Standard N285.4, *Periodic Inspection of CANDU Nuclear Power Plant Components*

In order to meet the PIP requirements of CSA N285.4, documents that outline the PIP inspections required for each major component have been prepared and submitted to CNSC staff (as identified in LCH). These documents have been adhered to since the last licence application with no major findings and will continue to be followed to ensure PIP requirements are met for the Darlington major components.

There was a recent finding within the feeder program that upper feeder hanger PIP inspections were not being completed as per the plan. This was reported to CNSC staff as per S99. This inspection has now been completed during D1341 and D1321 with no adverse findings. Going forward the inspections will be completed in subsequent planned outages as per the Feeder PIP plan.

Darlington implemented the 2005 edition of CSA N285.4-05 in November 2011 to reflect CNSC acceptance of OPG's Leak Before Break (LBB) assessment for feeders in Reference 1. This plan was revised and accepted by CNSC staff in 2013 (Reference 2) for the new feeder inspection scope. The PIP for steam generators and fuel channels had already been accepted.

Transition Plan for CSA Standard N285.4-09*, Periodic Inspection of Nuclear Power Plant Components (Update No.1 and Update No. 2)*

OPG is currently reviewing the impact of the transition to the newer edition of CSA Standard N285.4. The transition plan to comply with the standard will be provided to CNSC staff by May 2014.

Fuel Channels

The Fuel Channel Life Cycle Management (LCM) plan specifies a combined program of in-service inspection, maintenance, engineering assessments and research and development. The plan is revised yearly to document and respond to inspection findings and industry observations.

The Fuel Channel LCM Plan provides the 10 year inspection and maintenance requirements (including periodic inspection), and the strategy for inspection and maintenance to end of life.

Performance

OPG maintains Fitness for Service (FFS) for fuel channels through the life cycle plans which require periodic inspections of pressure tubes to maintain assurance of FFS on an ongoing basis. Sufficient data and inspection results have been collected to date to monitor pressure tube behaviour. Based on known flaws and dimensional conditions from in-service inspections, the limiting Effective Full Power Hour (EFPH) for each Darlington unit is beyond the start of the next planned outage for the unit and there are no restrictions to the number of remaining thermal cycles. In-service inspections have shown that there is no Pressure Tube (PT) to CT contact to date, or anticipated prior to refurbishment. For PT dimensional changes, which include PT axial elongation, PT diametric expansion, and PT wall thinning, they have been shown to not exceed

allowable limits until well beyond 215 k EFPH. Pressure tube LBB has been assured up to 215 k EFPH.

Future Plans

Current inspections and maintenance will continue as per the Fuel Channel LCM plan until the refurbishment outage of each unit. Fuel channel inspection and maintenance includes full length inspections, PT to CT gap measurements, hydrogen isotope concentration measurements (body of tube and rolled joint), elongation and diametral creep measurements, sag measurements, single fuel channel replacement, and flaw replicas if required.

The Fuel Channel Life Management (FCLM) project was created in 2009 to define and perform the required research and development for the critical fuel channel degradation mechanisms, and to provide updated assessment methodologies and models to demonstrate pressure tube fitness-for-service for the target service life. A protocol was agreed to with CNSC staff and other industry partners to prioritize the required research and development in the FCLM project to assure safe operation of the fuel channels.

The research and development execution work in phase 1 of the FCLM project has been completed, and the deliverables have been submitted to CNSC staff as per the agreed schedule.

Findings from the research and development work to date have resulted in changes to the fuel channel inspection and maintenance plans for the Darlington units to focus on the collection of reactor condition data in those areas having the greatest impact on fuel channel integrity. These changes are documented in the Long Term Life Management Plan for Inconel X-750 annulus spacers and have been incorporated into the Fuel Channel Life Cycle Management Plan.

Per the CNSC protocol, the scope of work for the FCLM project was prioritized such that the investigation of the most critical degradation mechanisms was completed first. Continuing research and development work and longer term improvements to assessment methodologies and models is on-going in the FCLM project. A second protocol agreement has been established with CNSC staff to manage the continuing work of the FCLM project.

Fuel channels are being replaced during refurbishment. Inspections after refurbishment will meet CSA N285.4 requirements.

<u>Feeders</u>

The Feeders LCM Plan contains requirements for inspections of pipe wall thinning, cracking, as well as visual inspection and evaluation of the feeder support components (e.g., feeder piping spacers, tie rods, hangers, etc.). This inspection and maintenance plan is forward looking and defines required activities to support feeder operation until the refurbishment outages.

The plan is regularly updated to incorporate changes to these requirements that may be warranted from inspection results on the rates and extent of active degradation.

The plan also contains strategies to deal with plausible aging mechanisms that are not active but may become active. It considers the probabilities, areas of vulnerability in the piping system, and mitigating actions to ensure that feeders remain within the design basis.

Performance

All of the feeder wall thickness values measured during inspection activities have been above their current minimum required thickness. Inspections have confirmed that feeders are thinning at a rate that shouldn't result in any feeders requiring replacement. No feeders were replaced during the current licensing period and no other replacements are planned to occur prior to refurbishment.

During the past two Darlington outages, there have been three instances of low clearance between the feeders and end fittings. All three were assessed and dispositioned as being fit-for-service through the next operating cycle. An action is in place to investigate a strategy for assessing feeder to end fitting clearance.

Future Plans

Inspections will continue as per the Feeders LCM plan to inspect for thickness and cracking. Visual inspections will also continue for the reactor face and in the feeder cabinets, with repairs completed as required.

A work plan and schedule was developed and submitted to CNSC staff in November 2012 regarding LBB demonstration for Dissimilar Metal Welds (DMW). A LBB assessment of Darlington DMW was also submitted to CNSC staff in the same submission (Reference 3). The deterministic assessment demonstrated that 40 of 44 feeders have sufficient margin to meet LBB within the current leak detection capability and operating procedure. The probabilistic assessment showed that the DMW rupture is a very low probability event. The final LBB assessment is planned to be completed in 2014.

During the Darlington refurbishment outages, feeders will be replaced. Following refurbishment, fitness-for-service inspections will be developed and performed as required based on LCM of the new components

<u>Steam Generators</u>

The primary goal of the Steam Generator (SG) LCM Plan is to operate all four units safely and reliably with the existing SGs over the life of the station including the life extension period, while maintaining the design and licensing basis, and optimizing station reliability, production and cost effectiveness.

Another key goal of the SG LCM Plan is to maintain or restore SG thermal performance. To achieve the above goals, the Inspection and Maintenance Program prescribed in the SG LCM plan must be effective at preventing or mitigating SG degradation and failures, and managing conditions that can contribute to decreased SG thermal performance. Inspection of pressure boundary shell welds, nozzles, and external vessel supports are prescribed separately in the PIP documents specific to each unit.

Performance

SG tube inspections, internals inspections, and waterlancing are completed each planned outage in accordance with the latest revision of the SG LCM Plan.

The latest inspection results continue to show that the Darlington SGs are in good condition, and there have been no forced outages due to primary to secondary leakage arising from SG tube failures since 1998. The main degradation mechanism within the Darlington SGs is tube fretting in the U-bend region. In order to mitigate this, auxiliary anti-vibration bars were installed in all SGs in 2003 to 2005. Tube hydrodynamic degradation in the preheater region was first recognized as a degradation mechanism in 2007. Since that time, all units have had multiple inspections in the preheater region and the hydrodynamic degradation is being monitored closely.

Future Plans

SGs will continue to be inspected and waterlanced as per the SG LCM Plan. OPG determined in 2008 to 2009, based on engineering and economic assessments, that the SGs can be operated safely, reliably, and economically during the life extension period, therefore the current SGs will remain in-service following refurbishment. Following the refurbishment outages, Darlington SGs will continue to be inspected and maintained as per the SG LCM plan. Consistent with current practices, the SG LCM plan will be regularly updated to consider the latest results of Darlington SG inspections and external SG operating experience, and to provide a forward looking plan out to 10 years.

Reactor Components and Structures

The Reactor Components and Structures LCM Plan addresses a number of components such as the calandria assembly, end shield assemblies, reactivity mechanisms, calandria supports, calandria relief ducts and CTs. The Reactor Components and Structures LCM Plan is updated annually to capture new information from inspection, research, and OPEX.

Future Plans

In an ongoing strategy to manage FFS under the Reactor Components and Structures LCM Plan, baseline inspection of CT to Liquid Injection Shutdown System (LISS) nozzle clearance is planned for the 2014 Unit 1 outage. Many of the other calandria components will be inspected during the Darlington refurbishment outages. CT-LISS nozzle contact inspections are also being added into Darlington Unit 3 2015 outage.

CSA N287.7 Standard, *In-service Examination and Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants*

CSA standard N287.7 defines the requirements for in-service examinations and positive pressure leakage-rate testing of concrete containment structures of a containment system that are designated as class containment components. According to CSA N287.7 reactor buildings, vacuum structure, pressure relief duct, certain

locations under central service area, and certain locations under fuelling facilities auxiliary area are designated class containment structures at Darlington NGS.

The objective of the CSA N287.7 PIP is to ensure that the design basis of the concrete containment structures is maintained.

Inspections and tests of the vacuum building, the dousing system and the pressure relief duct are completed at least once every twelve years, as agreed with CNSC staff in Reference 4. In addition, OPG shall perform a test to measure the leakage rate, at full positive design pressure, of the reactor buildings and inspect the concrete structures and components once every six years. Vacuum building in-leakage and main containment out-leakage testing was performed during the 2009 VBO and the results were well below targets and safety analysis values.

N-PLAN-01060-10004, *Aging Management Plan for Containment Structures* has been prepared in accordance with RD-334. The plan envelops and evaluates the current programs and practices currently in place at OPG stations to create a systematic and integrated approach to manage aging of containment structures.

All inspection reports and findings, produced under CSA N287.7-08, have been submitted to CNSC staff as per agreed schedules.

Future Plans

In accordance with Annex E of CSA N287.7-08, a case has been made to perform the full positive design pressure leakage rate test frequency, currently at six years for the Reactor Buildings and inspect the concrete structures and components, to 12 years which will coincide with the vacuum structure inspection frequency (Reference 5).

The next vacuum structure positive pressure test shall be conducted in 2015 during the VBO.

Transition Plan for CSA Standard N287.7-08, *In-service Examination and Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants (update No.1 2010)*

Transition/implementation plan is as stated in current Darlington NGS LCH.

Aging Management

The objectives of the Integrated Aging Management (IAM) program are to ensure the condition of critical equipment is understood, and required activities are in place to ensure the health of these components and systems while the plant ages.

Aging management is accomplished by implementing an integrated set of programs and activities that ensure the performance requirements of all critical station equipment are met on an on-going basis.

The HTS Aging Management Strategy was established in July 2010 to capture all related OPG site-specific and fleet-wide activities on the management of HTS aging. An update of the HTS Aging Management Strategy was issued in September 2012

(Reference 6), in conjunction with semi-annual progress report submissions to CNSC staff (Reference 7).

The HTS Aging Management Strategy focuses on developing new HTS aged models and updating the analyses for the most-affected design basis events (Neutron Overpower (NOP), small break loss of coolant accident, loss of feedwater etc), improving analysis methodology (enhanced-NOP methodology) to demonstrate larger margins, and also implementing design changes (37M fuel bundle design) to restore safety margins. Research and development work is also continually being undertaken by OPG to support the acceptance criteria and code validation activities for HTS aging related safety analysis.

NOP analysis shows that based on the current rate of aging, the currently installed NOP trip setpoints support the acceptability of Darlington operation with mitigating measures (e.g. occasional derating) to continue safe operation of the units. Monitoring of the aging trends on a periodic basis is used to confirm that compliance is maintained with the analysis assumptions used in the NOP analysis to represent aged PHT System conditions.

Transition Plan for RD-334, *Aging Management for Nuclear Power Plants (2011)*

OPG performed a gap assessment between RD-334 requirements and OPG governance. This gap assessment showed that OPG IAM governance is aligned with RD-334. The assessment also identified gaps in OPG governance with respect to a couple of areas for which there are actions in place to address. A transition plan for compliance will be provided to CNSC staff by May 2014 for inclusion in the Darlington LCH.

7.2 Refurbishment

7.2.1 Maintenance

A large portion of the refurbishment maintenance work program will be completed by contractors (e.g., fuel channel replacements, fuel channel feeder replacements, turbine overhaul and various mechanical work, computer and electrical system work). Contractor work during the refurbishment outage will be completed using a combination of OPG procedures and contractor developed procedures that meet the requirements of CSA N286-05. A guide has been produced that describes these procedural requirements for refurbishment operations and maintenance. Also documented are the requirements for testing, turnover and commissioning of the systems to ensure fitness for service of the SSCs that have undergone maintenance.

7.2.2 Outage Scope

OPG is readying refurbishment work (assessing, reviewing and ensuring proper scoping), and completing refurbishment scope definition. This is being done utilizing existing station/OPG staff and contractors, with Nuclear Refurbishment staff providing oversight of contractor work.

7.2.3 Outage Management

A planned outage management procedure will be issued which will capture the specific details of roles and responsibilities required to establish an outage management process within the refurbishment project structure.

In addition to the major refurbishment projects being undertaken, the outage will include normal breakdown and preventive maintenance. Breakdown maintenance will be selected to ensure a high level of system reliability on restart. Existing PM tasks will be evaluated to select those that are required to support the unit and equipment condition.

The outage will be coordinated to link the cyclic maintenance work with the refurbishment project work in defined windows. It is anticipated that system layup requirements will dominate the positioning of outage work windows for non-critical path work. OPG's current plan is to start systems up as early as we conveniently can in order to ensure that most system testing and corrective maintenance is completed before the system is required for planned start-up evolutions. This plan will also place systems in normal operational state as a preferred layup condition for many systems.

The coordination of refurbishment projects with cyclic maintenance work will be accomplished using an integrated schedule. This integrated schedule uses key activities from each individual project schedule and ties them together through interfacing milestones.

7.2.4 Systems Important to Safety

Assessments and analyses of the specific unit configurations being performed will identify which specific systems are required and which have been declared out of service for all refurbishment configurations.

Systems which are required to be in-service will be subject to testing and reliability monitoring (and reporting) in accordance with current OPG procedures and practices. Systems declared out of service will not be serving any safety related function and thus, do not need to be tested, monitored, or reported on. Particular attention will be paid to common systems and any specific modifications to the monitoring program to account for an islanded unit.

As with many other plant systems, SIS which have been modified or taken out of service during the refurbishment outage will be subject to the RTS plan (see Section 7.2.6) specified in RD-360 prior to returning the refurbishment unit to commercial operation. This plan will ensure that the SIS conform to the defined physical, functional, performance, safety, and control requirements, and that management arrangements have been appropriately updated.

7.2.5 Equipment Surveillance and Testing

OPG will perform surveillance and testing of equipment and systems that are put into a shutdown or lay-up state, in accordance with applicable equipment and system lay-up specifications.

Equipment Lay-up Specifications have been prepared for the following major equipment categories: pumps, motors, valves, piping and piping components, heat exchangers, pressure vessels, and transmitters and controllers.

Systems that are refurbished early in the outage, upon completion of the refurbishment, will be put into a normal shutdown, or lay-up state. The system lay-up specification identifies the end state after refurbishment, and the applicable equipment and system surveillance requirements.

Systems that are being refurbished later in the refurbishment outage and are not required to be put into a shutdown or lay-up state may not require system lay-up surveillance and testing. They would progress directly to the associated surveillance and testing during Commissioning and Available for Service as part of the Return to Service Strategy.

Some components, the condition of which cannot directly be determined based on observed results (e.g., piping not subject to periodic inspections) may be removed from the system they belong to and subjected to special testing or inspections. Requirements for testing of removed components to confirm aging mechanisms are driven through OPG's aging management program in accordance with N-PROC-MP-0060, *Aging Management Process*. Inspection of removed components (e.g., as found inspections) are a subset of activities to confirm aging mechanisms and predictions.

7.2.6 Return to Service

The RTS portion of the refurbishment outage covers the range of activities from completion of installation work by the contractor to reactor power at 100%, including modification commissioning and system restart activities. The RTS activities will occur in four phases:

(1) Phase A: restart activities prior to fuel load.
(2) Phase B: fuel load and activities leading up to, but not including, Guaranteed Shutdown State (GSS) removal and first Approach to Critical (ATC).
(3) Phase C: ATC and low power testing.
(4) Phase D: high power testing and power escalation to full power.

During these phases, the test program will integrate:

- normal start-up testing,
- non-standard tests that are unique to a refurbishment outage,
- outstanding modification commissioning tests.

The processes that will be used during the Nuclear Refurbishment Program, to manage the commissioning and restart activities and demonstrate that all licence conditions have been met, are outlined in the Return to Service Management Plan, NK38-PLAN-09701-10067, Sheet 18 (Reference 8).

7.2.7 Aging Management

As part of refurbishment, when equipment is refurbished or replaced, resetting the aging management for this equipment is accomplished through the Integrated Ageing Management Program. Guides have been prepared to:

(1) Provide requirements for obtaining baseline system / component performance data, including data for the aging management program.

(2) Prepare detailed restart specifications that:

- Identify baseline data to be collected to support the aging management programs.
- Specify any tests required to re-establish baseline information for future system monitoring, if such tests are not already included in operating procedures, test procedures or detailed commissioning specifications.

7.2.8 Periodic Inspection Program

PIPs will continue to be performed in accordance with existing PIP plans and schedules during refurbishment.

As a result of the unique refurbishment unit conditions, OPG will consider optimizing the PIP inspection schedule (performing inspections prior to due date).

References:

1. CNSC letter, P.A. Webster to S.A. Seedhouse, "Darlington NGS 'A' – Request for CNSC Acceptance of the DNGS Outlet Feeder Dissimilar Metal Weld Leak-Before-Break Assessment", March 11, 2011, E-DOCS # 3689595, CD# NK38-CORR-00531-15466.

2. CNSC letter, F. Rinfret to W.M. Elliott, "Darlington NGS 'A' – CSA N285.4-05 Compliant Periodic Inspection Programs Revision for Fuel Channels and Feeders – Closure of Action Item 20101306", May 21, 2013, E-DOC # 4137777, CD# N-CORR-00531-06165.

3. OPG letter, Brian Duncan to P.A. Webster, "Darlington NGS 'A' – Outlet Feeder Dissimilar Metal Weld Leak-Before-Break Assessments – Update 2", November 27, 2012, CD# NK38-CORR-00531-16143.

4. CNSC letter, B.R. Leblanc to G. Preston, "Vacuum Building Test and Inspection Frequency", March 22, 2002, E-DOCS # 26-0-0-3-2, CD# NK38-CORR-00531-11060.

5. OPG letter, Brian Duncan to P.A. Webster, "Darlington NGS 'A' – Request for Approval to Change the Main Containment System Positive Pressure Test Frequency", December 21, 2012, CD# NK38-CORR-00531-15921.

6. OPG letter, W. M. Elliott to M. Santini and P.A. Webster, “Progress Report on OPG Heat Transport System Aging Safety Analysis”, September 25, 2012, CD# N-CORR-00531-05810.

7. OPG letter, W. M. Elliott to M. Santini and P.A. Webster, “Progress Report on OPG Heat Transport System Aging Safety Analysis”, August 15, 2013, CD# N-CORR-00531-06219.

8. OPG letter, D. Reiner to F. Rinfret, “Darlington NGS ‘A’ Refurbishment – Return to Service Program Management Plan”, November 29, 2013, CD# NK38-CORR-00531-16584.

8.0 RADIATION PROTECTION

Darlington NGS, under the current PROL, is required to maintain a Radiation Protection Program in accordance with the *Radiation Protection Regulations.*

OPG's key documents for the Radiation Protection (RP) SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Radiation Protection	N-PROG-RA-0013	R008
Controlling Exposure As Low As Reasonably Achievable	N-STD-RA-0018	R005
Occupational Radiation Protection Action Levels for Power Reactor Operating Licences	N-REP-03420-10001	R001
Dose Limits and Exposure Control	N-PROC-RA-0019	R005

8.1 Current Operations

Over the last three years, CNSC staff have assessed the RP SCA as meeting or exceeding all regulatory requirements and expectations. Given OPG's robust processes that are in place, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

8.1.1 Radiation Protection Program

The RP program is governed by N-PROG-RA-0013, *Radiation Protection*. The over-riding objective of the RP Program at Darlington is the control of occupational and public exposure to radiation. For the purposes of controlling doses to workers, this program has four implementing objectives:

- Keeping individual doses below regulatory limits.
- Avoiding unplanned exposures.
- Keeping individual risk from lifetime radiation exposure to an acceptable level.
- Keeping collective doses ALARA, social and economic factors taken into account.

In terms of protecting the public, the RP program prevents the uncontrolled release of contamination or radioactive materials from the site by controls and monitoring of people and materials.

In addition, the RP program includes a set of action levels that alert the licensee before a regulatory dose limit is reached. The established action levels have not changed during the licensing period and can be found in *Occupational Radiation Protection Action Levels for Power Reactor Operating Licences,* N-REP-03420-10001 and the LCH.

Worker Dose Control

Worker exposures are planned and managed to ensure doses are kept well below regulatory limits and to ensure unplanned exposures are avoided. This ensures individual risk from lifetime radiation exposure is kept to an acceptable level.

The worker dose control program at Darlington is managed through the following processes:

- limiting individual worker dose
- assessing hazards and maintaining knowledge of conditions
- planning radioactive work to keep exposures ALARA and avoiding unplanned exposures
- using best practices and RP procedures during radioactive work performance
- controlling the use of licensed radioactive devices and equipment.

Individual worker doses, including those for contractors and visitors, are managed to Exposure Control Levels that are below Administrative Dose Limits (ADLs) that are in turn below the regulatory limits. This process ensures planned exposures keep individuals within the regulatory dose limits.

Performance

There were no radiation exposures at Darlington that exceeded regulatory limits and no radiation exposures at Darlington that exceeded ADLs during the licensing period. During the 2013 Unit 2 planned outage there was one event that involved an exposure to tritium oxide that resulted in an individual exceeding an OPG established action level. This event is being reviewed by line management for lessons learned and recurrence prevention.

Since 2009, there have been improvements in the precursor indicators related to worker dose control such as the number of unplanned exposures and electronic personal dosimeter dose alarms, which have generally trended downwards and are consistent with industry benchmarks. This is attributed to improved line accountability and focus on preventing alarms.

Additionally, significant improvements in precursor-level tritium uptake events have been observed due to focus on reinforcing the right protective measures to be taken and actions to reduce tritium hazards in confinement and containment rooms. Challenging targets are established each year to drive continual improvement.

A recent enhancement in protection of workers from unplanned uptakes in case of exposure to a mixture of airborne radiation hazards has been made through the innovative design and implementation of new dual-purpose respirator cartridges, which protect against both tritium and airborne particulate.

Application of ALARA

The RP program implements a series of standards and procedures for the conduct of activities within the nuclear site and with radioactive materials intended to keep Collective Radiation Exposure (CRE) ALARA.

The Darlington Site ALARA Strategy identifies initiatives, actions and programs that will support achieving these objectives, and the means by which the effectiveness of these initiatives are measured. The strategy applies to all units at Darlington, whether operating or in outage. Equally, the strategy applies to all staff, contractors and visitors at Darlington. The strategy is updated annually to reflect the results of benchmarking, corrective action plans and industry best practices.

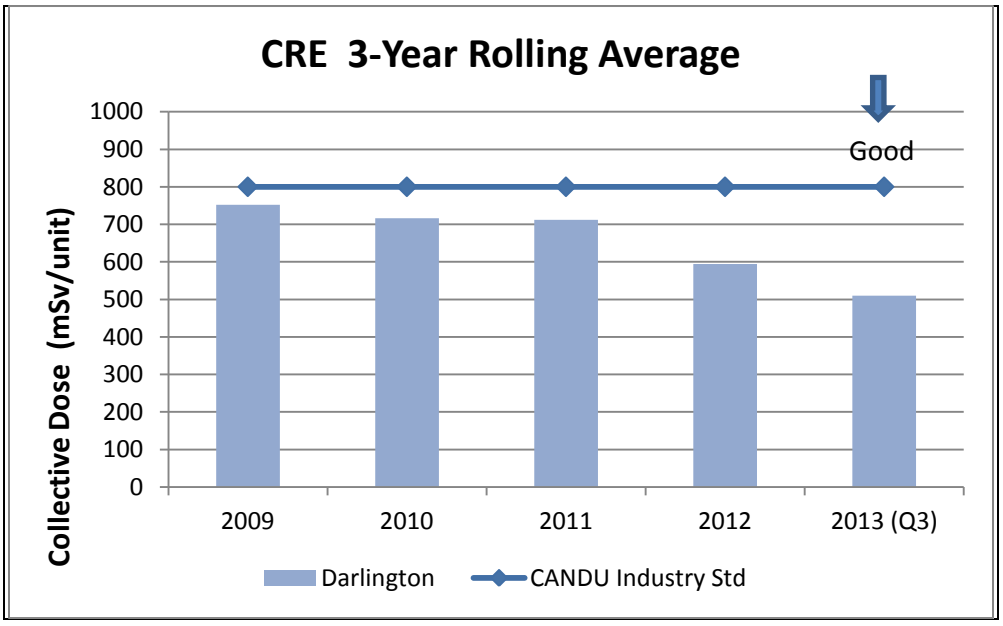
Management of collective dose is implemented in N-STD-RA-0018, *Controlling Exposure As Low As Reasonably Achievable*. Collective dose performance targets for Darlington are established by OPG. Annual targets take into account planned maintenance outage scope, past performance, and anticipated dose savings from planned initiatives and application of ALARA techniques. As work is planned in more detail, collective dose projections are reviewed and actions taken to ensure dose is ALARA. Actual performance against targets is reviewed and corrective actions taken where expectations are not met.

Performance

The effectiveness of the ALARA program is measured against the following metrics:

- CRE
- Collective Internal Radiation Exposure

Figure 14 – Collective Radiation Exposure 3-Year Rolling Average



As shown in Figure 14, Darlington's collective dose performance of 597 mSv/unit (59.7 rem/unit), averaged over three years from 2010 to 2012, is significantly better than the CANDU industry standard of 800 mSv/unit (80 rem/unit). The station's sustained good dose performance is a result of equipment reliability, low forced loss rate and implementation of dose reduction initiatives including increased line accountability for dose.

Successful achievements in reducing dose during the licensing period include:

(1) Effective control of internal dose was achieved by reducing the gravity filled state during outages since 2011 thereby decreasing D_2O leakages, timely deployment of portable dryers to reduce air-borne tritium concentrations in recent outages.

(2) A comprehensive program was implemented in 2011 for alpha hazard classification and control. This program includes the provision of alpha monitoring instruments, increased surveys to measure surface and air-borne alpha contamination, and the use of personal air samplers to measure alpha uptakes as per radiological exposure permit requirements.

(3) A four-fold reduction in reactor face dose rate was achieved by installing a combination of overhead shielding canopy and end fitting shielding tiles. Total dose savings in excess of 26 rem (260 mSv) were realized during Darlington outages: D1111, D1231, D1341 and D1321.

(4) Use of remote real time gamma and tritium monitors during outages in 2012 and 2013 to reduce Radiation Protection Coordinator dose by minimizing the need for routine vault gamma and tritium surveys.

(5) In 2013, a single point of contact was established in the Maintenance organization to provide better oversight and coordination of scaffold installation and removal to prevent rework. Work platforms and other means of access are pursued to minimize scaffold use and dose associated with its setup and removal during planned outages.

(6) In 2011, new feeder jackets with remote application tools were fabricated to reduce ice-plug dose received by operators. This improvement has effectively decreased dose received from ice-plug activities by more than a factor of two (80.9 msV to 36 mSv) in recent outages.

The above dose reduction initiatives have resulted in continuing improvement in dose performance for major projects (e.g. boiler campaign), outage dose performance and finally the station's over all collective dose performance.

Future Plans

Initiatives to continually drive improvements to the ALARA program are documented in the Site ALARA Strategy. The comprehensive strategy includes the following key aspects to improve future performance.

Comprehensive surveys will continue to be performed during planned outages and during operation to characterize the radiological condition and source term of each unit, enabling the development of current ALARA plans and effective dose reduction initiatives for jobs. If radiological 'hot spots' are identified, ALARA staff determine the benefit of removal of the hot spot versus other dose reduction methods including shielding. If warranted, the removal of the hot spot is managed via the station work management program.

Industry best practices will continue to be implemented to reduce source term and accordingly the dose to workers. A reduction in fueling machine filter pore sizes will improve the removal of insoluble radionuclide, which will in turn reduce general dose rates and hot spots.

Darlington will maintain an aggressive on-line D_2O transfer strategy to reduce internal dose to workers through moderator tritium reduction prior to a planned outage. An aggressive goal to reduce tritium content by at least 25% has been established.

OPG will continue to lead the industry in the innovative use of shielding applications. The use of temporary shielding has proven effective in reducing dose rates where the source could not be eliminated. Custom designed shielding (e.g. molded shielding for horizontal flux detectors and liquid poison injection lines) will continue to be used to reduce worker dose and dose associated with installations.

Remote monitoring and teledosimetry is a key component of the ALARA program. The installation of remote monitoring equipment has improved radioactive work planning and reduced dose to workers. Remotely operated cameras have been used to perform visual inspections and monitoring of inaccessible areas in support of plant Operations and Maintenance activities.

Remotely operated robotic equipment has been used and will continue to be used to mitigate high dose rate projects such as vertical flux detector removal.

Contamination Control

The RP Program prevents the uncontrolled release of contamination or radioactive materials from the site by on-site controls and monitoring of people and materials.

These measures control occupational exposure to contamination and prevent public exposures. The contamination control program ensures that contamination is prevented from leaving the radiologically controlled area, and that the spread of contamination within this area is minimized.

There are three elements to maintaining contamination control:

- Controlling contamination at the source,
- Containing and controlling radioactive and contaminated materials,
- Monitoring to verify the effectiveness of contamination control.

Performance

Since 2010 Darlington's contamination control program has been enhanced as part of continuous improvement through the following measures:

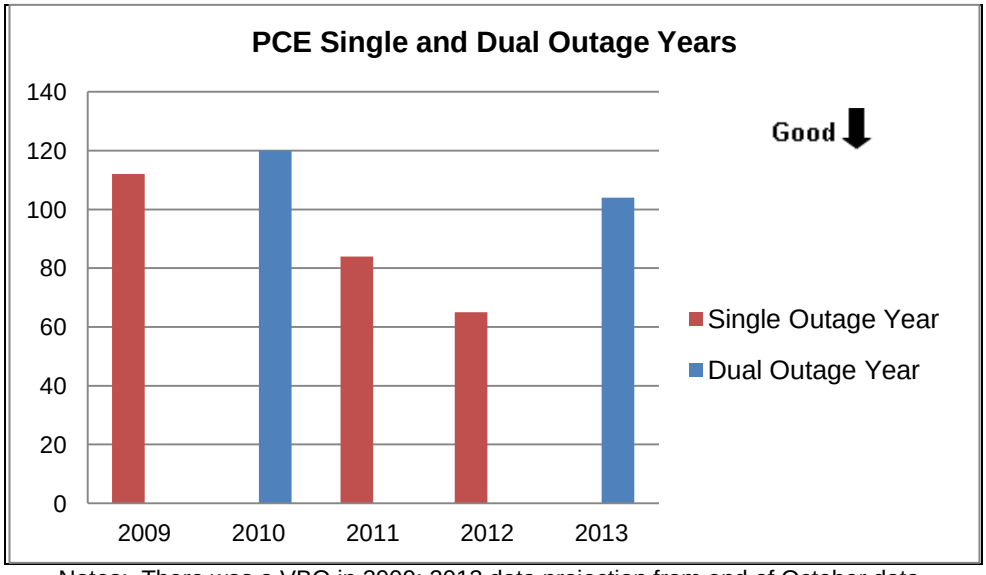
- Enhancement of alpha contamination controls and alpha classification in accordance with Electric Power Research Institute guidelines.
- Increased clarity of contamination control boundary delineation and positioning of contamination control monitoring equipment.
- Zone readjustments on 92.5 m elevation and 87.7 m elevation to reinforce the worker understanding of monitoring requirements.

- Establishment of additional contamination monitoring requirements for access to plant roof areas.
- Lowering of alarm set points on whole body monitors in the east and west fuelling facilities auxiliary areas.

The primary industry indicator for contamination control performance is the number of Personal Contamination Events (PCEs). Challenging PCE targets are established for both on line and outage work evolutions. Such targets are established in accordance with industry benchmarks.

Contamination control improvements, coupled with increased field oversight by RP and line ownership, have resulted in improvements (i.e. reduction) in PCEs as seen in Figure 15. These results show an improving trend in PCE occurrences for both single and dual outage years.

Figure 15 – PCE Single and Dual Outage Years



Notes: There was a VBO in 2009; 2013 data projection from end of October data.

8.2 Refurbishment

8.2.1 Radiation Protection Program

The Radiation Protection Program for refurbishment will be in compliance with N-PROG-RA-0013, *Radiation Protectio*n and its implementing procedures.

Refurbishment will be executed in a manner consistent with OPG's safety values and objectives, as well as best industry practices. OPG shall provide RP field staff who will provide oversight to EPC contractors and will ensure that OPG RP program requirements are met. EPC contractors will follow OPG RP procedures for refurbishment activities including compliance with the OPG's radiation protection action levels and ADLs for Darlington NGS.

Nuclear Refurbishment will develop and implement strategies during the execution of refurbishment, such as:

- Controlling or eliminating radiation hazards and implementation of shielding to reduce collective dose;
- Routinely analyzing and reviewing radiological source terms associated with major system and components likely to interface with the refurbishment; operations, in order to minimize the possibility of unforeseen radiation hazards;
- Ensuring contamination control is adequately addressed in tool, equipment, and process designs;
- Performing thorough review of plans to achieve dose reduction and minimization;
- Ensuring lessons learned from first outage experience are documented and applied to subsequent outages to further reduce collective doses; and
- Monitoring refurbishment work scope that may provide dose reduction benefits for continued operations, such as closure plug redesign, reactor component crud removal, radiation hot spot removal/remediation, and breathing air upgrades.

9.0 CONVENTIONAL HEALTH AND SAFETY

Darlington NGS, under its current PROL, is required to have in place a program that manages workplace safety hazards and to protect personnel and equipment.

OPG's key documents for the Conventional Health and Safety SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Work Protection	N-PROG-MA-0015	R009
Health and Safety Policy	OPG-POL-0001	R005
Conventional Safety	N-PROG-HR-0004	R003
Respiratory Protection	N-STD-RA-0037	R001
Fire Protection	N-PROG-RA-0012	R009
Application of CSA N293-7 to Structures, System and Components for Darlington Nuclear	NK38-LIST-78000-10001	R001

9.1 Current Operations

Over the past three years, CNSC staff have consistently assessed the Conventional Health and Safety SCA as exceeding regulatory requirements and expectations. Given the robust processes in place within OPG, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations during the next licensing period.

9.1.1 Conventional Safety Program

The goal of OPG's Conventional Safety Program is to ensure workers work safely in a healthy and injury-free workplace by managing risks associated with activities, products and services of OPG's Nuclear operations. Risk reduction is primarily achieved through compliance to operational controls, developed through risk assessment and safe work planning.

It is a legal requirement in Ontario to prepare and review, at least annually, a written occupational health and safety policy. The 2013 Health and Safety Policy has been approved by the Board of Directors and reflects OPG's commitment to the prevention of workplace injuries and ill health, and to continuous improvement in employee health and safety performance. OPG will accomplish this through the application of continuous improvement principles and systems to promote and maintain the physical, mental and social well being of employees in an injury-free and healthy workplace.

The Policy is communicated and promoted annually to ensure that employees at all levels are aware of OPG's commitment to health and safety and of their individual health and safety obligations.

Darlington has a Joint Health and Safety Committee (JHSC); which is a Tripartite committee comprising Power Workers Union (PWU), Society of Energy Professionals and management member representatives. As well there is a Worker Trades

Committee comprised of Building Trades Union (BTU) and management representatives. Senior management appoints the management representatives; while the unions select their PWU, Society and BTU representatives. Each committee has a co-chair from each of the workplace parties. The JHSC and Worker Trades Committee members work together to identify and recommend solutions to health and safety problems in the workplace, they have the common goal of making the workplace safer and healthier for all employees.

Work Protection is discussed in Section 4.1.2 under Operating Performance.

Performance

OPG uses the Canadian Electricity Association (CEA) safety measures to report safety performance and to compare against similar industries. The CEA indicators used to measure the conventional safety performance of OPG employees at DNGS are:

- Accident Frequency (AF) Rate (number of Lost Time Accidents + Medically Treated Injuries/200,000 hours worked).
- Accident Severity Rate (ASR) (number of days lost due to Lost Time Accidents/200,000 hours worked).

With the exception of ASR in 2012, Darlington's actual safety performance has been within the CEA top quartile for comparable industries for the past five years. OPG's focus on Proactive Musculoskeletal Disorders (MSD) reporting for ergonomic solutions and improvements with material handling, training, and procedures have led to excellent CEA performance. Figures 16 and 17 depict safety performance from 2008 through 2012.

Figure 16 – Accident Severity Rate

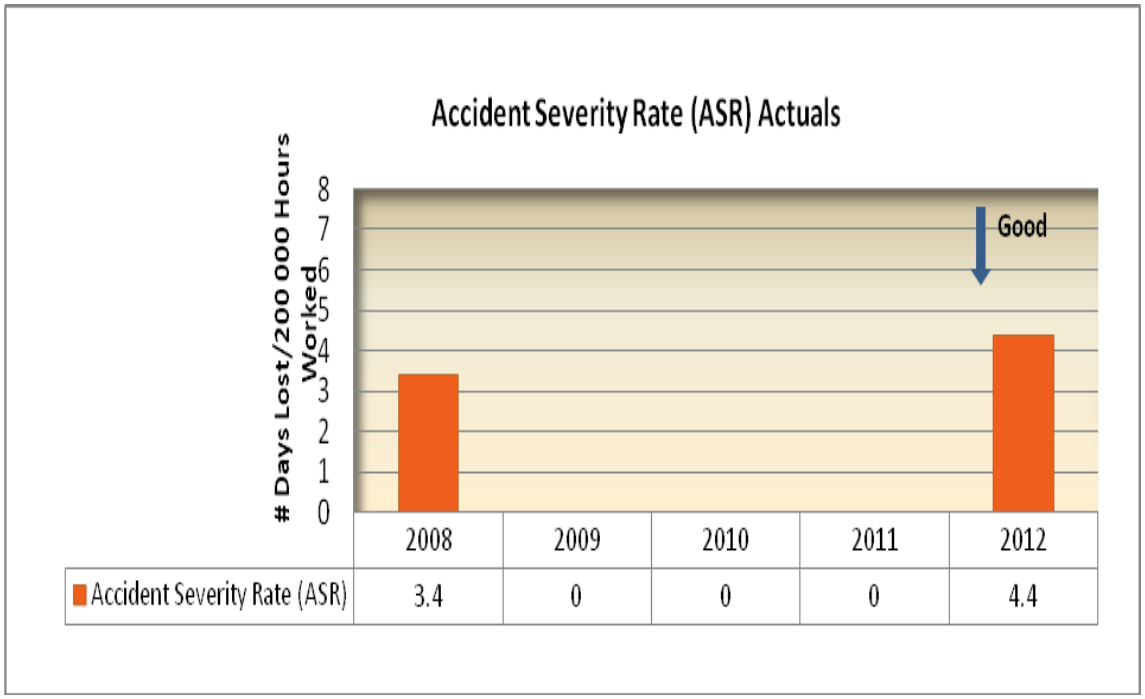
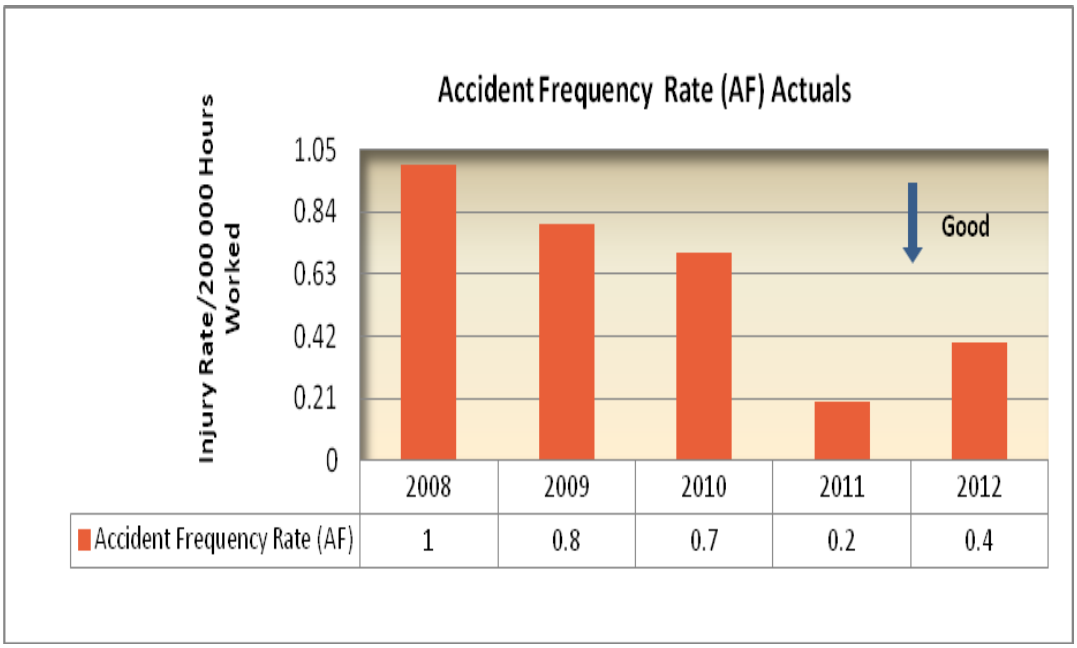


Figure 17 – Accident Frequency Rate



Darlington continues to rate events that result in no injury to personnel but are evaluated for learning and prevention, in order to take corrective action to prevent serious injuries from occurring in the future. In one such event in 2012, a worker received an electrical shock while working on live electrical equipment. The worker did not sustain any injury from this incident. As a result, one Ministry of Labour (MOL) order was issued under Ontario Occupational Health and Safety Act (OHSA) 851 Section 42(1). The requirements of this MOL order have been fully met.

In 2012 there were three hand injuries, and one back injury for a total of four medically treated injuries at Darlington for the year. The AF Rate was 0.4 for Year End 2012. The ASR for Year End 2012 was 4.4. This was above the Business Plan year end target of 2.04. There was one LTI on March 19, 2012 which occurred when an employee tripped over a scaffold pipe and fell injuring their arm; and resulted in a fracture (critical injury per OHSA definition).

Specific areas targeted for improvement in 2012 included situational awareness at the workplace, continued focus on material handling fundamentals and proactive hazard identification. This additional focus on proactive hazard identification resulted in the creation of a Workplace Safety Enhancement List which is managed through work control processes to correct identified hazards. This work is monitored monthly by Senior Site Management and corrective strategies developed when any trends are identified.

For 2012, tracking of proactive MSD hazards was extended to include tracking of all proactive safety hazards through the Workplace Safety Enhancement List. The Work Place Safety Enhancement program tracks safety improvement work orders which are discussed monthly by the management team. Specific target areas for improvement in 2013 include improvements to work protection events and situational awareness.

Darlington management will continue to drive commitment and communications around 2-Minute Job-Site Drills using the Safety Basics principles.

To reflect Darlington's commitment to continuously improving and challenging performance the 2013 target numbers for AF is 0.89 and for ASR is 2.04. These targets are set at industry leading levels based on the CEA top quartile performance for Group 1 Members (Electricity Generators, Transmission, Distribution and Utilities with >1500 employees). Efforts around proactive MSD hazard reporting garnered a strength in a 2012 Industry Peer evaluation for effectively identifying and correcting conditions around MSD hazards.

As of September 2013 Darlington is trending better than business targets for ASR which stands at 0.0 against a year end target of 2.04 and AF which is currently at 0.20 against a year end target of 0.89. Darlington is tracking toward its best performance ever in both ASR and AF for 2013. For 2014 Darlington will focus on three main areas:

(1) Situational Awareness
(2) Slips and Trips Prevention, and
(3) Contractor Safety

9.2 Refurbishment

9.2.1 OPG Personnel

Nuclear Refurbishment complies with the nuclear program document N-PROG-HR-0004, *Health and Safety*.

Nuclear Refurbishment will also comply with the nuclear program document N-PROG-MA-0015, *Work Protection.* Due to the large amount of equipment that will be worked on in the refurbishment outage, OPG will issue a new work protection procedure, equivalent to N-PROC-MA-0012, *Work Protection,* which will address the unique challenges with managing work protection on such a large scale. The Refurbishment-specific procedure will redistribute the accountabilities of the Maintenance Authority position. This, along with other administrative changes, will improve efficiency while maintaining work protection safety.

9.2.2 Refurbishment Contractors

Nuclear Refurbishment will engage contractors that have proven health and safety programs and experience. This will be verified in a prequalification process that reviews industry experience, historical safety performance, implemented management system elements, and prior OPG experience.

With respect to EPC contractors, OPG Nuclear Refurbishment will be the "constructor" and the contractors will be the "employer" as defined in the OHSA, and are governed by the requirements set therein.

External construction and support staff will be working under the "employer" programs and procedures. This allows the contractor front line supervisors and workers to work within the programs and procedures they are trained and experienced in. This will

improve performance of the teams while reducing human performance errors related to working with multiple programs and systems. This process aligns with the internal responsibility methodology as fostered in the OHSA.

A guide has been developed and built into contracts related to the Nuclear Refurbishment Program. This guide sets the expectations for conventional health and safety elements related to refurbishment, thereby ensuring that the contractor is fully aware of and will be held accountable to OPG's health and safety expectations. OPG will be reviewing the contractor's health and safety submissions against these expectations prior to their being approved to commence activities. This document also sets out common elements that will apply to all contractors within the Nuclear Refurbishment such as:

(1) Safety performance metrics and key performance indicators,

(2) Problem/ incident notification and investigation requirements,

(3) Common safety rules,

(4) Safety culture requirements,

(5) Communication requirements,

(6) Oversight and surveillance.

The Nuclear Refurbishment team recognizes that effective oversight throughout all stages of the program life cycle is paramount to the program's success.

10.0 ENVIRONMENTAL PROTECTION

Darlington NGS, under its current PROL, is required to have in place an environmental protection program in accordance with CNSC RD S-296, *Environmental, Policies, Programs and Procedures at Class I Nuclear Facilities and Uranium Mines and Mills.*

OPG's key documents for the Environmental Protection SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Environmental Policy	OPG-POL-0021	R003
Environmental Management	N-PROG-OP-0006	R016
Environmental Manual	NK38-MAN-03480-10001	R012
Radiological Environmental Monitoring Programs	N-PROC-OP-0025	R009
Monitoring of Radioactivity in Effluents	N-STD-OP-0031	R005
Derived Release Limits and Action Levels for Darlington Nuclear Generating Station	NK38-REP-03482-10001	R001
Hazardous Material Control	N-INS-07080-10000	R003

10.1 Current Operations

Over the last three years, CNSC staff have consistently assessed the Environmental Protection SCA as meeting all regulatory requirements and expectations. Given OPG's robust processes that are in place, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations over the next licence period.

10.1.1 Environmental Management Program

OPG's Board of Directors has set an environmental policy that requires, amongst other things, that OPG establish an Environmental Management Program consistent with the International Organization for Standardization ISO 14001 *Environmental Management System (EMS) Standard*. OPG's Environmental Management Program requires assessment of environmental risks associated with station 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 support compliance with applicable statutory and regulatory requirements. The EMS provides the structure and processes to ensure implementation and follow-up on management programs needed to deliver the environmental policy.

Performance

Darlington undertook the annual review of its Significant Environmental Aspects (SEA) during 2012 as required by the EMS, to ensure that all environmental aspects are captured. There followed an external audit of the OPG Nuclear EMS system by the Registrar, SAI Global, after which OPG Nuclear was re-registered under the ISO 14001:2004 standard. Subsequently, OPG implemented a Corporate-wide EMS to replace the Nuclear EMS which is also registered under the ISO 14001:2004 standard.

A large number of new background groundwater monitoring wells have been installed over the past few years. The new wells allow identification of contaminants that may be entering the Darlington NGS at differing depths from external sources.

Beyond the impacts of operations, Darlington NGS has a strong commitment to the community and has numerous programs aimed at embracing the broader principles of biodiversity and habitat stewardship, as described in the following.

The program to enhance the natural habitat on site includes monitoring programs for birds, amphibians, pollinators and bats. The bird monitoring program in particular has data for more than 15 years and has been conducted using the same protocol for all of those years, giving a rare data set for this region. Also, in 2011, Darlington NGS was once again re-certified by the Wildlife Habitat Council (WHC) under its Wildlife at Work program, based on meeting the WHC standards.

In 2008 and 2011, Darlington NGS was honored with the very prestigious WHC "Corporate Habitat of the Year" award. This recognition is for successful implementation and maintenance of a comprehensive wildlife habitat management program and a commitment to long-term wildlife habitat enhancement.

The Darlington NGS site covers more than 1,000 acres and is host to almost 900 species of plants and animals. The site includes a 7.5 km public hiking trail, the Waterfront Trail. Darlington staff provide on-site public programming and coordinate tree-planting, habitat enhancement and other environmental initiatives both on and off site with community partners.

In addition, Darlington NGS obtained re-certification in 2011 for its WHC Corporate Lands for Learning Program, which focuses on community partnerships, enriching environmental educational opportunities, and increased community use of the Waterfront Trail. These programs continue to support the Darlington NGS biodiversity plan. They also help instill confidence in our community neighbors and stakeholders about our commitment and ability to responsibly manage the impact of our business on the natural environment. Darlington NGS has been recognized as a pioneering site for the Corporate Lands for Learning "Fifty for the Future" initiative.

This site biodiversity plan complements the EMS since conservation actions demonstrate environmental performance to employees and the local community at a level which they can see and be involved in.

10.1.2 Radiological Releases

The objectives of the program are to maintain radiological releases ALARA, thereby minimizing dose to the public resulting from Darlington operations. Because radiological releases are very small in comparison with the Derived Release Limits (DRL) and Action Levels, lower Internal Investigation Levels (IILs), are used to demonstrate and maintain adherence to the ALARA principle.

Darlington NGS reports to approved DRL which can be defined as the calculated release rate of a given radionuclide or radionuclide group which, if released from a nuclear station for one year, would result in a typical member of the critical group receiving the maximum permissible dose (1,000 μSv) for a member of the public. For operational purposes, the

airborne DRLs are divided into weekly amounts and the waterborne DRLs into monthly amounts. Darlington NGS has never exceeded a DRL for any radionuclide or radionuclide group, and all releases remain at a small fraction of the limit.

The public dose resulting from Darlington operation remains essentially unchanged over the licensing period and has been consistently less than 0.1% of the legal limit. (see Table 4).

Table 4 - Public Dose from Darlington NGS

Year	2009	2010	2011	2012
Legal Limit (μSv/ year)	1000	1000	1000	1000
Public Dose μSv	0.7	0.6	0.9	0.6
% Legal Limit	0.07	0.06	0.09	0.06

New DRLs, listed in the report, *Derived Release Limits and Environmental Action Levels for Darlington Nuclear Generating Station*, NK38-REP-03482-10001 were implemented at the beginning of 2012. The most recent standard for the calculation of DRLs, CSA N288.1-08, was followed. The new DRLs also incorporate changes to the locations and characteristics of potential critical groups that were determined from the most recent Darlington Site-Specific survey.

Radiological Releases to Air

Powerhouse stack ventilation flows are monitored to measure the gaseous effluent releases (tritium oxide, carbon-14, noble gas, particulate, iodine-131 and elemental tritium). The results are compiled weekly and compared to the applicable weekly DRL. Darlington NGS has never exceeded a DRL for airborne releases, and in all cases releases are at small fractions of this limit.

Recalculated DRLs were implemented at the beginning of 2012. For gaseous effluent, the biggest change was for carbon-14 where the DRL was reduced by over 80% based on the previous value. The 2011 and 2012 carbon-14 release levels were almost identical at 27 Ci for each year. Similarly, particulate and iodine-131 DRLs were reduced by approximately 70% each.

The 2012 tritium oxide release level was 9% lower than for 2011. Noble gas and elemental tritium DRLs changed only marginally by comparison.

Radiological Releases to Water

Waterborne radiological release data are compiled monthly and compared to monthly DRLs. Most radiological releases are routinely managed through the Active Liquid Waste (ALW) system and monitored before discharge. Darlington NGS has not exceeded a waterborne DRL and releases in all cases are at a small fraction of this limit.

10.1.3 Conventional Releases

Releases to Air

Conventional releases to air from Darlington NGS consist of by-products from the combustion of diesel fuel, and of ozone depleting substances. Releases of acid gases SO_2 and NO_x, and greenhouse gas CO_2 from the Darlington site arise from operation of the standby generators and the emergency power generators during the course of routine testing, required to demonstrate reliability. Releases are well below the threshold for routine annual reporting to Environment Canada.

Darlington NGS has in the past used ozone-depleting substances CFC-11, CFC-12, HCFC-22 and HFC-134a in air-conditioning units, chillers and other refrigeration equipment. Routine reportable releases to Environment Canada of CFC-11 in 2010 and 2011 totaled 122 kg and 77.6 kg respectively. The implementation of new chillers eliminated the use of CFC-11 and CFC-12 in accordance with the Federal Halocarbon Regulation and the Ontario Refrigerants Regulation O.Reg. 189/94 (as amended) and hence the need for future reporting of CFC-11. There were no releases of CFC-12 during the licensing period**.**

Releases to Water

ALW, boiler blowdown (water removed from boilers to avoid concentration of impurities), and building effluent, discharge via the condenser cooling water discharge duct. This duct has a diffuser situated on the lake bottom with 90 exit ports. Treatment systems are used to remove toxicity and these streams are monitored routinely to ensure they are non-toxic.

The condenser cooling water intake structure, pumpwells and pumphouses are affected by zebra and quagga mussel infestations. Chlorination and mechanical removal are the two methods for mitigating infestation, and sodium hypochlorite is used as a biocide. The use of sodium hypochlorite had been increasing over the years due to increasing prevalence of mussel infestation. Since the use of sodium hypochlorite may cause changes to populations of aquatic species in receiving waters when used over an extended period, a dechlorination system was installed to ensure that the final discharge meets the Environmental Compliance Approval (ECA) total residual chlorine limit of 0.01 mg/L

The ECA effluent objective of 0.5 mg/L at the end of each Low Pressure Service Water (LPSW) and Emergency Service Water system and the effluent discharge limit of 0.01 mg/L remain unchanged. Darlington NGS has never exceeded the discharge limit.

Hydrazine, ammonia and morpholine, are used to provide pH control and corrosion protection in the boiler feedwater systems. In the licensing period, Darlington NGS met all the regulatory effluent release requirements and reported routine planned discharges to the Ontario Ministry of Environment in the annual ECA compliance reports. The first full-year use of morpholine was in 2012, following successful trials in 2011.

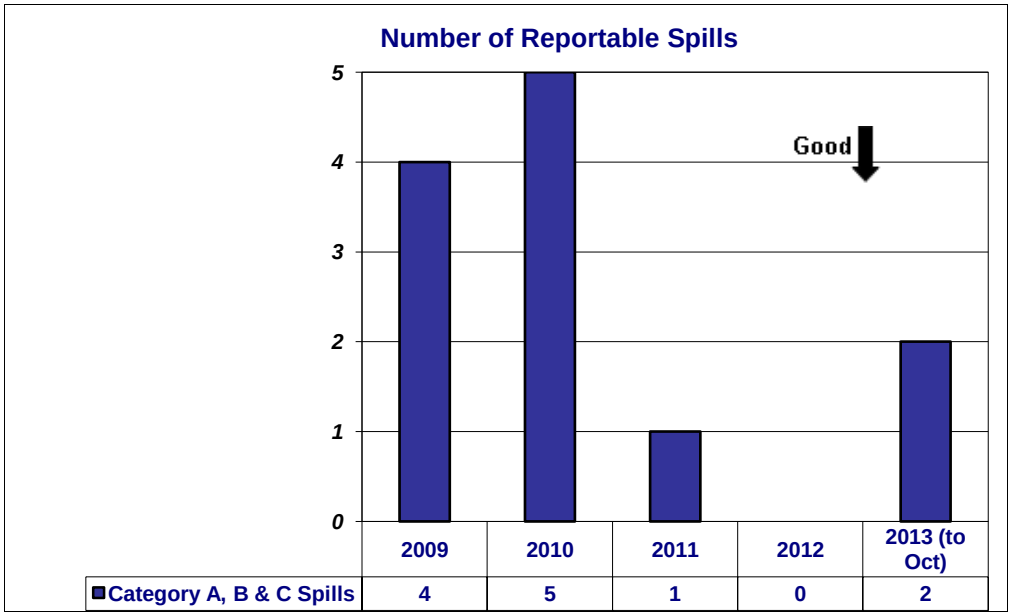
Hydrazine and ammonia are also included in the National Pollutant Release Inventory, and Darlington NGS is required to report these releases by June of each year to Environment Canada.

The magnitude of hydrazine and ammonia releases are influenced by the number of reactor outages during a given year with fewer outages tending to result in lower releases. The 3-year outage cycle for the reactors are expected to reduce ammonia and hydrazine releases.

10.1.4 Unplanned Releases

Figure 18 shows the total number of Category 'A', 'B' and 'C' spills from 2009 to October 2013 inclusive, all of which are reportable to the Ministry of the Environment. During this period, there were zero Category 'A' spills, one Category 'B' spill and eleven Category 'C' spills. The Category 'B' spill was caused by an overflow of the Injection Water Storage Tank (IWST) in December 2009 which resulted in a tritium release to the natural environment. Groundwater wells continue to be monitored to ensure no adverse impact off site. The Category 'C' spills in 2009 and 2010 were related to mobile equipment and refrigerants. Spills and refrigerant leaks are an OPG EMS Significant Environmental Aspect applicable to the Darlington Site.

Figure 18 - Category A, B & C Reportable Spills



In October 2013, a slow leak was discovered in the LPSW cooling flow from one of the Generator Seal Oil heat exchangers on Unit 1. Approximately 6000 L of oil may have discharged to the lake over a two month period before the heat exchanger was isolated on October 7 and the associated pump shut down. Subsequent sampling and analysis indicated no oil in the LPSW. The LPSW discharge is diluted by the large volume of station cooling water before it reaches the lake, and therefore no oil sheen or any other signs of visible oil were observed. OPG concludes that this event had no environmental impact, however, the event was reported to the Ministry of Environment Spills Action Center in accordance with our procedures.

In response to concerns expressed by interveners at the 2012 CNSC public hearing (EA and relicensing) on IWST spill in 2009, CNSC staff explained that an environmental site assessment is underway to further define the distribution and extent of contamination

of the IWST spill in groundwater. The Commission requested that OPG provide an update on this work. The field investigations have been completed and work is continuing in analysing the data and preparing a report which will characterize the spill. The report is anticipated to be completed in Q1 2014.

For radioactive releases, both air and water, IILs are used to indicate the potential development of a problem and a warning of a possible Action Level exceedence (note that no action level exceedences have ever occurred at Darlington NGS). IILs are site-wide and apply to each radionuclide or radionuclide group; they are set at the high end (97.5^{th} percentile) of the range of normal radionuclide release levels. Exceeding an IIL requires a Corrective Action Plan to address the occurrence. Although these are "internal levels", courtesy reporting of all IIL exceedences is routinely included in the S99 Quarterly Operations Report to CNSC staff.

The number of IIL exceedences during the current licencing period are at the expected level, which demonstrates that radioactive releases are being maintained at ALARA.

Program Improvements

The ISO14001 standard embodies the expectation of continual improvement of the EMS 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. The OPG SEA which apply to Darlington NGS allow for a focus of efforts in those areas where there is the potential to have a negative (or positive) impact on the environment. Meeting the objectives and targets of these SEAs is accomplished through either operational controls or specific programs. Some of these program areas are briefly identified as follows.

(1) Darlington has a groundwater monitoring program which provides the ability to identify and remediate contaminated soils.

(2) Habitat Management programs have the corporate objective of retaining what is ecologically significant, restoring habitats that have been degraded, replacing habitats which have been destroyed, recovering habitats and populations of species at risk.

(3) Following the 2011 Spring Fish Community Sampling Program, OPG committed to the Round Whitefish Action Plan with the CNSC, Ministry of Natural Resources, Fisheries and Oceans Canada, and Environment Canada which is currently in progress. Fish impingement and entrainment is an OPG EMS Significant Environmental Aspect applicable to Darlington NGS.

In response to concerns expressed by several interveners at the 2012 CNSC Public Hearing (EA and relicensing) on thermal effects from the diffuser, the CNSC asked if there were plans to update the 1980s study on thermal effects on round whitefish. A study, being conducted by the CANDU Owners Group, was in progress at that time, and is on track for completion in 2014. OPG will forward the final report to CNSC staff when it becomes available, and will use this new information to re-analyse the effects of Darlington operations on round whitefish.

(4) A mandate to recommend steps to reduce tritium emissions resulted in implementing targets for each unit together with prompt investigation of higher than target releases by the station staff, including walk-downs of equipment and leak searches. Tritium Emission is an OPG EMS Significant Environmental Aspect applicable to Darlington NGS.

(5) All of the confinement room system dryer desiccants have been replaced and the dryer heat exchanger tubes have been cleaned increasing the efficiency of the driers in removing tritium.

(6) Following recent CNSC hearings, OPG has reviewed information disclosure in relation to the public's interest in availability of environmental emissions data. To address this interest, OPG has proposed to provide environmental emissions data on its public website, consistent with the requirements and frequency of environmental emissions reporting to the CNSC under OPG's nuclear facilities operating licences. Current planning has targeted summer 2014 as the launch date for the first publicly available quarterly report.

Future Plans

Engineering Modifications pertaining to the Tritium Removal Facility (TRF) are planned for longer-term tritium reduction in order to implement recommendations from industry peers. This includes replacing the chilled-water-cooled vent condensers with high efficiency vent condensers; installing an adsorbent-based dryer system at the aforementioned heat exchangers; modifications to reduce tritium oxide emissions at the final stages of the tritium container unloading process and a number of more minor changes which will help with emissions reduction.

A plan is in place to replace all of the radiological stack monitors now that the stack monitor computers have all been replaced. It is expected that this work will take place early in the upcoming licencing period.

There are plans to tie in the sites sewage lines to the municipal sewage treatment system in 2013. Once completed the sewage treatment plant will cease operation.

Transition Plan for Compliance with 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* (update No.1, 2011); CSA Standard N288.4-10, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills,* CSA Standard N288.5-11 *Effluent monitoring programs at [Class I nuclear facilities and uranium mines and mills*] and CSA N288.6-12 *Environmental Risk Assessment*

OPG is committed to complying with the requirement of the CSA N288 series which provides guidance on the framework and methodology for establishing an environmental management program. This includes the assessment of risk and the development of monitoring programs to address these risks and demonstrate regulatory compliance. OPG is evaluating the standards which were recently revised and or issued for the first time to develop implementation plans.

CSA standard N288.1, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities* provides

guidelines and a methodology for calculating DRLs for routine releases of radionuclides to air and surface water. OPG has conducted an assessment of the recently revised (May 2011) version of the N288.1 CSA standard to determine the impact of these changes to the calculation of public dose and DRLs for DNGS. This assessment has determined that these changes will not affect the calculation of the DRLs, hence a revision to the current DRLs will not be necessary. An implementation plan with compliance dates was provided to CNSC staff for CSA N288.4-10, *Environmental Monitoring Program*. OPG will provide similar plans to CNSC staff for the remaining standards by May 2014.

10.2 Refurbishment

10.2.1 Environmental Management Program

The Nuclear Refurbishment Environmental Protection Program will be in compliance with N-PROG-OP-0006, *Environmental Management*.

To maintain good environmental performance during refurbishment, an environmental requirements guideline document has been issued to outline the required actions for all work groups, including contractors, and all of the elements needed to ensure a robust program in key areas.

The Darlington EA assessed activities in the Refurbishment Program to identify potential project-environment interactions. As a result, an EA follow-up program was developed to confirm that the predictions of environmental effects are accurate and that the mitigation measures will be applied. This detailed plan to address the follow-up program elements was submitted to the CNSC in October 2013 and was developed in consultation with the CNSC, stakeholders and the public (Reference 1).

The EA follow-up program activities associated with pre-refurbishment phase have begun, including the effluent characterization, benthic invertebrate community study, and monitoring of fish eggs, larvae and invertebrates entrained by the cooling water intake structure.

A fish entrainment study is planned prior to the start of the refurbishment outage, using a larger sample volume to improve estimation of intake aquatic biota losses. The information from this study will be used to develop performance thresholds for impingement and entrainment especially in reference to species at risk and aquatic species of conservation concern. OPG plans to complete these baseline characterization updates prior to the commencement of the refurbishment outage for the first unit, anticipated in 2016.

10.2.2 Control and Monitor Releases of Nuclear Substances

Nuclear Refurbishment control and monitoring of nuclear substances will be in compliance with N-PROG-OP-0006, *Environmental Management* and N-PROC-OP-0025, *Management of the Radiological Environmental Monitoring Programs*.

During refurbishment planning, activities expected to release a radioactive substance are required to have early completion of a documented evaluation of the environmental impact. This evaluation describes all the environmental impacts expected, including radioactive releases, and any mitigating actions associated with these activities. The

evaluation is approved by the Refurbishment Chemistry and Environment Manager. This process allows an opportunity to address potential impacts during the planning phase of the project. Additionally, engineered changes capture environmental risk during the modification outline process and then later during the design phase. Both of these incremental checks ensure all environment risk, including emissions risk is properly addressed. Finally, all installation or execution plans associated with these activities, require inclusion of environmental emission controls and approval of the Refurbishment Chemistry and Environment Manager.

During the execution and return to service phases of refurbishment, contractor staff will be adhering to, and monitoring their own compliance with, all relevant environmental protection governance and procedures. Oversight of contractor environmental protection performance will be performed by OPG.

10.2.3 Control and Monitor Releases of Hazardous Substances

Nuclear Refurbishment control and monitoring of hazardous substances will be in compliance with N-PROG-OP-0006, *Environmental Management* and N-INS-07080-10000, *Hazardous Material Control*.

A spill prevention and contingency plan will be established for refurbishment to address effluent, releases of chemicals, products planned for use, or products that are present at the facility. The purpose of the plan is to demonstrate the contractor's "project specific" commitment to spill prevention, preparedness, response, reporting and clean-up. Should there be a spill; the contractor will use the OPG template for spills reporting. Hazardous materials spill response will be provided by the station's Emergency Response Team in accordance with current procedures. Spills are to be reported and communicated in accordance with protocols outlined in N-PROC-RA-0020, *Preliminary Event Notifications*. OPG will have primary responsibility for reporting spills as required under S-99.

The Nuclear Refurbishment organization will require a hazardous materials management plan from the contractors that is in accordance with documented expectations and that complies with the OPG Health and Safety Framework for control and assessment of non-radioactive hazardous materials. Hazardous materials controls are required to include labelling, storage, handling, inventory information, system material compatibility, training requirements, disposal details and access to Material Safety Data Sheets.

Reference:

1. OPG letter, D. Reiner and B. Duncan to F. Rinfret, "OPG Submission of the DNGS Environmental Assessment Follow-up Program (Revision 001)", October 2, 2013, CD# NK38-CORR-00531-16500.

11.0 EMERGENCY MANAGEMENT AND FIRE PROTECTION

Darlington NGS, under its current PROL, is required to maintain an emergency preparedness program in accordance with CNSC RD-353 *Testing and Implementation of Emergency Measures* and a fire protection program in accordance with CSA Standard N293-07, *Fire Protection for CANDU Nuclear Power Plants*.

OPG's key documents for the Emergency Management and Fire Protection SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Emergency Preparedness Program		
Consolidated Nuclear Emergency Plan	N-PROG-RA-0001	R012
Fire Protection Program		
Fire Protection	N-PROG-RA-0012	R009

11.1 Current Operations

Over the last three years, CNSC staff have assessed the Emergency Management and Fire Protection SCAs as meeting regulatory requirements and expectations. Given the robust processes in place within OPG, it is expected that these SCAs will continue to meet or exceed regulatory requirements and expectations during the next licensing period.

11.1.1 Emergency Management Program

The objective of OPG's Emergency Preparedness Program, and specifically the Nuclear Operations unit, is to ensure that an effective response can be made to address emergencies affecting the safety or health of employees and contractors, business continuity, property and equipment, the environment or members of the public.

OPG nuclear emergency procedures receive authority from the Consolidated Nuclear Emergency Plan (CNEP). The CNEP is a nuclear-level plan that serves as the common basis of site-specific nuclear emergency preparedness and response arrangement at OPG's Nuclear stations. It describes concepts, structures, roles and processes to implement and maintain an effective OPG response to radiological emergencies that could endanger onsite staff, the public, or the environment. It is designed to be integrated with the Provincial Nuclear Emergency Response Plan.

Performance

Darlington continues to maintain a successful Emergency Preparedness drill and exercise program. This program provides all crews and Site Management Centre teams an opportunity to improve and sustain their emergency response capability as directed per station emergency procedures. Each crew practices their response to simulated station emergencies twice a year and participates in an annual evaluated crew drill or evaluated station drill.

In 2012 and 2013, OPG executed various levels of Severe Accident Management and Emergency Mitigation Equipment (EME) Drills and Exercises. The 2013 Exercise at Darlington was conducted over a two day period in August and involved the activation of the CNSC Emergency Operations Centre. Planning is underway for a large scale Exercise (Unified Response) in May 2014. This exercise will involve a number of Federal, Provincial and Regional entities to test a prolonged response to a severe accident.

OPG also participated in Durham Region Reception Centre Exercises in 2012 (Durham College) and 2013 (Fleming College). OPG continues to provide support for the Monitoring and Decontamination Unit at the Emergency Worker's and Reception Centres.

In accordance with Provincial Nuclear Emergency Response Plan requirements, outdoor public alerting sirens are operational in the Municipality of Clarington. OPG has also purchased indoor tone alert radios for the Durham Emergency Management Office (DEMO) as part of DEMO'S indoor alerting strategy in the Contiguous Zone (0 to 3 km). Additional enhancements to public alerting in the Primary Zone (3 to10 km) are being evaluated by a Public Alerting working group, including participation by Emergency Management Ontario, DEMO, and OPG.

OPG maintains an active role in the Provincial Nuclear Emergency Management and Public Education Committees. OPG provided support during the development of the Radiation Health Plan and Potassium Iodide Fact Sheet under the direction of the Provincial Ministry of Health and Long Term Care. Plans are underway for OPG, with the support of the Province and Durham Region, to issue a new emergency preparedness public information document to residences and businesses located in the primary zone of Darlington by June 2014

OPG actively participated in the CSA Technical Committee for the development of N1600, *General Requirements for Nuclear Emergency Management Programs*. This document was released for public review in August 2013 and is on track to be published in June 2014. Once issued, OPG will develop an implementation plan to incorporate improvements in the standard into OPG's programs.

In August 2013, Darlington responded to the CNSC direction stemming from the Darlington EA Day 1 hearings, and submitted information which identified the authorities responsible for Emergency Plan application and described how the various plans are integrated (Reference 1). This information was presented to the Commission at a public meeting in August 2013 and provided a comprehensive overview of the integration of the emergency response organizations at all levels of government.

Significant work has been completed updating the Emergency Response Organization (ERO) Training documentation to full SAT compliance and work will continue until the project is completed in early 2014.

In 2012, OPG completed a tabletop exercise to ensure the organizational response resiliency to a pandemic event. This exercise successfully demonstrated OPG's ability to maintain preparedness in the event of a pandemic and meet the requirements under

N-PROG-RA-0018, *Nuclear Pandemic Plan* (listed in Section 4.0 Operating Performance) to complete a drill every 3 years.

At the CNSC public hearing in December 2012, the Commission requested that CNSC staff prepare a report addressing the potential consequences of a more severe accident. CNSC requested OPG develop a series of more severe "stress test" case studies to illustrate the range of potential effects from a larger, more severe radioactive release for study. The results of this work will be discussed by CNSC staff in a meeting of the Commission in early 2014.

Given the intent of the emergency plans to maintain the capacity for a timely and safe evacuation in the event of a nuclear emergency, OPG continues to monitor population growth and engage with the Province, Region of Durham and the Municipality of Clarington, regarding land use policy in the emergency planning zones associated with the DNGS.

11.1.2 Fire Protection Program

The OPG Fire Protection Program establishes provisions to prevent, mitigate and respond to fires such that fire risk to OPG Nuclear workers, public, environment, nuclear physical assets, and power generation, is acceptably low and controlled.

The Fire Protection Program goals are to:

- minimize the risk of radiological releases to the public due to fire,
- protect plant occupants from death or injury due to fire, and
- minimize economic loss resulting from fire damage to structures, equipment, and inventories.

Performance

Darlington has implemented a comprehensive fire protection program to minimize the risk to the health and safety of persons and to the environment from fire, through appropriate fire protection system design, fire safety analysis, fire safe operation and fire prevention.

Darlington's Fire Safe Shutdown Analysis (FSSA) and Fire Hazard Assessment (FHA), Code Compliance Review and Inspection, Testing and Maintenance reports were submitted to CNSC staff by the end of 2011 in compliance with the Darlington PROL.

In July of 2013, during the FHA document review, CNSC staff determined that the FHA was not appropriately supported by adequate information and more information was required to demonstrate that the safety objectives of CSA N293-07 were met. In November 2013 (Reference 2), OPG provided the requested information to CNSC staff. This issue will remain open until all information has been reviewed by CNSC staff.

The Space Allocation Transient Material (SATM) process is to ensure that all transient material in the station is controlled and documented and as a result, administrative requirements are provided to ensure placement is properly assessed, analyzed, and authorized before being implemented in the field. SATM compliance has been a focus for Darlington and significant, effective and sustainable improvements have been

made in SATM control. A Fire Prevention branch has been formed across the Nuclear Fleet which will provide increased oversight of the SATM program and implementation of strategic initiatives.

An industry peer Technical Support Mission (TSM) was conducted at Darlington on Fire Protection in June 2012. The TSM concluded with three beneficial practices, one recommendation, and two suggested improvements. The three beneficial practices identified are listed below.

- Managers have taken strong ownership of the SATM program and are driving continuous improvements, thus reducing the combustibles and improving overall station housekeeping.
- The fire protection staff actively promotes fire prevention. This has significantly reduced the number of hazards throughout the station.
- The incident command training program provided to the site emergency response managers and the emergency response managers for OPG is more comprehensive than typically found within the industry.

The TSM recommendation to eliminate the use of plastic materials where suitable non-combustible materials are available was implemented and completed earlier this year. Suggested improvements included the development of a self-facilitated critique process similar to the current process used for operations simulator training critiques and to train the fire brigade leaders, members, and drill staff on the new self-facilitated critique process. These improvements have also been successfully implemented.

Transition Plan for CSA Standard N293-12, *Fire Protection for CANDU Nuclear Power Plants*

A code-over-code review was performed between CSA N293-12 and N293-07. The changes are editorial or clarification in nature. The Fire Protection program governance will be updated by the end of 2014 to reference the 2012 edition of CSA N293 with the exception of the design-related aspects of this standard. As per Reference 3, a CED for the design-related aspects of the standard has been established as N293-07.

11.2 Refurbishment

11.2.1 Emergency Management

OPG's Nuclear Program, N-PROG-RA-0001, *Consolidated Nuclear Emergency Plan* is being followed during refurbishment.

OPG will ensure that personnel, programs and processes for emergency preparedness are integrated into refurbishment activities. This will include:

- Contractors will follow the same procedures as OPG staff.
- Additional assembly and accounting areas will be set up to accommodate refurbishment staff and contractors.

11.2.2 Fire Protection

OPG's Nuclear Program, N-PROG-RA-0012, *Fire Protection* is being followed during refurbishment.

During refurbishment OPG will:

(1) Prepare fire protection strategies.
(2) Perform FHA and FSSA for the islanding areas and refurbishment units.
(3) Act as Controlling Authority and fire protection subject matter expert for SATM permits.
(4) Act as hot work permits issuer.
(5) Provide sufficient resources to response to first aid, fire fighting, rescue and hazmat incidents in refurbishment units and operating units.

References:

1. OPG letter, B. Duncan to M. Leblanc, "Darlington NGS 'A' Response to Record of Proceedings on OPG's Application for Station Licence Renewal - Emergency Plans Presentation", August 14, 2013, NK38-CORR-00531-16443.

2. OPG letter, Brian Duncan to F. Rinfret, "Darlington NGS 'A" - OPG's Final Response to Fire Hazard Assessment Action Item 201313-4190 Directive", November 19, 2013, CD# NK38-CORR-00531-16562.

3. CNSC letter, P.A. Webster and M. Santini to W.M. Elliott, "Design Code and Standards Effective Dates for OPG Nuclear Fleet", June 22, 2012, E-DOC # 3947068, CD# N-CORR-00531-05758.

12.0 WASTE MANAGEMENT

Darlington NGS, under its current PROL is required to have in place a program that covers internal waste-related programs related to the operation of the plant. Plans for decommissioning are also required under this SCA.

OPG's key documents for the Waste Management SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Waste Management		
Nuclear Waste Management Program	W-PROG-WM-0001	R012
Environmental Management	N-PROG-OP-0006	R016
Waste Management	N-PROC-OP-0043	R003
Segregation and Handling of Radioactive Wastes	N-PROC-RA-0017	R006
Materials Management	N-PROG-MM-0001	R006
Decommissioning Planning		
Decommissioning Planning	W-PROC-WM-0090	R001
Preliminary Decommissioning Plan - Darlington Nuclear Generating Station	NK38-PLAN-00960-10001	R001

12.1 Current Operations

Over the last three years CNSC staff have consistently assessed the Waste Management SCA as meeting regulatory requirements and expectations. Given the robust processes in place within OPG, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations during the next licensing period.

12.1.1 Waste Management Program

OPG's Environmental Management Program describes Nuclear Waste Management's program which controls the handling, storage and disposal of conventional and radioactive waste. Operating and maintenance practices focus on limiting the production of waste and facilitating its handling, storage and disposal.

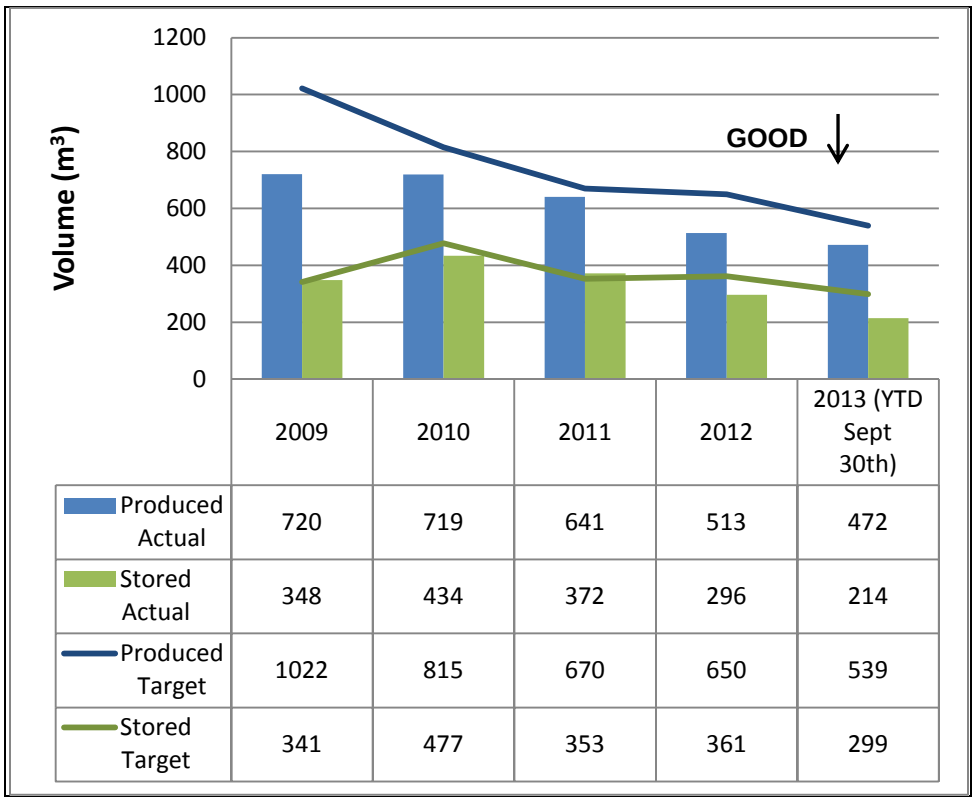
Performance

Low and Intermediate Level Radioactive Waste (L&ILRW) is generated more significantly during outages, but also arises from day-to-day operations. Targets have been established for both L&ILRW "produced" and L&ILRW "stored". L&ILRW produced is the volume of waste generated from nuclear operations that is shipped to the Western Waste Management Facility for processing and storage. L&ILRW stored is the final volume of waste that is actually stored at the Western Waste Management Facility following their review, acceptance, processing and storage of the produced waste from the same time period. Figure 19 shows the volume of L&ILRW both

produced and stored on an annual basis from 2009 to 2013 year to date, as compared to their respective targets.

L&ILRW is composed of three main categories: incinerable, compactable and non-processible, and includes such materials as disposable protective clothing, wastes from decontamination and other clean-up activities, desiccants, resins, filters, contaminated tools and system components. As can be seen by Figure 19, some volume reductions have been achieved in each of the last four years; the largest contributor being the expansion of the re-washable radioactive personal protective equipment program. Looking forward, Darlington is currently on target for the end of 2013 with year end targets of 885 m^3 and 492 m^3 for L&ILRW produced and stored respectively.

Figure 19 - Low and Intermediate Level Radioactive Waste Produced



	2009	2010	2011	2012	2013 (YTD Sept 30th)
Produced Actual	720	719	641	513	472
Stored Actual	348	434	372	296	214
Produced Target	1022	815	670	650	539
Stored Target	341	477	353	361	299

For conventional solid wastes, Darlington has a target of 70% landfill diversion. From 2009 through 2012, Darlington achieved landfill diversions of 69%, 72%, 65%, and 77% respectively.

Future Plans

Ongoing improvement initiatives for L&ILRW include incorporating considerations into outage planning, continuing to reduce incinerable waste through re-washable Radiation Personal Protective Equipment, and improving waste characterization.

Station Radioactive Solid Waste Minimization Plans are developed annually which include operational programs such as:

- a de-packaging program to remove packaging materials prior to items being sent into radioactive areas
- establishment of a Darlington Solid Waste Minimization Team
- continue to utilize re-washable products, and
- work with Nuclear Waste Management Division (NWMD) through their Nuclear Waste Management Program (W-PROG-WM-0001).

Also, L&ILRW is an OPG EMS Significant Environmental Aspect applicable to Darlington NGS.

For chemical wastes, techniques developed at Darlington to separate/ filter active oily liquid wastes for incineration and for the solidification of other active aqueous wastes continue to assist in the processing of active chemical wastes on an ongoing basis. These innovations have had a major impact on the number of chemical waste drums stored at Darlington (approx 275 drums processed through these initiatives over the past six years) and have significantly eased the financial burden of active chemical waste disposal (with savings of over $3.8M over the same six year period).

Transition Plan for CSA N292.3-08, *Management of Low and Intermediate Level Radioactive Waste*

OPG has reviewed CSA N292.3-08, *Management of Low and Intermediate Level Radioactive Waste* and determined there are no impacts to OPG's waste management programs. OPG is currently compliant with N292.3-08 and no transition plan is required.

12.1.2 Program for Planning the Decommissioning of the Nuclear Facility

Planning for the eventual decommissioning of the Darlington NGS is an ongoing process, taking place throughout each stage of the licensed facility's life cycle. The proposed plan for the decommissioning is described in NK38-PLAN-00960-10001, *Preliminary Decommissioning Plan – Darlington Nuclear Generating Station*. This Preliminary Decommissioning Plan (PDP) was prepared in accordance with CNSC Regulatory Guide G-219 *Decommissioning Planning for Licensed Facilities* and CSA N294-09 *Decommissioning of facilities containing nuclear substances* and it is updated periodically as required.

The DNGS PDP 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 technology and it provides a basis for estimating the cost of the decommissioning. The PDP includes schedules and cost estimates based on the assumptions that form the basis for this plan.

The DNGS PDP was revised and submitted to the CNSC in June 2012 (Reference 1) and accepted by the CNSC in December 2012 (Reference 2) in support of the 2013 to 2017 CNSC Financial Guarantee. The requirements of CSA N294-09 as well as any relevant domestic and international experience obtained in the last five years were

incorporated into this revision. The next revision of the PDP will be submitted to the CNSC by January 31, 2017 in support of the 2018 to 2022 CNSC Financial Guarantee.

The Darlington PDP will be replaced by a Detailed Decommissioning Plan prior to the commencement of dismantling and demolition and will be submitted to the CNSC, according to the applicable regulatory requirements.

12.2 Refurbishment

12.2.1 Waste Management Program

The Nuclear Refurbishment Program will be in compliance with the program documented in N-PROG-OP-0006, *Environmental Management*, and W-PROG-WM-0001, *Nuclear Waste Management Program*. These program documents will control the handling, storage, and disposal of both conventional and radioactive waste by OPG and contractors.

During refurbishment, radioactive waste will be dealt with by a contractor in a specifically designed Retube Waste Processing Building with support of radiation protection assistants to ensure correct segregation. The waste generated from the reactor components will be stored on site in the Retube Waste Storage Building.

New procedures based on the requirements in W-PROG-WM-0001, *Nuclear Waste Management Program* to address the waste from the reactor, are in development and are expected to be ready for use in 2016. All other generated waste will be treated as per current processes and procedures.

OPG is implementing actions to ensure that the Irradiated Fuel Bays will be ready from a heat removal and space standpoint prior to receiving a units full core discharge of fuel prior to the start of refurbishment.

References:

1. OPG letter, A. Sweetnam to D. Howard, “Submission of Preliminary Decommissioning Plans, Proposed Supporting Financial Guarantee and Documentary Information Summary”, June 27, 2012, CD# N-CORR-00531-05696.

2. CNSC letter, Louise Levert to Albert Sweetnam, “Record of Proceedings and Licences – OPG’s Financial Guarantee”, December 20, 2012, E-DOCS # 4056605, CD# N-CORR-00531-06031.

13.0 SECURITY

Darlington NGS, under its current PROL, is required to have in place a security program in accordance with CNSC regulatory documents and regulations.

OPG's key documents for the Security SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Darlington Nuclear Generating Station Security Report	8300-REP-61400-10003	R005
Attachment 1: Primary Firearm Course of Fire and Qualifications	N-CORR-00531-04980	N/A
Attachment 2: Secondary Firearm Course of Fire and Qualifications	N-CORR-00531-04980	N/A
Nuclear Security	N-PROG-RA-0011	R005
Transport Security Plan	TRAN-PLAN-03450-10000	R010
Threat and Risk Assessment	NK38-REP-08160.3-00001	R006

13.1 Current Operations

Over the past three years, CNSC staff have consistently assessed the Security SCA as meeting regulatory requirements and expectations. Given the robust processes in place within OPG, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations during the next licensing period.

13.1.1 Security Program

The objective of OPG's security program is to ensure safe and secure operation of the station, by maintaining protection through use of equipment, personnel, and procedures.

OPG's site security program at Darlington has continued to evolve in order to meet all regulatory requirements and commitments over the period of the current operating licence.

Training is conducted to enhance and sustain improved performance in the Security Division. Nuclear Security Tactics and Training provides training to armed/unarmed security officers, to ensure qualifications are maintained and re-qualifications and new qualifications are delivered, so that all security officers remain current in all aspects of training.

Performance

Since 2001, there has been an armed response force on site at all times. In April 2012, OPG completed its transition of armed response duties from the Durham Regional Police to OPG Nuclear Security Response Team (NSRT).

As required by the Nuclear Security Regulations, OPG submits Threat and Risk Assessment Reports annually to the CNSC. The most recent one was submitted in December 2012. An update to the *Darlington Nuclear Generating Station Security Report*, 8300-REP-61400-10003 is currently in progress and will be submitted to CNSC staff early in 2014.

The security drill program is a means of validating security practices, ensuring regulatory compliance, and identifying areas for improvement in security operations. These drills are conducted both with armed and unarmed members of the security force ensuring full integration of OPG's security program.

The CNSC Force on Force program has been implemented. Force on Force exercises were executed successfully in 2013 to assess the integrated response capabilities of the OPG Nuclear Security armed and unarmed elements, against adversaries equipped and performing within the Design Basis Threat.

OPG participates in an Inter-Utility Security Working Group which includes all power reactor operators in Canada. This group is part of the overall program to ensure nuclear security programs in Canada continue to evolve to meet future requirements. OPG continues to use external benchmarking and consultative services to ensure that the security program meets industry standards.

Since 2011, Nuclear Security has continued to operate at a high standard and meet all regulatory requirements. Regular meetings with CNSC staff at site and at Ottawa ensure open communication and that evolving security requirements are understood.

In 2012, NSRT captured the gold medal in the Superstars event of the Toronto Police Games. This is the second time in three years that OPG has been crowned Superstar Champions. In addition, OPG was the recipient of the Security Educator and Women in Security award from the American Society of Industrial Security. It is the second year that OPG has been honored with the Security Educator award.

OPG also participated in the 2012 Ontario Tactical Advisory Body Competition claiming first place, winning the Nuclear Security category but also posted the best marks for the 18 Police and Nuclear Tactical Teams in the competition.

Future Plans

Enhancements to the Physical Barrier System at the Darlington sally port are being installed to completely encase the protected area and comply with the Nuclear Security Regulations.

Nuclear Security will be replacing its current personnel screening equipment as it reaches end of life. The new screening equipment that will be deployed ensures a higher level of search rigour is applied allowing OPG to remain compliant with the Nuclear Security Regulations.

Nuclear Security is currently involved with all projects being executed at the Darlington site. This involvement includes review of project design to ensure existing security systems remain unimpeded and operational. Secondly, the review ensures required

changes to security systems or new security requirements are applied to ensure full compliance is maintained.

Transition Plan for Compliance to REGDOC 2.12.2 *Site Access Security Clearance (2013)*

An implementation strategy has been developed for compliance with REGDOC 2.12.2. Security will be in full compliance by December 31, 2014.

13.2 Refurbishment

13.2.1 Security Program

OPG's Nuclear Program on Nuclear Security N-PROG-RA-0011, *Nuclear Security* is being followed during refurbishment.

To support the large numbers of contractors on site during refurbishment activities, a Refurbishment Project Office is scheduled to begin construction in 2014 on the west side of the station with completion set for 2015. The Refurbishment Project Office will host an additional search area for refurbishment staff including a new entry point to the protected area. The Refurbishment Project Office building has been designed to meet all of the requirements of the Nuclear Security Regulations. The Refurbishment Project Office will see the extension of the protected area from its current configuration as the existing Physical Barrier System is extended to the north side of the building.

Security has begun conducting multi vehicle inbound searches at the Darlington sally port in support of increased project work within the station. The construction of a sally port extension is scheduled to begin for the spring of 2014. The extension will increase the capacity of vehicles that can be searched at one time without compromising the requirements of the Nuclear Security Regulations and ensuring detailed searches are conducted and continuity of searches maintained.

Security staffing requirements will increase over the next few years to meet the needs of the station and refurbishment work that will be conducted at Darlington NGS. The Design Basis Threat will be reviewed and updated to include changes being made in support of the refurbishment specific to the Refurbishment Project Office building and sally port enhancements. An access authorization process is followed to ensure personnel and contractors requiring access to Darlington NGS or access to OPG Confidential, OPG Confidential Exclusive or Security Protected information, do not pose a risk to the facility, its employees or company assets.

14.0 SAFEGUARDS

Darlington NGS, under its current PROL is required to have in place a program that ensures all obligations arising from the Canada/International Atomic Energy Agency (IAEA) Safeguards agreement are met.

OPG's key documents for the Safeguards SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Nuclear Safeguards	N-PROG-RA-0015	R006
Nuclear Safeguards Implementation	N-STD-RA-0024	R005

14.1 Current Operations

Over the last three years, CNSC staff have consistently assessed the Safeguards SCA as meeting regulatory requirements and expectations. Given the robust processes in place within OPG, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations during the next licensing period.

14.1.1 Safeguards Program

Darlington continues to meet its licence conditions concerning Canada's international obligations under the Treaty on the Non-Proliferation of Nuclear Weapons. 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.

Darlington staff completes an annual Physical Inventory Taking (PIT) as part of licence conditions pursuant to the implementation of safeguards by the IAEA. Canadian facilities are selected at random by the IAEA for a Physical Inventory Verification (PIV) that follows the PIT. If a facility is not chosen for PIV, then CNSC Safeguards Staff performs limited confirmation activities following the annual PIT. The IAEA conducted a PIT at Darlington in 2011 and 2012 and completed a PIV in October 2013.

These IAEA inspections were 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 IAEAs adherence to its rights and obligations relevant to the inspection. No significant compliance issues were identified.

Darlington transitioned to full compliance with CNSC Regulatory Document RD-336, *Accounting and Reporting of Nuclear Material,* as of July 1, 2012.

14.2 Refurbishment

14.2.1 Safeguards Program

OPG will maintain the safeguards program on the Refurbishment unit(s) in compliance with Power Reactor Operating Licence Condition 14.1 and CNSC regulatory document RD-336, *Accounting and Reporting of Nuclear Material* as applicable.

OPG documents N-PROG-RA-0015, *Nuclear Safeguards* and N-STD-RA-0024, *Nuclear Safeguards Implementation* are being followed during refurbishment.

On behalf of Nuclear Refurbishment, Darlington NGS will provide required routine and advance notifications and declarations to the IAEA of refurbishment outage dates and details related to defueling, initial core loading, and maintenance work which may interfere with the functionality of safeguards equipment.

15.0 PACKAGING AND TRANSPORT

Darlington NGS, under its current PROL, is required to have in place a program that covers the safe packaging and transportation of nuclear substances and radiation devices to and from the licensed facility.

OPG's key documents for the Packaging and Transport SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Radioactive Material Transportation	W-PROG-WM-0002	R008
Radioactive Materials Transportation Emergency Response Plan	N-STD-RA-0036	R002

15.1 Current Operations

Over the last three years, CNSC staff have consistently assessed the Packaging and Transport SCA as meeting regulatory requirements and expectations. Given the robust processes in place within OPG, it is expected that this SCA will continue to meet or exceed regulatory requirements and expectations during the next licensing period.

15.1.1 Packaging and Transport Program

OPG's NWMD is responsible for the management of radioactive waste for OPG. NWMD has direct responsibility for transportation, central processing and interim storage of nuclear waste. This responsibility starts from the point where the waste is packaged and ready for removal from the generating station.

The NWMD Radioactive Material Transportation Program establishes the necessary controls for safe and efficient transportation of radioactive material. These controls provide procedures for the handling, packaging, shipment, carriage and receipt of radioactive materials. The controls also address emergency response to transportation accidents.

Performance

There have been no dangerous occurrences reportable under the Packaging and Transport of Nuclear Substances Regulations for consignments shipped from Darlington station during the licence period. OPG drivers transporting radioactive materials have an excellent safety record on the roads. With the exception of one minor collision where OPG was not at fault, OPG drivers have travelled 3 million kilometers over 5 years without incidents.

In 2012, CNSC staff conducted a Type II inspection of the conduct of radioactive shipments at Darlington. There were no findings as a result of this inspection.

Radioactive material transportation packaging and conveyances are regularly maintained. The completion of package maintenance is tracked monthly as a performance metric.

OPG maintains the required complement of trained and qualified Class 7 shippers, carriers, handlers and receivers.

Future Plans

NWMD is in the process of replacing its older transportation packages. The designs of the new packages incorporate improvements based on NWMD's operating and maintenance experience, and utilizing industry best-practices.

15.2 Refurbishment

15.2.1 Packaging and Transport Program

Nuclear Refurbishment will follow the program W-PROG-WM-0002, *Radioactive Material Transportation*, and N-STD-RA-0036, *Radioactive Materials Transportation Emergency Response Plan*.

OPEX from other refurbishment programs indicates that a limited volume of new Intermediate Level Waste, such as magnetite, may be generated. This waste can be shipped in the same manner as is currently used for spent resin.

16.0 NUCLEAR FACILITY SPECIFIC – TRITIUM REMOVAL FACILITY

OPG's key documents for the Tritium Removal Facility SCA are listed in the table presented below. These documents are in the current LCH.

Document Title	Document Number	Revision #
Darlington Nuclear Operating Policies and Principles	NK38-OPP-03600	R028
TRF Planned Outage Management	D-INS-39000-10003	R002
Heavy Water Management Plan	N-PROG-AS-0008	R003

16.1 Current Operations

The TRF and Heavy Water Management Building (HWMB) maintains low tritium levels at Darlington and all Ontario CANDU reactors, and maintains isotopic purity requirements for heavy water at Darlington.

Performance

Safe operation is the top priority at the TRF and there have been no lost time accidents since 1999.

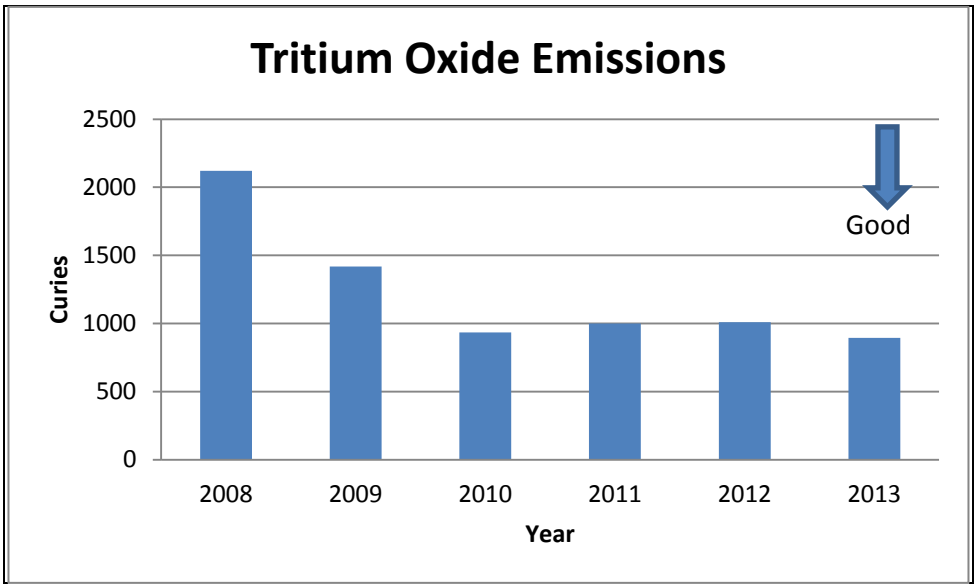
All TRF staff training is now based on the Systematic Approach to Training as a result of successful implementation of the training corrective action plan in 2012.

Darlington instruction, D-INS-39000-10003, *TRF Planned Outage Management* is being used to plan and execute the 2013 TRF Outage. Lessons learned from the usage of this procedure are being documented in SCRs for incorporation into lessons learned for future outage planning.

Taking into account outage durations there has been a continued increase in throughput and capacity factor to 2011. In 2011, the TRF had a record year with an 87.3% capacity factor, processed greater than 2800 Mgs of D_2O and immobilized 30 million Ci of tritium. Implementation of Life Cycle Plan initiatives in 2015 to 2016 and maintenance performed in the 2013 TRF outage will address the issues with lower performance experienced in 2012 and 2013.

Emissions reduction and minimization has remained a strong focus, with a decreasing trend demonstrating excellent results to 2013 (Figure 20).

Figure 20 – Tritium Oxide Emissions (to Sept. 2013)



Future Plans

To ensure continued detritiation capability and to improve TRF equipment reliability to end of design life (2025), a Life Cycle Plan was developed. During the next 10 years, the TRF will continue implementation of the Life Cycle Plan. Major elements are important engineering changes and projects intended to sustain system health, improve equipment reliability, and address equipment obsolescence.

One of these initiatives is to install a condition monitoring system for the cryogenic refrigeration system hydrogen compressors. The enhanced monitoring and early failure prediction capabilities of the condition monitoring system will provide confidence and safe operation while extending the time between TRF outages by up to 50%.

In order to extend the operating life of the TRF to 2055 (the end of Darlington NGS extended life), various options have been reviewed including: life extension of the existing TRF, major refurbishment of the existing TRF, and construction of a new TRF.

By the end of 2012, component condition assessments were completed and recorded in the Darlington component condition assessments database to determine the potential scope and cost of Tritium Removal Facility life extension. The results indicate that life extension will be the lowest cost option to ensure adequate detritiation capability to 2055. Further work will be progressed to refine the life extension scope and determine the feasibility of life extension implementation, while maintaining low tritium levels at Darlington and at all Ontario CANDU reactors. A decision to continue with TRF life extension is expected by 2017.

Life extension of the TRF is being addressed in a separate but parallel effort to the Nuclear Refurbishment Program.

17.0 DARLINGTON SITE INFRASTRUCTURE IMPROVEMENTS

The campus plan is the site utilization master plan that supports the current and future needs of the Darlington site including refurbishment. It was created to institute a framework for future land use changes and growth for buildings inside and outside the protected area of Darlington NGS and for ensuring that spatial planning accommodated OPG's vision for the site over the next 30 to 40 years. The following changes to the Darlington site are planned:

(1) Boiler House

The objective of this project is to replace the current life-expired construction oil-fired boiler house facility with an auxiliary heating steam facility with acceptable reliability and availability to provide an alternate source of heating steam to the Darlington building heating steam system when the normal source of supply (extraction steam from an operating generating unit) is unavailable.

(2) Heavy Water Storage Facility

The objective of this project is to build a new Heavy Water Storage Facility at Darlington NGS in order to provide sufficient heavy water storage capacity at the Darlington site during the refurbishment period. The facility would also address the operational needs for sufficient heavy water storage and segregation to improve the existing heavy water management process.

(3) Water Treatment Plant Replacement

The objective of this project is to ensure a continuous, high quality, cost effective supply of demineralised water to Darlington NGS until the end of the station life. The Darlington Water Treatment Plant (WTP) has been in service since 1987. Despite past reliable operation, the WTP will be challenged to maintain satisfactory system health status and reliability as it reaches or exceeds the end of its design life.

(4) Buildings and Supporting Infrastructure

A number of facility and infrastructure projects are being under-taken to support station operations and planned outages including refurbishment. Broadly these fall into two categories.

The first is the addition of shop and office facilities to support the increased level of work activities, including task driven requirements such as:

- The construction of a new security protected entrance and change-room facility through which construction worker access will be provided.
- The construction of a facility for volume reduction of reactor component wastes.
- Improvements to D_2O handling facilities to accommodate Heat Transport D_2O shrink and swell (during system cooldown and warm-up) and to support de-watering the units in preparation for refurbishment.

- Additional shop and office facilities as required to support the work force required for planned outages including refurbishment.

The second is changes or improvements to supporting infrastructure for the additional facilities, including:

- Changes to sewer and water infrastructure to support these new facilities.
- Changes to electrical power distributions systems as required.
- Changes to site roads and access supporting the new facilities and the increased traffic levels associated with station project activities.

18.0 FUKUSHIMA ACTION PLAN UPDATE

Following the March 11, 2011 Fukushima event in Japan, OPG has worked closely with industry partners and CNSC staff on a coordinated and comprehensive response to the lessons learned and issues raised from the event. OPG has kept CNSC staff informed of OPG's progress on station robustness reviews, action plan development, and the implementation of modifications to procedures and equipment to increase OPG's defence in depth capability to respond to beyond design basis occurrences.

The CNSC, through its Fukushima Task Force, has developed a set of recommendations and CNSC staff have developed an Action Plan for implementation in Canada. The recommendations and Action Plan have been conveyed to OPG as Fukushima Action Items (FAIs) (Reference 1).

In Reference 2, OPG provided its latest status of progress on addressing the FAIs. For OPG, the implementation priorities are to improve capability to:

- Prevent the occurrence of fuel damage and release of radioactive materials to the environment, by improving defences against hazards and by providing additional portable emergency water and power supplies.
- Arrest progression of fuel and core damage through additional operational measures.
- Implement timely protective and mitigating actions to respond to beyond design basis accidents.

OPG's assessment of the lessons learned from Fukushima indicated that the OPG NPPs are safe, with robust means to respond to design basis events and beyond design basis accidents. However, there were recognized enhancements that could be implemented to support the response to accidents such as a total loss of all ac power event, and other severe accident response measures. These provisions are included in the CNSC FAI Plan.

As outlined in Reference 2, OPG has made significant progress in a number of areas in support of the Action Plan. CNSC staff have closed 78 of the 101 FAIs tracked for OPG, and have noted OPG's considerable progress against the Action Plan (Reference 3). The following are particularly noteworthy:

- Hydrogen mitigating Passive Autocatalytic Recombiners (PARs), which are in addition to hydrogen igniters but do not rely on electrical power, are being installed on all units during their planned outages – with three units completed, and the remaining unit targeted to be completed by July 2014.
- An additional level of defence in depth has been implemented at Darlington NGS – with the delivery of important EME – including portable diesel pumps and diesel generators / portable uninterruptible power supplies to supply essential fuel cooling through multiple paths and to power key monitoring equipment in the event of the loss of normal and backup emergency power supplies. This equipment is in service, the associated operating and maintenance instructions have been issued, and required staff have been trained.
- An EME storage facility has been built near the station but outside the protected area to house the new equipment.

- Response to potential loss of cooling capability in the IFBs has been enhanced and analysis has demonstrated that bay integrity will be maintained under elevated temperature conditions.
- Additional seismic assessments of the Darlington IFBs have been completed to confirm adequacy.
- An automated real-time station boundary radiation monitoring system has been installed and is operational.
- SAMG have been implemented at Darlington and training has been conducted. SAMG has also been updated to utilize the new EME equipment if required to support the response.
- Emergency Preparedness plans to support the response to severe accidents, including updates to ERO operational procedures and instructions have been implemented.
- A Mutual Aid Agreement has been established between Canadian Nuclear Operators to provide support in the event of an emergency at any site.
- Associated confirmatory Emergency Preparedness drills have been planned and executed – including response to station extended loss of all ac power events, and severe accident response.

OPG will continue to progress the analysis and implement the modifications to procedures and equipment to meet the requirements of the CNSC FAI. As detailed in Reference 2, OPG's plans include:

- Enhancements to the tie-in provisions for EME to station equipment are being developed, streamlining and simplifying the deployment of EME after an event.
- Additional EME will be provided, allowing additional capability to re-power key station pumps and instrumentation – to be able to recover and re-inject cooling water, and to protect containment integrity. Associated procedures and training will be put in place to ensure the availability of this additional layer of defence.
- Shield Tank overpressure relief will be enhanced on all units thereby providing an additional water source for core cooling.
- Filtered containment venting capability for severe accidents will be enhanced.
- Emergency communications are being further enhanced to provide additional capabilities for communications within the plant and to outside support organizations after a beyond design basis event.
- Severe Accident Management enhancements will be implemented, additional studies will be performed and modifications implemented as required. These include response to multi-unit events, and response on shutdown units.
- Planning for a Remote Emergency Response Support Centre is underway – with potential to store additional response equipment and EME that could be delivered to site immediately after an event.
- Emergency Planning and coordination enhancements continue to progress with lessons learned being incorporated at each phase. A major Emergency Preparedness exercise – Unified Response – involving utility, government and support agencies is planned for May 2014.

OPG also has continued to work with CNSC staff, industry, and international regulatory bodies supporting the development and implementation of new regulatory requirements based on lessons learned from Fukushima. OPG is a member of and chairs the CANDU Industry Integration Team – an international forum under the COG

that provides a means for all COG members to share common principles and approaches to implement required modifications to equipment and processes.

OPG will continue to provide bi-annual updates on its progress against the Fukushima Action Plan, and will provide CNSC staff with required implementation updates as required.

OPG is committed to ensure that the lessons learned from the Fukushima event and CNSC FAIs are implemented in a timely manner. Through supporting analysis, and modifications and additions to station equipment and procedures, our defence in depth capability to respond to beyond design basis accidents including severe accidents has been improved and further enhancements will be implemented as part of the committed Action Plan.

References**:**

1. CNSC letter, G. Rzentkowski to W.M. Elliott, "Opening of Fukushima Action Item on Ontario Power Generation", February 17, 2012, E-DOCS # 3879171, CD# N-CORR-00531-05607.

2. OPG letter, W.M. Elliott to M. Santini and F. Rinfret, "OPG Progress Report No. 3 on CNSC Action Plan – Fukushima Action Items", July 15, 2013, CD# N-CORR-00531-06184.

3. CNSC letter, M. Santini and F. Rinfret to W.M. Elliott, "CNSC Review of OPG Status Update #3 on Fukushima Action Items", December 4, 2013, E-DOCS # 4232716, CD# N-CORR-00531-06376.

19.0 COMMUNITY RELATIONS AND PUBLIC INFORMATION PROGRAM

19.1 Nuclear Operations and Refurbishment

OPG ensures timely, open and transparent communication to maintain positive and supportive relationships and the confidence of key stakeholders. OPG is committed to being an ethical and credible company in its relationships with employees, suppliers, customers, the public and in the communities in which it operates.

OPG develops, maintains and implements a public information work program conducted in accordance with the ethical principles of integrity, excellence and citizenship as outlined in the OPG Code of Business Conduct. The annual public information and disclosure program takes into consideration:

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

OPG ensures transparent disclosure of operations and potential impacts (both positive and negative) that may occur as a result of operations. OPG has reviewed its public information and disclosure policies, and in 2012 implemented a revised Public Disclosure Protocol supported by a Nuclear Public Information Disclosure Protocol.

OPG benchmarks current practices among other industries to ensure continuous performance improvement

Performance

OPG regularly and proactively provides information to the public on its on-going facility activities.

Information is communicated on an ongoing and timely basis, and is respectful of both the public's views regarding risk and the level of public interest of station operations, activities, and anticipated effects on the environment and the health and safety of the public.

For operational status changes or unscheduled operations that may cause public concern or media interest, OPG follows a Public Interest Notification 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. The purpose of the protocol is to ensure emergency agencies (fire, police, and emergency management) and political offices are kept aware and are able to respond accurately if they receive questions from constituents. OPG communicates within one business day or sooner if possible, any unplanned events exceeding regulatory limits or offsite effects which could result in public or media interest or concern.

On a quarterly basis, OPG publicly posts a listing of CNSC regulatory event reports relating to Darlington NGS on www.opg.com, as well as quarterly performance reports on facility operations. Annually, OPG posts the Radiological Environmental Monitoring Program report on www.opg.com. In addition, there is a refurbishment web page to provide information and receive input from interested parties.

Additionally, key segments of the public are targeted with a variety of activities to encourage them to interact with OPG staff and to visit the Information Center. Public education is considered a key component of this program. Two-way dialogue with community stakeholders and residents is facilitated through personal contact, community newsletters, speaking engagements, educational outreach, the Internet and many other products and programs.

Senior management interaction with the public is encouraged and opportunities are sought for the station Vice-President, Directors and Managers to attend public events and interact with members of the public in local communities.

OPG provides regular updates to key stakeholders on nuclear operations and refurbishment. Presentations are regularly made at the Darlington Community Advisory Council and the Durham Nuclear Health Committee. In addition, presentations and informal meetings are held with local elected officials and community leaders a number of times each year to provide updates on performance and other activities taking place both at the stations and waste facilities.

To increase the understanding of nuclear operations and Refurbishment, community presentations and Darlington station and facility tours are provided to key stakeholder groups, media and interested groups.

OPG's Corporate Citizenship Program provides financial support for community-based programs to foster sustainable partnerships to benefit the community. The program focuses on education, environment and aboriginal community-building events.

OPG receives, documents, and responds to concerns, complaints and inquiries raised by stakeholders and the public. This is a managed process to track actions through to closure.

Two community newsletters*, Darlington Neighbours* and *Darlington Refurbishment* are distributed three to four times per year to approximately 110,000 residents and businesses in the Municipality of Clarington and parts of the City of Oshawa. OPG also utilizes social media.

A public information centre has been in operation at the Darlington NGS, which provides a community information phone line with recorded information and an Information Center phone line which is also staffed five days a week. Both the newsletters and website provide access numbers and an e-mail address for public inquiries. A refurbishment specific, toll-free information telephone line has been put in place.

Future Plans

Over the course of the proposed licensing period, OPG plans to:

- Continue to develop and implement a yearly public information program as per the Licence Condition Handbook.
- Move the Darlington NGS Information Centre from its existing location, to a new facility located in the Darlington Energy Complex.
- Continue its Refurbishment specific communications program and includes;
  - Refurbishment specific displays in the new Darlington Visitor Centre at the Darlington Energy Complex,
  - Stakeholder tours of the reactor mock-up and training facility at the Darlington Energy Complex,
  - Updated and revised Project specific web site, including social media such as YouTube and Twitter.

19.2 Public Information and Disclosure Efforts for Darlington Licence Renewal Process

Consistent with the revised Public Disclosure Protocol supported by the expectations in RD-99.3 *Requirements for Public Information and Disclosure,* OPG will develop and implement a public information communications plan to inform host community residents, stakeholders and interested parties about the CNSC federal approvals process being held in the second and fourth quarters of 2014.

Our protocol ensures information is provided in a timely manner to host communities, the public, First Nations and Métis, stakeholders and organizations with an interest in nuclear operations. Information is communicated in a number of ways based on audience identification, their interests, areas of concern particularly regarding risks, and their preferred means of communication. This ensures clear understanding of nuclear operations, activities and projects to allow the public to make informed objective decisions through readily accessible information, open dialogue and opportunities to have concerns addressed. OPG supports the opportunity for public participation in the hearings, providing CNSC contact information, and information on the process to make public views known.

This information is communicated through OPG's broad communications program to the general public, local community members, key stakeholders, elected officials, and media, through the following vehicles and methods:

- OPG's public website (www.opg.com) will develop several pages on the website devoted exclusively to the hearing. They will include a summary of the Commission Member Document, as well as easy-to-understand descriptions of the station's safety, reliability and economic strengths;
- OPG's community newsletter ("Neighbours");
- OPG will also conduct a local advertising campaign that will help the general public get a better understanding of the station's safety, reliability and economic benefits to the community;
- Included in OPG update presentations to elected officials (municipal councils) in meetings attended by local media and open to the general public;

- Included in OPG update presentations to local community groups (Darlington and Pickering Community Advisory Councils, Durham Nuclear Health Committee);
- Included in OPG information sharing sessions with First Nations and Métis communities; and
- Promoted to interested parties as part of ongoing project information updates through emails, twitter and the company's own website.

Contact information for both OPG and the CNSC will be provided in the communications and on the OPG website to allow for public inquiries and response. OPG will continue to provide information or respond to information requests up to and including the hearing date. Media and public opinion will be monitored and misinformation corrected as necessary.

19.3 First Nation and Métis Engagement

OPG is committed to ensuring that the Nuclear Refurbishment Program, DNGS' ongoing operations and other future related projects do not have any adverse impacts on Aboriginal or Treaty rights and to discuss with First Nation and Métis communities, opportunities for them to participate in the economic benefits of these projects and operations.

OPG recognizes that it must conduct its business in a manner that is both socially and environmentally responsible. OPG's demonstration of this commitment is founded within a corporate-wide policy (est. 2007) that provides a framework for engaging with aboriginal peoples and supporting programs, committees and community initiatives that reflect its tenets and puts the philosophy into practice. The principles of OPG's First Nation and Métis Relations Policy include:

- An acknowledgement of aboriginal and treaty rights of First Nation and Métis communities as recognized and affirmed in the *Constitution Act*, 1982; and
- A commitment to develop relationships on a foundation of respect for the languages, customs, political, social and cultural institutions of First Nation and Métis communities

OPG recognizes that Darlington NGS lies within the traditional territories of the Williams Treaty First Nations, including the Mississauga Nations. OPG has established an information sharing protocol with the Williams Treaty First Nations to ensure open exchange of information and dialogue related to our ongoing operations as well as any new developments, such as refurbishment.

OPG provides First Nation and Métis communities with up-to-date information via update letters highlighting Nuclear Refurbishment Program status and milestones. The letters also serve to inform First Nation and Métis communities of the Nuclear Refurbishment Program activities and provide contact information in the event they wish to provide input, seek clarification or request additional information

Information sharing sessions and round table discussions have been, and will continue to be undertaken at key points during Refurbishment to ensure that identified First Nations, Métis councils and organizations have adequate time to receive information and developments about Refurbishment, and share information should they wish to do so.

20.0 FINANCIAL GUARANTEES

The financial guarantee for decommissioning the nuclear facility is reviewed and revised by OPG every five years or following a revision of the preliminary decommissioning plan.

OPG is required to provide and maintain financial guarantees for the liabilities associated with operating and decommissioning OPG's Class 1 facilities which include operational and long-term waste management and decommissioning costs. The financial guarantee is normally updated on a five-year cycle in accordance with the criteria set out in CSA standard N294-09 and CNSC regulatory documents G-219 and G-206.

In addition to the five year update cycle, OPG provides an annual financial guarantee report to CNSC detailing the status of the guarantee including the amounts accumulated in segregated funds and the value of the Provincial Guarantee required.

The sources to satisfy the Financial Guarantee are the Ontario Nuclear Funds Agreement segregated funds augmented by a Provincial Guarantee. CNSC access to these funds is provided by the "CNSC Financial Security and Ontario Nuclear Funds Agreement Access Agreement" between the CNSC, OPG and the Province of Ontario, and the Provincial Guarantee Agreement between the CNSC and the Province of Ontario.

In December 2012, the CNSC accepted OPG's proposed 2013 to 2017 consolidated financial guarantees.

21.0 NUCLEAR LIABILITY INSURANCE

OPG continues to maintain Nuclear Liability Insurance for its Darlington NGS Generating Station consistent with the requirements of the *Nuclear Liability Act* (1976), and will continue to be compliant with the Act. A copy of the most current certificate is attached, confirming that the appropriate insurance is in place. Insurance inspections are conducted at Darlington every 18 months by the nuclear property insurers. These inspections are also attended by conventional insurers who inspect the non-nuclear side of both stations.

MARSH

Certificate of Insurance

No. **2013-2** Dated: **January 11, 2013**

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:

Evidence of Insurance

Type(s) of Insurance	Insurer(s)	Policy Number(s)	Effective/ Expiry Dates	Sums Insured Or Limits of Liability	
NUCLEAR LIABILITY • Darlington Nuclear Generating Station	Nuclear Insurance Association of Canada	OF-21	Jan 01, 2013 to Jan 01, 2014	Limit of Liability	$ 50,000,000
NUCLEAR LIABILITY • Darlington Nuclear Generating Station	European Liability Insurance for the Nuclear Industry(ELINI)	EL031CA13	Jan 01, 2013 to Jan 01, 2014	Limit of Liability	$ 25,000,000
NUCLEAR LIABILITY • Pickering Nuclear Generating Station	Nuclear Insurance Association of Canada	OF002	Jan 01, 2013 to Jan 01, 2014	Limit of Liability	$ 50,000,000
NUCLEAR LIABILITY • Pickering Nuclear Generating Station	European Liability Insurance for the Nuclear Industry(ELINI)	EL032CA13	Jan 01, 2013 to Jan 01, 2014	Limit of Liability	$ 25,000,000
NUCLEAR LIABILITY • Waste Management Inc.	European Liability Insurance for the Nuclear Industry(ELINI)	EL036CA13	Jan 01, 2013 to Jan 01, 2014	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.

Marsh Canada Limited
161 Bay Street, Suite 1400
Toronto, ON M5J 2S4
Telephone: 416-868-2841
Fax: 416-815-3569
[redacted]

Marsh Canada Limited
[redacted]

22.0 OPEN ACTION ITEMS

The following is a list of open CNSC Action Items specific to Darlington, followed by a list of open CNSC Action Items that are generic to OPG (Darlington and Pickering). Note: Shaded areas indicate closure has been requested by OPG.

Action Item #	Title/ Description	Status
2894 (20081308)	*Hydrogen Behaviour in Containment* - Generic Action Item 88G02 closed out and new Action Item opened. Install and implement PARs in Darlington units. Will remain open until PARs installed on last unit.	Installation to be completed on remaining unit by end of July 2014.
2043 (20101307)	Path Forward on HTS Liquid Relief Valve (LRV) Waterhammer Issues - Replace LRV's during refurbishment. Inspections are performed during each unit outage until LRV's replaced.	Final due date depends on Refurbishment project evolution and was agreed in principle for end of October of 2018.
3219 (20111305)	Outlet Feeder Dissimilar Metal Weld Leak-Before-Break Assessment - N285.4-05 PIP Revision for Fuel Channels and Feeders.	Project update to be submitted end of November 2013.
201113-2297	Modified and Reference 37-Element Fuel Bundle CHF/PDO Test Results and BLA Correlation Development: CNSC staff review of background information.	OPG staff to meet with CNSC staff December 6, 2013 to discuss path forward.
201213-3167	Concession Request to Operate Moisture Separator Drains System to a Pressure Higher than the Design Pressure	Units 3 and 4, re-registration completed, Unit 2 in progress. Unit 1 to be completed in 2014.
201213-3300	Request for Approval for Full Core Implementation of Modified 37 Element Fuel Bundles - Issues identified by CNSC staff need to be discussed with OPG staff to gain a better understanding and to chart a path forward for resolution of these concerns with the objective of obtaining full credit for the safety margin benefits of the improved 37M fuel.	Meeting to be scheduled before end of 2013.
201213-3894	Type II Compliance Inspection Report, "Radiological Hazard Control", Report #DRPD-A-2012-014 - Bridging strategy in place to ensure calibrated (in past 12 months) instruments in accessible areas.	OPG to provide a further update in April 2014.
201313-4037	Reclassification of Category 3 CANDU Safety Issues IH6: "Need for systematic assessment of high energy line break effects" to Category 2 for Darlington	Action to be completed by end of October 2014.

Action Item #	Title/ Description	Status
201313-4056	Request Concurrence to Complete Installation and Commissioning of Primary HTS Liquid Relief Valves (LRV) in Refurbishment Outages	This action item was entered by CNSC staff for Primary HTS LRV Waterhammer Inspection Plan Revision. OPG is to provide CNSC staff with an update once these inspections have been completed.
201313-4057	CNSC Approval Request for Code Variance to ASME Section III, for the Transfer of Heavy Water from Moderator D2O Supply Tanks 0-38110-TK4/TK6 to D2O Cleanup System Product Tanks 0-38410-TKl/TK2	Re-registration of the system and Overpressure Report update will be provided to CNSC staff before end of 2013.
201313-4059	Request for Information Related to Premature Exercise Termination of the January 16, 2013 Operations Minimum Shift Complement Validation Exercise	Darlington NGS to provide integrated feedback to CNSC staff addressing remaining information Requests 1, 2, 3 and 4 by April 15, 2014.
201313-4134	Status Update for Logic Module Failsafe Modification Proposal - Closure of Action Item 201013-09 and Opening of New Action Item 201313-4134	Final update to CNSC staff on installation progress and closure of the action item scheduled for February 2014.
201313-4184	Annulus Gas System Unavailability and Flow Transmitter Replacement -Closure of Action Item 201213-3736 New Action Item 201313-4184	Darlington NGS to provide CNSC staff with final update and request closure of the Action Item – July 2014.
201313-4276	Type II Compliance Inspection Report, "Unit 4 D1341 Planned Maintenance Outage", Report # DRPD-A-2013-005	An update will be provided to CNSC staff by January 19, 2014.
201313-4296	Type II Compliance Inspection Report, "Buried Piping Systems -Low Pressure Service Water and Emergency Power Supply Generators Fuel Management", Report # DRPD-A-2013-009	A response was provided to CNSC staff on November 29, 2013.
201213-3273	Unit 3 Steam Generator Lower Lateral Support Plate 3-21100-SG#2 Flaw Request for Acceptance of Disposition-D1231 Planned Outage	Closure requested on January 21, 2013, CNSC staff's review in progress.
201213-3951	Non-Compliance with Protection of Seismic Equipment and Routes Procedure	Closure of the Action Item 201313-3951 was requested on April 9, 2013
201313-3962	Long Term Darlington Life Management Plan for Inconel X-750 Spacers	Closure requested on August 30, 2013, CNSC staff's review in progress.
201313-4215	Type II Compliance Inspection Report, "Radiation Protection - Worker Dose Control", Report # DRPD-A-2013-010	Closure requested on September 18, 2013, CNSC staff's review in progress.
201313-4240	Type II Inspection Report: Unit 0 Control Room Operator Simulator-Based Certification Examination Report # DRPD-A-2013-003	Closure requested on October 7, 2013, CNSC staff's review in progress.
201313-4190	Fire Hazard Assessment -Action Item 201313-4190 Directive	Closure requested on November 30, 2013.

Action Item #	Title/ Description	Status
2009-OPG-06	NOP Protection Methodology - CNSC staff to further verify the adequacy of the mitigating measures and of OPG compliance with them while work continues to permit final acceptance of the enhanced NOP methodology.	CNSC extends their acceptance of the removal of the 2% correction until April 2014 within the current interim acceptance of use of NOP Methodology results – (as per CNSC letter dated April 13/13 N-06134 -grants 12 month extension)
2010OPG-05	Implementation of RD-310-Safety Analysis for Nuclear Power Plants - CNSC have closed Station Specific Action Items and Opened an OPG Action Item to track the Implementation of RD 310.	OPG to Provide progress report on Safety Analysis Improvement and RD-310 Implementation activities by April 30, 2014.
2011OPG-01-	CANDU Safety Issue AA3: Computer Codes & Plant Model Validation-TUF Validation Work - CNSC have provided a review of OPGs TUF Validation Work.	Action Item will remain open to track OPG's progress in validating the TUF computer code. A meeting is being planned with CNSC staff in December 2013.
2011OPG-2299	CNSC Evaluation of Nuclear Operator Training Program, TPED-Darlington NGS "A"-2007-T10546-T1-TEPD-Pickering A/B 2008-T10892-T1- OPG is required to develop a Corrective Action Plan to update the training matrices and to ensure the proper implementation and maintenance of a SAT-based training program.	Last remaining action with regards to non-licensed operator training to ensure that course materials are current for OPG stations by September 30, 2014.
2011OPG-2390	Training and Employment of Shift Managers and Control Room Shift Supervisors at OPG opened to track outstanding issues specific items have been requested regarding SM and CRSS roles/training.	Action Item will remain open pending successful completion of Items 1, 2 and 6. Response due by February 28, 2014.
2011OPG-2632	Mitigation of Consequences of Potential Terrorist Acts Involving Aircraft Crash - CNSC request further evaluation of the Aircraft Impact Assessment.	OPG provided a response to CNSC staff issues November 2011 for CNSC staff's review.
2012-OPG-3317	Closure of GAI 00G01-Channel Voiding during a Large LOCA – New OPG Action Item for OPG to perform scaling analyses for Darlington and Pickering reactors.	OPG to submit revised version of COG report COG-04-2023 to CNSC staff by January 31, 2014.
2012-OPG-3465-	Closure of Generic Action Item GAI01G01 Fuel management and Surveillance Software Upgrade - New Action Item for OPG to implement a monitoring program to periodically confirm the adequacy of the various approximations in the station core model and fuel management code method and accuracy of code predictions of safety-related core neutronic parameters.	Submit station specific monitoring plans for Darlington and Pickering by July 30, 2014.
2012-OPG-3519 (see also Darlington specific 2894)	Hydrogen Issues at Darlington and Pickering NGS - CNSC staff have opened new Action Item 2012-OPG-3519 with the closure criteria for Darlington and Pickering.	OPG will provide periodic updates on the progress of remaining work by May 15, 2014 and November 13, 2015.

Action Item #	Title/ Description	Status
2012-OPG-3711	CNSC Inspection of OPG Emergency Response Organization Training Program - CNSC staff have raised ANs regarding SAT based training requirements. The inspection has been deferred until OPG correct the ERO training program deficiencies.	OPG to provide quarterly updates on the progress of ERO Training CAP, next one due December 31, 2014.
2012-OPG-3760	CNSC review of OPG document N-PROC-HR-0002 R004, Limits of Hours of Work - OPG was requested to provide clarification on how the criteria in the LCHs for limits of hours of work are met when contractor workers perform SR tasks or are working on SRSs.	OPG provided a response in July 2013. With CNSC staff for review.
2012-OPG-3900	CNSC Compliance Inspection -Shift Manager and Control Room Shift Supervisor Training Program - OPG's self-assessment actions address most of the preliminary issues that CNSC staff had identified preparing for inspection. Rather than completing the CNSC Type II inspection, CNSC staff will allow OPG staff to complete their actions	Submit quarterly progress reports on the activities addressed in CAP, and the activities to bring the training programs into full SAT compliance by December 20, 2013.
2013-48-3965	**OPG CONFIDENTIAL/SECURITY PROTECTED** Type II Security Compliance Insp. Conducted 19-13 December 2012, Report No. PRPD-PICKAB02012	Provide update by February 28, 2014.
2013OPG-4114	TUBRUPT-IST - CNSC staff have closed initial AI 2009OPG-04 and issued new AI 2013OPG-4114. Additional work on industry's behalf is needed-OPG to resolve issues.	OPG to provide a plan and schedule to address by February 28, 2014.
2013-OPG-4163	Opening of New OPG specific AIs Related to Closed Fukushima AIs - Evaluation of bleed condenser/degasser condenser relief capacity.	Requested information to be provided by March 31, 2014.
2013-OPG-4126	Further follow up to closed Fukushima AI's providing specific closure criteria. Evaluation of existing emergency plans and programs and plan and schedule address gaps.	OPG to submit Progress Report of Fukushima AI by March 31, 2014.
2013-OPG-4127	Further follow up to closed Fukushima AI's providing specific closure criteria. Evaluation of adequacy of back-up power for emergency facilities and plan and schedule to address gaps.	OPG to submit Progress Report of Fukushima AIs by March 31, 2014.
2013-OPG-4286	New Action Item opened to monitor execution of the proposed plan to improve multi-unit severe accident modeling.	OPG to submit Progress Report of Fukushima AIs by March 31, 2014.
2013-13-4187	CNSC Type II Compliance Inspection DNGS Nuclear Security, Report No.DRPD-A-2013-008.	OPG to provide update by February 28, 2014.
2013-OPG-4432	CNSC review of OPG business Model.	OPG to submit response by January 18, 2014
2013-OPG-4164	Further follow up to closed Fukushima AI's providing specific closure criteria.	Closure requested on November 5, 2013.

APPENDIX 1

Site Description and Plan

1. The Darlington NGS facility site is described in the Darlington NGS Safety Report, NK38-SR-03500-10001-R03 (Reference 1):

   Part 1 – Plant/ Site Description – Section 1 Introduction and Description of Plant

   Part 2 – Design Description – Structures, Systems and Components

2. The nuclear facility is located on the north shore of Lake Ontario in the township of Darlington, in the Municipality of Clarington, in the Regional Municipality of Durham, Province of Ontario, as showed in:

   i. Ontario Hydro layout Drawing number NK38-DOH-10220-1001, Rev 9, November 1981, and

   ii. Ontario Hydro layout Drawing number NK38-DOH-10220-1002, Rev 4, March 1982.

   The location of the exclusion zone and any structures within the zone are found in Drawing number LO4254 DZS 10162 0531, being a plan of survey dated June 7, 1999, prepared by J.D. Barnes Limited, Ontario Land Surveyors, and certified by S.E. Coons, O.L.S.

Reference:

1. OPG Letter, S.A. Seedhouse to P.A. Webster, “Darlington NGS `A’ – Safety Report Update, Part 1 and 2”, December 23, 2010, CD# NK38-CORR-00531-15339.

APPENDIX 2

Land Ownership Control

With reference to Ontario Power Generation Inc. (OPG) providing evidence of site ownership, or authority to carry on the activity to be licensed, as required by the Class I Nuclear Facilities Regulations, clause 3.(c), supporting material in that regard was previously submitted to the CNSC in Reference 1.

The latest revision of Volume 1, Parts 1 and 2, of the Darlington Safety Report, NK38-SR-03500-10001-R003, submitted to CNSC staff (Reference 2) captures the information provided above. Furthermore, OPG confirms that no change or amendment has taken place with respect to such material since the issue of the updated Safety Report.

References:

1. OPG Letter, T. Mitchell to I. Grant and B. Howden, "Ontario Power Generation Inc. – Articles of Amalgamation", February 19, 2007, CD# N-CORR-00531-03821.

2. OPG Letter, S.A. Seedhouse to P.A. Webster, "Darlington NGS `A' – Safety Report Update, Part 1 and 2", December 23, 2010, CD# NK38-CORR-00531-15339.

APPENDIX 3

Other CNSC Licences and Internal Authorizations

Nuclear Substance and Radiation Devices Licence
Industrial Radiography (812), 12861-1-15.1, February 21, 2012 to March 31, 2015
Consolidated Licence (815), 12861-2-15.3, May 20, 2010 to March 31, 2015
Darlington Heavy Water Sales Facility, Possession of Deuterium (916), 12861-10-16.0, April 1, 2011 to March 31, 2016
Temporary Possession – no use (918), 12861-15-17.0, February 1, 2012 to January 31, 2017
Development and Testing (817), 12861-16-14.0, April 11, 2013 to March 31, 2014
Dosimetry Service Licence
CNSC Licence 12861-11-15.3, May 3, 2012 to May 31, 2015
Class II Nuclear Facilities and Prescribed Equipment Licences
CNSC Licence 12861-7-14.2 (Irradiator Facility (535)), December 11, 2012 to March 31, 2014
CNSC Licence 12861-13-15.0 (Service Irradiator (566)) May 1, 2010 to April 30, 2015
Licence to Transport
Licence to Transport (up to one bundle of nuclear fuel), TL-S-12861-05.01/2014, August 11, 2010 to May 31, 2014
Radioactive Waste Facility Operating Licence - (Class 1B Nuclear Facilities)
Darlington Waste Management Facility, WFOL-W4-355.00/2023, Mar 13, 2013 to April 30, 2023
Internal Authorizations
N-CERT-00531.1.RL-10080 – Internal Authorization #29 issued under the terms and conditions of CNSC Licence 12861-1-15 Industrial Radiography expires March 15, 2015
N-CERT-00531.1.RL-10081 – Internal Authorization #29A issued under the terms and conditions of CNSC Licence 12861-2-15 Consolidated Uses expires March 31, 2015
N-CERT-00531.1.RL-10087 – Internal Authorization #30A issued under the terms and conditions of CNSC Licence 12861-2-15 Consolidated Uses expires March 31, 2015
N-CERT-00531.1.RL-10085 – Internal Authorization #69A issued under the terms and conditions of CNSC Licence 12861-2-15 Consolidated Uses specific for the Darlington Learning Centre expires March 31, 2015

APPENDIX 4

Summary of Nuclear Substances

Nuclear Substances Identified:

Natural Uranium (as fuel bundles)
Depleted Uranium (as fuel bundles)
Depleted Uranium (as Reactor Maintenance Shielding components)
Irradiated uranium (as spent fuel bundles that contain fission and activation products including actinides, such as Pu-239)
Heavy Water (D_2O, DTO)
Tritium as gas (DT, T_2)

The maximum quantity is interpreted as the maximum amount that can be accommodated in inventory as per design by Darlington NGS (including the TRF for its operation)

Nuclear Substance	Form/ Location	Maximum Quantity
Natural Uranium	Solid as Fuel Bundles: new Fuel Inventory, New Fuel Transfer Mechanisms, Fuelling Machine heads, Service Area Rehearsal Facility, Pressure Testing Facility	10838 bundles *
Irradiated Uranium	Solid as Spent Fuel bundles: All Bays – Storage Bays, Reception Bays, wet Cask bays All Reactor cores – Units 1,2,3,4	402180 bundles * 24960 bundles
Depleted Uranium	Solid as Fuel Bundles: new fuel Inventory, Spent Fuel discharged to bays	Included in above totals marked with asterisk
Depleted Uranium Shielding Components	Solid: Reactivity mechanism flask, pedestal body, lower inner sleeve for adjusters, split shielding block. Split shielding ring	2000 kg
Heavy Water	Liquid (D_2O, DTO)	5900 Mg
Tritium	Gaseous (DT, T_2)	0.884 MCi
Tritium	Solid (Titanium Tritide)	654 MCi

APPENDIX 5

Hazardous Substances

Name	Form	Characteristics	Where Used (System)	Purpose	Storage	Disposal	Quantity (inventory)	Quantity (In system)
Ammonia	Liquid (20%)	Toxic, corrosive base	SG FW; condensate FW	pH control and corrosion control	Chemical addition station in turbine hall	Atmospheric discharge; and SG blowdown	maximum two totes x 1,020 kg/tote	225 kg as 20% ammonia for station
Argon	Liquified gas	Asphyxiant	TRF	Inert gas for Tritium immobilization glove boxes and other systems.	Outdoor tank.	Vented to atmosphere	1500 gal tank (liquid argon)	Used as needed.
Carbon dioxide gas	Compressed Gas	Mildly toxic, asphyxiant in high concentrations, heavier than air.	AGS generator	AGS – carrier gas; generator – purging gas	Outdoor tank (gas cylinder)	Annulus gas system – to reactor building exhaust; generator – vented to atmosphere	12,700 kg	14.4 m^3
Ethylene glycol	Liquid	Toxic	Various Systems	Chillers	Small head tanks in powerhouse	Removed by licensed contractor if necessary	2 drums, 205 L each	1000 L per unit estimated
Gadolinium Nitrate Hexahydrate	Solid, mixed with D2O.	Toxic, severe irritant	Moderator system	Reactivity control	Warehouse and Chem Lab	Removed by IX resin in the moderator purification system	~44 containers of 5 kg each	Combined all units: LISS: 132 kg Poison Addition Tanks : ~ 5 kg

Name	Form	Characteristics	Where Used (System)	Purpose	Storage	Disposal	Quantity (inventory)	Quantity (In system)
Helium gas	Compressed Gas	Compressed gas, simple asphyxiant, lighter than air.	Cover gas for moderator; LZC; HT storage tank, TRF.	Cover gas to prevent air ingress	Gas cylinders	Periodically purged to reactor building exhaust for chemistry control	12 tubes, total 2832 m^3 for station 3 tubes, total 708 m^3 for TRF	Normally none. Used when needed.
Hydrazine (35% solution)	Liquid	Corrosive base, Toxic	ECI system; SG, FW; condensate FW; RCW and ESC water	Removal of O2 and pH control	Totes in chemical addition station in turbine hall	Consumed but residual may be discharged to lake or atmosphere. A breakdown product in feedwater is ammonia.	(Feedtrain + ECI + RCW) is 1,890 kg as 35% hydrazine for station	Maximum eight totes x 850 kg/tote
Hydrogen gas	Compressed Gas	Flammable Compressed Gas, lighter than air.	Main generators	cooling for the generators	Mobile trailer and gas cylinders	periodically vented to atmosphere from the main generators	800 m^3 in multi tube H_2 trailer 900 m^3 in six storage cylinders as backup	4 x 650 m^3 = 2600 m^3 nominalised to atmospheric pressure
Hydrogen gas	Compressed Gas	Flammable Compressed Gas, lighter than air.	HT system;	Remove O2	gas cylinders	Consumed in the HT system and vented to containment	Warehouse ~ 15 cylinders @ 197ft^3 Addition station combined: 24 cylinders @ 197 ft^3 when full.	Combined: ~60 ft^3

Name	Form	Characteristics	Where Used (System)	Purpose	Storage	Disposal	Quantity (inventory)	Quantity (In system)
IX resin Cation	Solid	Toxic, irritant	Moderator	Removal of cations to prevent gadolinium precipitation	Warehouse	Temporary storage – spent resin tank	~30 containers of 0.5 ft^3 bag and 2 bags in each container	Combined all units: 40 ft^3
IX Resin Anion	Solid	Toxic, irritant	HT system	pH control and removal of impurities	Warehouse	Temporary storage – spent resin tank	~36 containers of 0.5 ft^3 bag and 2 bags in each container	Combined all units: 72 ft^3
IX resin: De-oxygenating Resin	Solid	Toxic, irritant	SCW system	Removal of O_2 to protect stator cooling copper components	Warehouse	Industrial waste disposal	Not normally in stock; order per demand: 15 containers of 1 ft^3 bag	Combined all units 60 ft^3
IX resin: Lithiated mixed bed resin	Solid	Toxic, irritant	HT system; ESC system; RCW system	pH control and removal of impurities	Warehouse	Temporary storage – spent resin tank	~ 40 containers of 0.5 ft^3 bag and 2 bags in each container	Combined all units: HTS 48 ft^3 RCW 28 ft^3 ESC 72 ft^3
IX resin: Neutral Mixed Bed Resin-	Solid	Toxic, irritant	Moderator; IFB; LZC, SCW ;HT system, D2O Cleanup System, ALW	pH control and removal of impurities	Warehouse	Temporary storage – spent resin tank	~ 250 containers of 0.5 ft^3 bag and 2 bags in each container	Combined all units: Moderator: 160 ft^3 IFB: 720 ft^3 LZC, 40 ft^3 SCW 8 ft^3 PHT 40 ft^3 D2O Cleanup system 36 ft^3 ALW 120 ft^3

Name	Form	Characteristics	Where Used (System)	Purpose	Storage	Disposal	Quantity (inventory)	Quantity (In system)
Lithium Hydroxide monohydrate	Solid, made into solution for addition.	Corrosive base	HT system; ESC system; RCW system	pH control	Chem Lab and Warehouse	Consumed (used when pH must be rapidly corrected; usually the pH is controlled by lithiated IX columns)	~23 bottles of 0.5kg each	Combined all units (in liquid): HT: ~1944 g ESC: 36000 g RCW: ~70 g
Lubricating oil and seal oil Teresso #46	Liquid	Non-toxic during normal use.	Turbine lubricating oil system; generator seal oil system	Lubrication and sealing	Three tanks on the north side of the turbine hall	Reused or removed by contractor	1640 L	Estimated 2800 L of oil in the system piping
Morpholine	Liquid	Combustible liquid, toxic, corrosive base.	SG FW; condensate FW	pH control and corrosion control	Chemical addition station in turbine hall	Partly consumed; atmospheric discharge; and SG blowdown	8 totes x 800 kg/tote	200 kg as 45% morpholine for station
Nitrogen gas	Compressed gas	asphyxiant	HT oxygen removal	Exclude oxygen from HT in outage.	Outdoor tank (as liquid) or gas cylinders in the station	Vented to the air	32,000 L bulk supply	N/A. Used when needed.
Nitrogen Liquid	Compressed Liquid	Cryogenic hazard	Formation of Ice Plugs	source of cold for ice plugs	On the south side of Unit 0	Consumed in forming ice plugs	32,000 L bulk supply	N/A. Used when needed.

Name	Form	Characteristics	Where Used (System)	Purpose	Storage	Disposal	Quantity (inventory)	Quantity (In system)
Oxygen gas	Compressed Gas	Strong oxidizer - increases flammability of flammable or combustible material.	Moderator cover Gas, AG; LZC gas	Added to recombine with D_2 gas; to maintain pressure integrity	Gas cylinders	Consumed; emitted to reactor building exhaust	2 oxygen cylinders (335 ft^3 each) for moderator cover gas, 2 cylinders for LZC gas. 4780 m^3 bulk storage at TRF.	Approx. 1340 ft^3
Reolube Turbofluid 46XC Fire Resistant Fluid	Liquid	Mildly toxic	Turbine governor	Hydraulic fluid for turbine governor valves	Tanks in powerhouse	Reused or drummed for disposal	17 drums @ 205 L = 3500 L	40000 L (10000 per unit)
Sodium Hypochlorite 12%	Liquid	Corrosive acid, oxidizer - increases flammability of flammable or combustible material.	LPSW,	Zebra mussel control	2 storage tanks in WTP and 4 day tanks in LPSW pumphouses 2 tanks in ESW chlorination building	Consumed and residual to Lake Ontario	2x 27,000 L storage tanks in WTP; 4x 4,000 L day tanks, one in each LPSW pumphouse; 2x 4,500 L tanks in ESW	N/A. diluted into system water.
Sodium Meta-bisulphite 38% aqueous	Liquid	Corrosive acid, toxic	Condensate water discharge duct	Dechlorination	Outdoor tanks with secondary containment	Consumed	3 x 1000 US Gallon Storage Tanks	N/A. diluted into system water.
Sodium Hydroxide	Liquid	Corrosive base	WTP	Regeneration of conventional IX resin	Bulk storage tank	Consumed in system and discharged to the lake (neutralized prior to discharge)	46,000 L max tank volume (connected to system)	Consumed in system.

Name	Form	Characteristics	Where Used (System)	Purpose	Storage	Disposal	Quantity (inventory)	Quantity (In system)
Sulphur hexafluoride	Compressed Gas	Compressed Gas, mildly toxic	Condenser circulating water system	Leak detection	Gas cylinders	To lake (small volumes only)	2 1A cylinders, 1.55 ft^3 each, total 3 ft^3	ZERO most of the time. 6 ft^3 during testing.
Sulphuric Acid	Liquid	Toxic and corrosive	WTP	Regeneration of conventional Ion Exchange resin	Bulk storage tank or tanker	Consumed in system and discharged to the lake (neutralized prior to discharge)	38,600 L max tank volume (connected to system)	N/A. diluted into system water.
Transformer Fluid - Oil (litres)	Liquid	Non-toxic during normal use. See MSDS.	Main output and service Transformer 10 MVA distribution transformers (outdoor)	Cooling for the transformers	Brought in by truck	Removed by contractor	currently not in stock.	4650 L per transformer x 16 = 74384 L =75 m^3 plus 1353 m^3 = 1428 m^3 total
Transformer Fluid – Silicone (litres)	Liquid	Non-toxic during normal use.	10 MVA distribution transformers (indoor)	Cooling for the transformers	45-gallon drums	Removed by contractor	currently not in stock.	4650 L per transformer x 22 = 102,278 L
Type 1 heating fuel oil,"Stove Oil", Diesel Fuel	Liquid	Combustible Liquid, toxic	Standby generator; EPG, Diesel fire pumps	fuel	Outdoor SG tanks with secondary containment Indoor EPG tanks	Consumed resulting in waste gases CO_2, NO_x, SO_x, etc.	SG: Total of 4 tanks. Approx. 3720 m^3 of fuel oil in all 4 tanks. EPG: ~660,000 L in 6 tanks	N/A. Consumed by equipment.

Legend: AG – annulus gas, ALW – active liquid waste, ECI – emergency cooling injection, EPG –emergency power generator, ESC – end shield cooling, ESW – emergency service water, FW – feedwater, HT – heat transport, IFB – irradiated fuel bay, IX – ion exchange, LPSW – low pressure service water, LZC – liquid zone control, RCW – recirculating cooling water, SCW – stator cooling water, SG – steam generator, WTP – water treatment plant

ACRONYMS
(to be interpreted in context)

Acronym	Definition
ADLs	Administrative Dose Limits
AF	Accident Frequency
AIA	Authorized Inspection Agency
ALARA	As Low As Reasonably Achievable
ALW	Active Liquid Waste
ANO	Authorized Nuclear Operator
AR	Additional Report
ASR	Accident Severity Rate
BTU	Building Trades Union
CANDU	Canadian Deuterium Uranium (trademark of AECL)
CEA	Canadian Electricity Association
CC	Corrective Critical
CED	Code Effective Date
CFVS	Containment Filtered Venting System
CI	Chemistry Index
CNEP	Consolidated Nuclear Emergency Plan
CN	Corrective Normal
CNO	Chief Nuclear Officer
CNSC	Canadian Nuclear Safety Commission
COG	CANDU Owners Group
C of A	Certificate of Authorization
CRE	Collective Radiation Exposure
CRSS	Control Room Shift Supervisor
CSA	Canadian Standards Association
CT	Calandria Tube
DARA	Darlington Risk Assessment
DBM	Days Based Maintenance
DC	Deficient Critical
DEMO	Durham Emergency Management Office
DER	Detailed Event Report
DMW	Dissimilar Metal Welds
DN	Deficient Normal
DOM	Director of Operations and Maintenance
DRB	Design Review Board
DRL	Derived Release Limit
EA	Environmental Assessment
ECA	Environmental Compliance Approval
ECC	Engineering Change Control
EFDR	Event Free Day Resets
EFPH	Effective Full Power Hours

Acronym	Definition
EHS	Emergency Heat Sink
EME	Emergency Mitigation Equipment
EMS	Environmental Management System
EPC	Engineer, Procure and Construct
EPG3	Emergency Power Generator 3
EQ	Environmental Qualification
ER	Equipment Reliability
ERI	Equipment Reliability Index
ERO	Emergency Response Organization
FAI	Fukushima Action Items
FCLM	Fuel Channel Life Management
FFS	Fitness for Service
FH	Fuel Handling
FHA	Fire Hazard Assessment
FIN	Fix-It-Now
FSSA	Fire Safe Shutdown Analysis
GA	Global Assessment
HTS	Heat Transport System
HWMB	Heavy Water Management Building
IAEA	International Atomic Energy Agency
IAM	Integrated Aging Management
IFB	Irradiated Fuel Bay
IIL	Internal Investigation Level
IIP	Integrated Implementation Plan
ISR	Integrated Safety Review
IWST	Injection Water Storage Tank
JHSC	Joint Health and Safety Committee
L&IRW	Low and Intermediate Level Radioactive Waste
LBB	Leak Before Break
LCH	Licence Conditions Handbook
LCM	Life Cycle Management
LISS	Liquid Injection Shutdown System
LPSW	Low Pressure Service Water
LTI	Lost Time Injury
LWPRB	Local Work Protection Review Board
MOL	Ministry of Labour
MRM	Management Review Meeting
MSD	Musculoskeletal Disorders
NGS	Nuclear Generating Station
NOP	Neutron Over Power
NPP	Nuclear Power Plants
NSCA	Nuclear Safety and Control Act

Acronym	Definition
NSRB	Nuclear Safety Review Board
NSRT	Nuclear Security Response Team
NWMD	Nuclear Waste Management Division
OHSA	Occupational Health and Safety Act
OP&P	Operating Policies and Principles
OPEX	Operating Experience
OPG	Ontario Power Generation
OSR	Operating Safety Requirement
PAR	Passive Autocatalytic Recombiners
PB	Pressure Boundary
PCE	Personnel Contamination Event
PDP	Preliminary Decommissioning Plan
PER	Preliminary Event Report
PIP	Periodic Inspection Program
PIT	Physical Inventory Taking
PIV	Physical Inventory Verification
PM	Preventive Maintenance
PROL	Power Reactor Operating Licence
PSA	Probabilistic Safety Assessments
PSC	Plant Status Control
PSVS	Powerhouse Steam Venting System
PT	Pressure Tube
PU&A	Procedure Use and Adherence
PRA	Probabilistic Risk Assessment
PWU	Power Workers Union
QA	Quality Assurance
RD	Regulatory Document
RP	Radiation Protection
RTS	Return to Service
SAMG	Severe Accident Management Guidelines
SAT	Systematic Approach to Training
SATM	Space Allocation Transient Material
SCA	Safety and Control Areas
SCR	Station Condition Record
SEA	Significant Environmental Aspects
SESA	Scientific, Engineering and Safety Analysis
SG	Steam Generator
SIO	Safety Improvement Opportunities
SIS	Systems Important to Safety
SM	Shift Manager
SNO	Supervising Nuclear Operator

Acronym	Definition
SOE	Safe Operating Envelope
SSC	Structures, Systems and Components
STOP	Shield Tank Overpressure Protection
TPAR	Technical Procedural Action Request
TRF	Tritium Removal Facility
TSM	Technical Support Mission
VBO	Vacuum Building Outage
WHC	Wildlife Habitat Council
WTP	Water Treatment Plant