ONTARIO POWER GENERATION

1675 Montgomery Park Road, P.O. Box 160, Pickering, Ontario L1V 2R5

December 11, 2017

CD# P-CORR-00531-05223

MR. M.A. LEBLANC
Commission Secretary

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

Dear Mr. Leblanc:

Supplementary Information to the Application for Renewal of the Pickering Nuclear Generating Station Power Reactor Operating Licence

The current Pickering Power Reactor Operating Licence (PROL) 48.04/2018 expires on August 31, 2018. OPG has applied for a 10-year licence renewal of the Pickering Nuclear Generating Station (NGS) to include continued commercial operation of all reactor units until the end of 2024 as well as post-shutdown activities associated with removal of fuel and water in preparation for the safe storage of all units.

The information required to demonstrate that the Pickering NGS meets or exceeds all of the applicable requirements of the *Nuclear Safety and Control Act (NSCA)* and the associated regulations was provided in the application sent on August 28, 2017 (Reference 1).

CNSC staff determined that the application contained the information required under the NSCA and the regulations during a completeness review of the application (Reference 2). CNSC staff requested further information on some of the sections in the licence application based on the technical sufficiency review of the application (Reference 3).

Additionally, due to an amendment to the Pickering PROL in October 2017 (Reference 4), the request for the licensed activities has been updated for licence renewal, as requested in Reference 2.

The supplementary information to the Pickering application for licence renewal is provided in Attachment 1.

Should you have any questions, or requests for further information, please contact Jack Vecchiarelli, Manager, Regulatory Affairs – Relicensing at (905) 839-6746, extension 5444.

Randy Lockwood
Senior Vice President
Pickering Nuclear

cc: CNSC Site Office – Pickering
CNSC Pickering Regulatory Division (Copy to each staff)

References:

1. OPG Letter, R. Lockwood to M.A. Leblanc, "Application for Renewal of Pickering Nuclear Generating Station Power Reactor Operating Licence", August 28, 2017, CD# P-CORR-00531-05055.

2. CNSC Letter, A. Viktorov to R. Lockwood, "CNSC Staff Completeness Review – Ontario Power Generation (OPG) Application for Renewal of the Pickering Nuclear Generating Station Power Reactor Operating Licence (PROL) 48.03/2018", September 13, 2017, e-Doc 5301022, CD# P-CORR-00531-05152.

3. CNSC letter, A. Viktorov to R. Lockwood, "Pickering NGS: CNSC Staff Technical Sufficiency Review of the Application for Renewal of the Pickering NGS Power Reactor Operating Licence (PROL)". October 17, 2017, e-doc 5343935, CD# P-CORR-00531-05181.

4. CNSC Email, J. Villeneuve to L. Moraru, "Applications to Amend OPG's Darlington and Pickering Nuclear Power Reactor Operating Licences", October 26, 2017, CD# P-CORR-00531-05192.

Attachment:

1. Supplementary Information to the Application for Power Reactor Operating Licence Renewal for the Pickering Nuclear Generating Station

Attachment 1 to OPG Letter, R. Lockwood to M.A. Leblanc, "Supplementary Information to the Application for Renewal of the Pickering Nuclear Generating Station Power Reactor Operating Licence", CD# P-CORR-00531-05223.

ATTACHMENT 1

Supplementary Information to the Application for Power Reactor Operating Licence Renewal for the Pickering Nuclear Generating Station

(41 pages including this coversheet)

Attachment 1

Supplementary Information to the Application for Power Reactor Operating Licence Renewal for the

Pickering Nuclear Generating Station

Table of Contents

List of Tables

List of Figures

1 Overview

1.1 Introduction

The current Pickering Power Reactor Operating Licence (PROL) 48.04/2018 expires on August 31, 2018. OPG has applied for a 10-year licence renewal of the Pickering Nuclear Generating Station (NGS) to include continued commercial operation of all reactor units until the end of 2024 as well as post-shutdown activities associated with removal of fuel and water in preparation for the safe storage of all units.

The licence application provided the information required to demonstrate that the Pickering NGS meets or exceeds all of the applicable requirements of the *Nuclear Safety and Control Act (NSCA)* and the associated regulations. The application described the management system and the various programs, processes, and personnel that Pickering has in place to ensure that all work is performed with quality to the appropriate standard and with minimal impact to the public and the environment. Collectively, these elements ensure that safety is the overriding priority in all of the necessary activities undertaken to maintain safe and reliable operation of the station.

The licence application for renewal of the Pickering PROL was sent on August 28, 2017 (Reference 1). It was determined by CNSC staff that the application contained the information required under the NSCA and the regulations during a completeness review of the application (Reference 2). As a result of the technical sufficiency review of the application, CNSC staff requested further information on some of the sections in the licence application (Reference 3).

This supplementary licence application document provides further information as requested by the CNSC staff on some of the areas in the licence application and it should be read in conjunction with the licence application submitted as Reference 1.

Item numbers which are referenced in this supplementary document correspond to the itemized list of CNSC staff comments in Reference 3. Note that some item numbers did not require a response.

Further, as discussed in Reference 2, the Pickering PROL was amended on October 26, 2017 and the Licence Conditions Handbook was revised, to allow for the import and export of nuclear substances consisting primarily of contaminated laundry. The additional purpose of this document is to revise the requested list of activities to be authorized under the new operating licence term.

In summary, the licence application, together with this supplementary document contains sufficient information to demonstrate that Pickering NGS meets all of the legal requirements of the NSCA and the associated regulations, and to demonstrate that OPG is qualified to carry on the licensed activities and makes adequate provisions to protect the health, safety and security of persons, and the environment.

2 Supplementary Information

2.1 Fitness for Service until 2024 [Items #1, 2 and 3]

OPG has in place well established Fitness-for–Service (FFS) programs for major components that will ensure fitness for service is demonstrated until the end of commercial operation. OPG has high confidence that these programs will continue demonstrating the continued fitness for service of major components and system, structures and components important to safety.

The Life Cycle Management Plans (LCMPs) for the major components document the strategies and actions planned to facilitate demonstration of fitness-for–service of the components throughout the planned operating period.

Fitness-for–service of major components is demonstrated and re-assessed on an on-going basis through planned periodic inspections and maintenance in accordance with the requirements of the periodic inspection standards, CSA N285.4, N285.5 and N285.8, and OPG's integrated aging management program and the major components program.

Fitness-for–service assessments are in accordance with industry standard guidelines that set out the permissible assessment methodologies and the mandatory requirements. The results are submitted to the CNSC in accordance with the standards.

Operation of Pickering NGS until 2024 is supported by the Periodic Safety Review 2 (PSR2). OPG is confident that the Pickering fuel channels will remain fit-for-service for continued commercial operation to the end of 2024. The PSR2 action plan for the fuel channels as documented in the Integrated Implementation Plan (IIP) will ensure the required actions are taken, for continued FFS through to the end of 2024.

Further information on the fitness for service of fuel channels has also been provided to the CNSC, as requested, in OPG letter, P-CORR-00531-05201.

2.2 Disposition Process of Periodic Inspection Results [Item #4]

Programs are in place at Pickering to perform planned periodic inspections in accordance with program and regulatory requirements. OPG has robust processes in place for dispositioning inspection or surveillance results, and for responding to relevant operating experience that could impact fuel channel fitness for service or plant operability. These processes are described below, and in *Fuel Channel Life Cycle Management*, N-PROC-MA-0044.

Periodic inspection is considered to include the fluid boundary portions of components and piping, including their supports, that comprise systems that: directly transports heat from nuclear fuel; systems essential for the safe shutdown of the reactor or the safe cooling of the fuel, or both, in the event of a process system failure; and other systems or components whose failure could jeopardize the integrity of the aforementioned systems.

The periodic inspections standards address failure aspects; classification of areas subject to inspection; provision for access; inspection techniques and procedures; personnel

qualifications; frequency of inspection; responsibilities; documentation; records; evaluation of inspection results; dispositioning; and repair, replacement, and modification requirements.

Inspection results are evaluated and dispositioned in accordance with N-PROC-MA-0052, *Flaw Dispositioning*, which establishes generic process and accountabilities for evaluation of CSA N285.4 and N285.5 periodic inspection results. This procedure also describes the process for the preparation and submission of a component disposition to the CNSC for acceptance, and describes how component disposition limits are monitored to ensure disposition conditions are not exceeded.

Station Condition Records (SCR) are initiated to identify fuel channel non-conformances in accordance with N-PROC-RA-0022, *Processing Station Condition Records* which provides a consistent reporting and evaluation process for identified adverse conditions. This process is used to ensure the adverse condition is adequately documented, the cause of the adverse condition is determined, corrective action is implemented to correct the adverse condition, as appropriate, to prevent the recurrence or reduce the risk of recurrence of a similar adverse condition. Lessons learned are captured in the SCR database and provide a valuable resource to OPG and industry through Operating Experience (OPEX) mechanisms in accordance with N-PROC-RA-0035, *Operating Experience Process*.

When fuel channel non-conformances are identified, a Technical Operability Evaluation is initiated, when required, in accordance with N-PROC-MP-0045, *Technical Operability Evaluation*. A Technical Operability Evaluation (TOE) is the process dealing with uncertainty about operability, i.e. scenarios where the ability of a System, Structure, or Component (SSC) to carry out its nuclear safety-related function(s) comes into question. A formal TOE is initiated when, following an initial assessment of a degraded condition, there persists doubt about SSC operability, but there is also an expectation that, with or without compensatory actions, SSC operability can be demonstrated by performing the TOE.

In addition, a Discovery Issue Resolution Process is initiated, when required, in accordance with N-PROC-RA-0094, *Discovery Issue Resolution Process* (DIRP) which identifies due diligence actions required of staff when the safety analysis of an OPG nuclear station is suspected to be less than adequate, or when a gap is discovered in the definition of the safe operating envelope. The DIRP is a managed process for dealing with discovery issues associated with the safety analysis. The DIRP, similarly to the TOE, deals with issues having potential bearing on operability, and is intended for cases when the operation of a nuclear facility conforms with its defined safe operating envelope, but an issue or situation is not addressed in the existing safety analysis. The DIRP, in this way, complements the TOE process for potential operability issues.

Repairs, replacements and modifications are performed in accordance with N-PROC-MA-0065, *Administrative Requirements for the Periodic Inspection of Nuclear Power Plant Components* which provides the administrative process for complying with the periodic inspection requirements.

2.3 Sustainable Operations Plan [Item #6]

The Sustainable Operations Plan (SOP) will be developed to address the unique challenges that could be faced as the end of commercial operations approaches. The SOP is based on each of the Safety and Control Areas (SCAs) as defined by the CNSC. This plan will be submitted to the CNSC 5 years prior to the permanent shutdown of the first unit at the Pickering station.

Fitness for Service (FFS) of station systems, structures and components (SSCs) will be assured to the end of 2024 by the successful implementation of the Integrated Implementation Plan (IIP) actions. The SOP will point to existing nuclear programs and the results of these programs to demonstrate FFS while approaching the End of Commercial Operation (ECO). OPG is committed to maintaining its effective robust nuclear programs, such as the Integrated Aging Management Program (IAMP) to ensure the FFS of SSCs. The SOP will include specific supplemental FFS actions to augment existing programs where it is determined that programmatic changes or stand-alone actions within existing programs are required to resolve unique challenges while approaching ECO.

2.4 Management System and Organization [Item #8 and 9]

OPG's nuclear management system provides the framework for programs, standards and other governing documents and processes which collectively ensure that Pickering NGS operates safely and that safety is the foremost consideration in management decisions and actions. The program N-PROG-AS-0001, *Managed Systems,* ensures that the applicable regulatory requirements and applicable codes and standards are embedded in the nuclear management system.

The nuclear management system has evolved over the past licence period to support the OPG business model. Several programs have transitioned from being only in the nuclear management system, to being owned by corporate business units. For these programs, ownership and accountability for the program resides with the corporate program owner, but the programs remain in the nuclear management system.

The Nuclear President and Chief Nuclear Officer (CNO) is accountable for establishing and implementing the nuclear management system and is accountable for its effectiveness. For programs within corporate business units, the CNO will delegate accountability to the interfacing organization and this role is identified as the authorization authority. The program owner receives approval from the authorization authority prior to issuing changes to the program document, while the authorization authority is accountable to the CNO for maintaining the integrity of the nuclear management system. The program owner is accountable for the content, accuracy, and execution of the program, including assurance that regulatory requirements are met. Specific roles and additional responsibilities are outlined within the program.

Table 1 lists all programs that are owned by corporate business units which perform licensed activities:

Former Program within Nuclear Business Unit		Current Program within Corporate Business Unit		
Document Number	**Program Name**	**Document Number**	**Program Name**	**Business Unit**
		N-PROG-TR-0005	Training	People & Culture
		N-PROG-OP-0006	Environmental Management	Environment
N-PROG-AS-0006	Records and Document Control	OPG-PROG-0001	Information Management	Finance – Information Management
N-PROG-MM-0001	Materials Management	OPG-PROG-0009	Items and Services Management	Supply Chain
N-PROG-HR-0004	Conventional Safety	OPG-PROG-0010	Health and Safety Management System	People & Culture – Health & Safety
N-PROG-RA-0018	Nuclear Pandemic Plan	OPG-PROG-0033	Business Continuity	Finance – Enterprise Risk Management
N-PROG-AS-0007	Project Management	OPG-PROG-0039	Project Management	Nuclear Projects

Table 1- Programs Owned Outside of the Nuclear Organization

The attached organizational charts (Figures 1-4) represent the organizational structure with respect to the nuclear program governance. The organizational charts include the person accountable for the management system (Nuclear President and Chief Nuclear Officer) and all positions with responsibilities for the management and control of the licensed activities, which includes program owners for programs listed under the 14 Safety Control Areas.

Figure 1 - Program Ownership (Page 1)

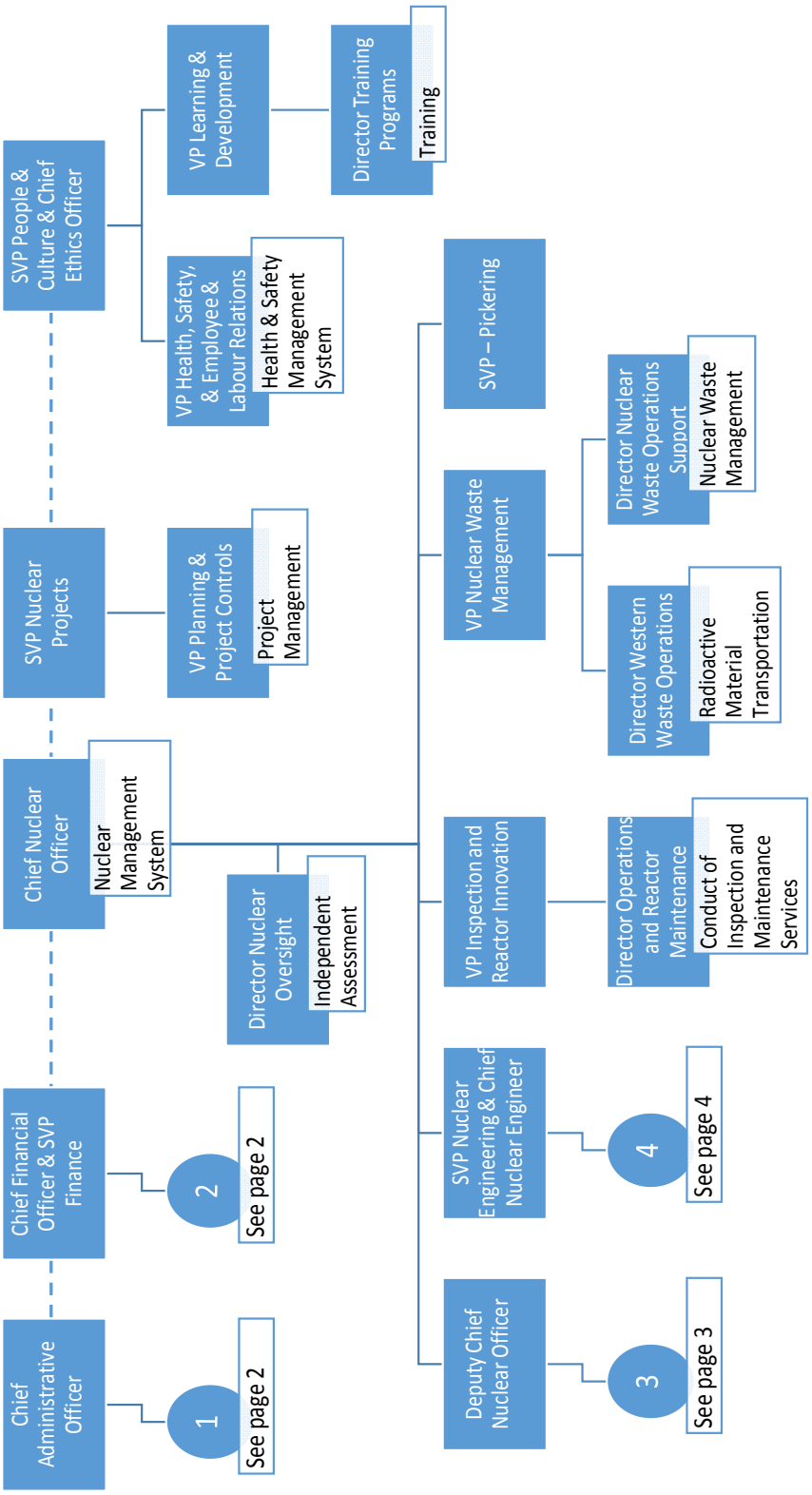


Figure 2 - Program Ownership (Page 2)

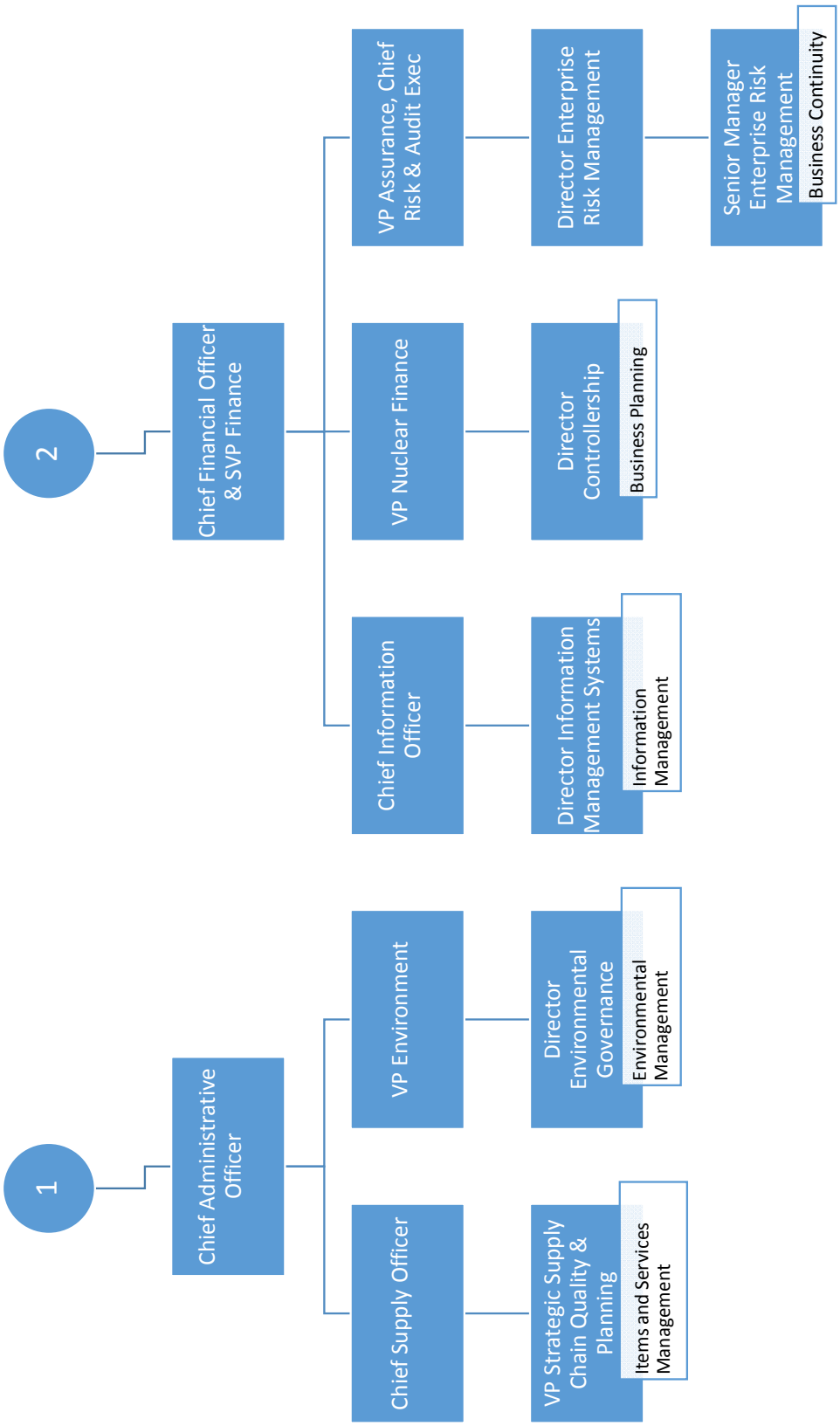


Figure 3 - Program Ownership (Page 3)

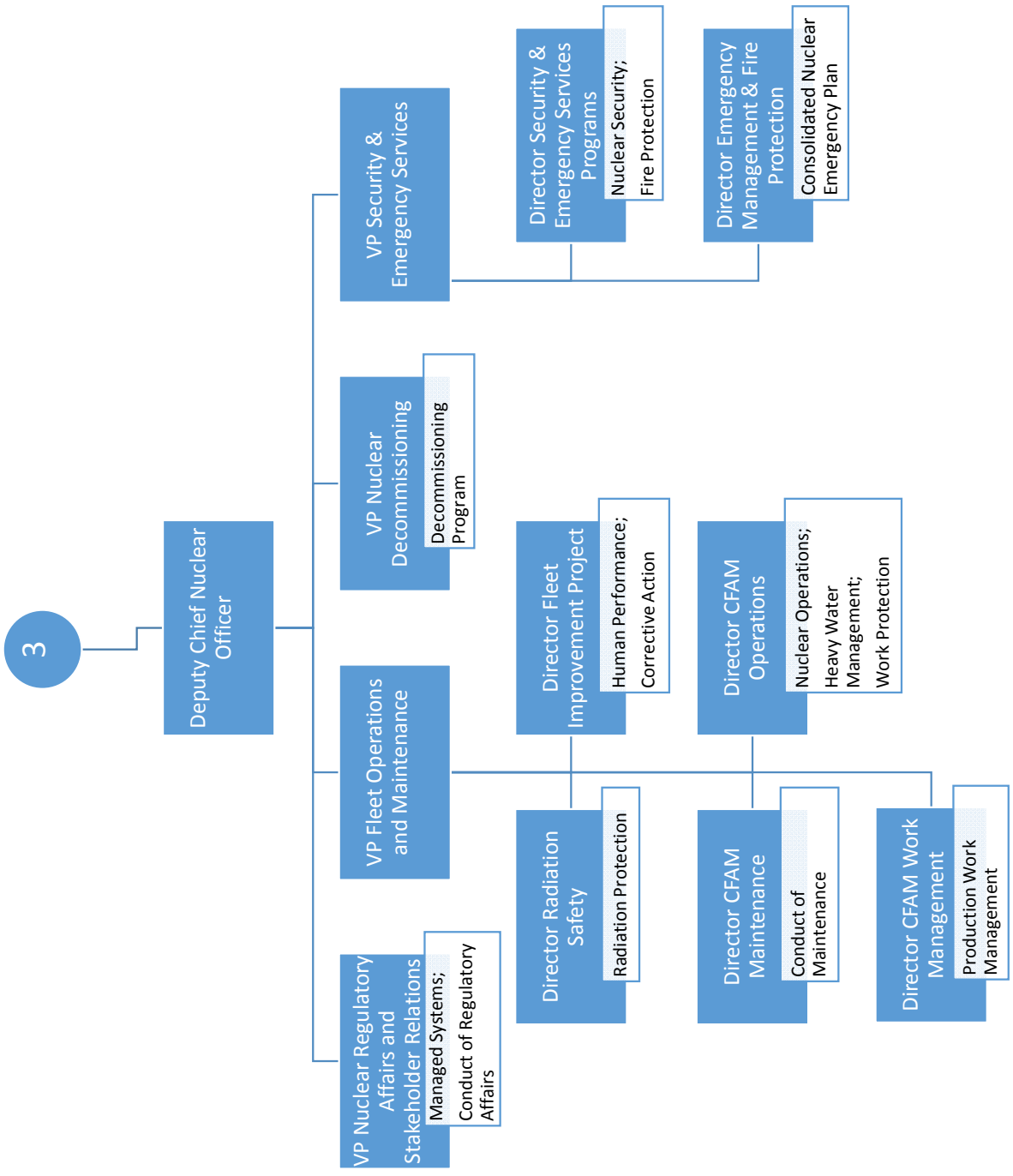
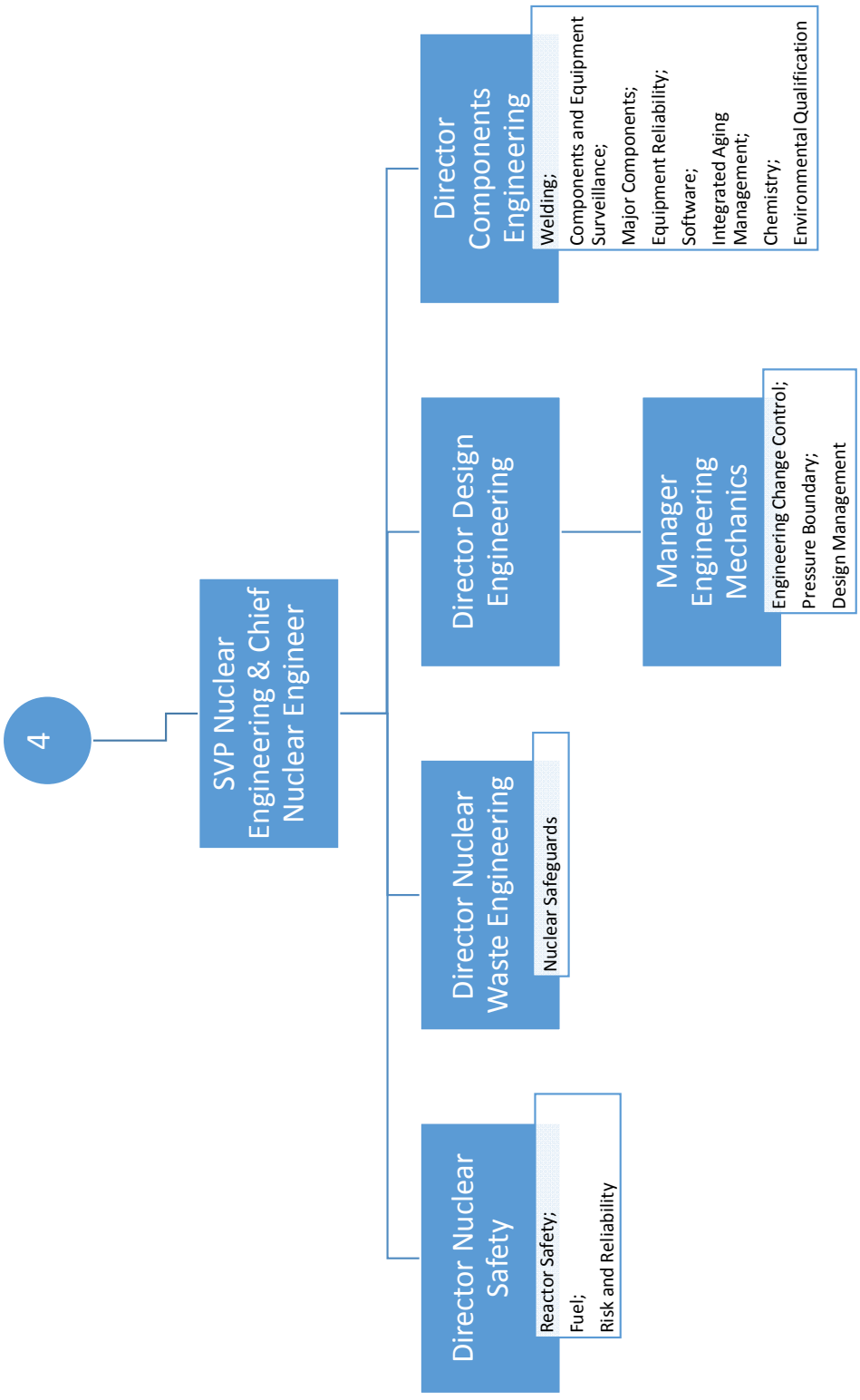


Figure 4 - Program Ownership (Page 4)



2.5 Knowledge Management [Item #10]

OPG has many well established methods to ensure people working in the organization have the qualifications, knowledge and skills required to perform competently. The knowledge management program complements these foundational programs by providing tools and techniques to consider and share tacit knowledge.

Given OPG's demographics, employee attrition and the lengthy training and development required for specialized roles, OPG has invested in knowledge management for ongoing operations as well as the delivery of projects and initiatives to ensure that the critical knowledge and expertise of employees is sustained.

OPG has adopted a corporate-wide approach for Knowledge Management (KM) and Retention. This approach comprises three steps designed to identify and mitigate knowledge risk within the organization: 1) Risk Assessment and Analysis, 2) Action Planning and Implementation, and 3) Verification and Sustainment activities.

Twice a year, an analysis is performed which lists potential retirement attrition within various business groups, viewed over a multi-year period. The areas of highest potential impacts are identified, and the business is alerted through the Human Resources Business Partners (HRBPs) of affected divisions/departments. A Knowledge Management Toolkit, along with associated messaging and tools, is available with support provided through OPG's Talent Centre of Expertise (COE). These Knowledge Management tools help determine knowledge risk for departing employees. The Knowledge Management Toolkit is comprised of an overview of OPG's approach to KM, and evaluation forms which help determine the severity of knowledge risk, as well as suggesting mitigation options. Mitigation options include a description of activities and solutions that can be used to help transfer knowledge (e.g., job shadowing, documentation, audio-visual recording of tasks). The tools are easy to understand and use, and are intended to be primarily self-serve in nature to give the business maximum agility.

Both short and long term mitigation strategies are presented as part of the planning and action portion of the KM approach, with the business group choosing the solution that works best for them. The creation of Individual Development Plans (IDPs) are available to all employees, and the business is encouraged to use the IDP to assign Knowledge Management activities for both incoming and outgoing parties. The IDP identifies the specific KM activities that the person will undertake to absorb and operationalize the critical knowledge required for the role. Mid-year and year-end reviews of these development goals with their Leader will help to verify the success of knowledge transfer and determine ongoing activities to sustain the implementation/use of this knowledge, and further embed it into the business.

Areas of higher risk within the business are able to leverage additional formalized tools and processes to reflect their needs. As an example, a high-risk group may declare certain KM activities mandatory on a prescribed cadence, and may measure compliance accordingly.

OPG's new Human Capital Management system will allow the IDPs to be created electronically and stored within the system. Using this system, the IDPs can be catalogued and reported upon to maximize visibility and impact. Information is visible to Leaders about their organizations, who can use this information to confirm that objectives are aligned with OPG strategic imperatives, thus helping maximize the positive impact of these activities on the business.

2.6 Management of Contractors [Items #11 and #12]

OPG Supply Chain Quality Services is responsible for prequalifying suppliers (vendor, seller, contractor, subcontractor, etc.) of items and services which require a quality program using N-PROC-MM-0010, *Establishing and Maintaining Ontario Power Generation Approved Supplier List.* All of the vendors performing directly under contract to OPG are evaluated, audited and qualified on the OPG Approved Suppliers List by the OPG Supply Chain Quality organization or their delegates who also establish and maintain the Ontario Power Generation Approved Suppliers List (ASL).

The quality performance of the top critical suppliers is continually monitored and reported by Supply Chain and corrective actions are initiated when required as per N-PROC-MM-0041 *Quality Engineering and Supplier Performance Management*. This procedure supports improvement of the quality of items and services procured from suppliers on the ASL. Processes described include methods for measuring and managing supplier's quality performance, investigation and management of supplier corrective actions related to Station Condition Records (SCR) and Operating Experience (OPEX), reduction of initial receipt inspection material quarantine, management of supplier reported non-conformances and development of suppliers. This includes maintaining ASL Criticality Supplier List, Quality Key Performance Indicators (KPIs), ASL Critical Supplier Quality Health Index, and supplier quality escalation process.

The supplier escalation process is as follows:

- Supplier quality performance is measured using scorecards of key performance indicators.
- A list comprised of OPG business critical, quality critical and low-performing suppliers is generated each year.
- Ongoing quality performance management of the list of suppliers is performed via a key performance indicator review, quality review meetings, focused supplier development and site visits.
- Non-conformance and corrective action requests are initiated in order to investigate and manage supplier corrective actions in response to any supplier quality related issues that are identified.
- These corrective actions to non-conformance enhance the suppliers' quality systems resulting in continuous improvement.

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

Oversight of the Contractor's performance in field execution is subject to pre-planned and risk based oversight by various groups. In the Projects and Modifications department, oversight starts with the Field Engineering teams who also execute the OPG Quality Assurance (QA) program. A separate oversight group in the Projects and Modifications department looks at trend indications, collected from all data generating bases, and ensures corrective actions are initiated and followed up.

Work to be contracted by OPG prior to the actual award of a contract has followed OPG processes covered in many levels of governance including (but not limited to):

OPG-PROG-0038 *Contract Management*, is the governance that establishes the program requirements for managing the contracted services, including the roles and accountabilities in significant detail from the Business Level Authorities through Safety, Legal, and Environment accountabilities and all contract management roles including: Contract Owner; Contract Administrator; Contract Monitor; Supply Chain; Constructor's Supervisor. For the contract management roles, an individual may fill one or more of these roles, depending on the complexity of the contract, but all roles are fulfilled. The organizational level of the individuals accountable may change depending on the risk and complexity of the contract. Although some roles may be merged, there shall always be a contract owner, and a separate and distinct supply chain purchasing agent.

Additionally, OPG-PROC-0204 *Contract Management* takes authority from OPG-PROG-0038 and goes further by establishing the minimum process requirements within OPG for managing contracted services including the identification of roles and accountabilities, contract planning, procurement, post award, execution and the closeout of contracted services. This procedure applies to all service-based activities contracted by OPG. It outlines in detail the responsibilities of the contract owner including; determining the scope of work for the contracted service, identifying all stakeholders that may be affected or impacted by the contracted service, determining labour requirements, determining which external agency approvals are required for the contracted service and assigns accountability to the appropriate party (i.e. OPG or the contractor). It also identifies the quality requirements and controls for the contracted service and assigns accountability to the appropriate party etc. Similarly, this procedure includes the responsibilities of the Contract Administrator, Contract Monitor and the Purchasing Agent.

2.7 Performance Assessment and Improvement [Item #13]

Nuclear Oversight (NO) performs audits in accordance with N-PROC-RA-0048, *Conducting Performance Based Audits and Assessments.* The audit is a planned and documented activity and may identify insights that are opportunities for improvement and for consideration by the line organizations. A 3-year audit plan provides the schedule for the audits that will be performed. As well, performance is also rated using specific audit rating criteria.

Nuclear Oversight performs annual self assessments and management reviews to confirm program coverage. The programs within the Nuclear Management System charter are aligned into three areas of Nuclear Oversight responsibility: Nuclear Cross-Functional, Engineering, and Operations and Maintenance. As specified in N-PROC-RA-0097, *Self-Assessment and Benchmarking*, NO conducts a self-assessment every year to review coverage by audits and assessments of programs identified in these areas of responsibility. This procedure requires management to conduct self-assessments to identify opportunities for continual improvement and to confirm that work meets the requirements of the management system.

The Self-Assessment and Benchmarking Program is utilized to evaluate actual performance against management expectations, industry standards of excellence and regulatory requirements. An effective Self-Assessment and Benchmarking Program exhibits self-critical behaviours which allow for achievement of higher quality and performance standards by

identifying and addressing gaps and eliminating adverse conditions within programs and processes.

At the end of each 5-Year program coverage plan cycle, the Senior Manager Nuclear Oversight conducts a review to demonstrate adequate coverage of all the programs identified in the three areas of NO responsibility. In addition, NO may perform an annual aggregate self-assessment of line management feedback collected for all the audits.

Nuclear Oversight performance indicators are based on Nuclear Quality Management Leadership (NQML) committee and best industry input. The goal of these indicators are to measure NO's ability to influence improvement at the station. Any performance indicator that is not to industry standard is required to have an improvement plan.

The performance indicators are:

- Issue Resolution Time, which is a measure of the effectiveness of the influence NO has on station management to resolve those issues requiring causal analysis (Root, Apparent, and Common), in a timely manner;
- Escalated Issue Average Age, which is a measure of the time it takes station management to resolve those issue escalated by NO;
- Staffing Health, which is a measure of NO's ability to maintain a core group of quality assurance professionals and a healthy rotation program; and
- Audit Feedback, which is a measure of the quality of the audits.

2.8 Records Management [Item #14]

OPG-PROC-0001, *Process Administrative Governance Documents* is used for governing documents including policies, charters, programs, procedures and standards. A governing document stipulates philosophy, mandatory rules, regulations, licensing requirements, and management controls, in order to implement business processes. This procedure describes review, comment disposition, validation and approval activities to ensure adequacy prior to being issued for use.

N-PROC-AS-0028, *Development, Review, and Approval of Technical Procedures*, describes the required activities to ensure documents are correct, meet the intended function, and are usable by a qualified individual. This includes controls for performing verification activities that ensure adequacy, such as checking that the procedure is operationally correct, the required reviews have been completed and mandatory changes, if any, have been adequately dispositioned. Verifiers of technical procedures are persons who are knowledgeable of the system or equipment to which the procedure applies, and qualified to at least the minimum level position necessary to perform the procedure or be considered a system expert. N-PROC-AS-0028 also defines the required approval level for the procedure, prior to issuance.

OPG-PROC-0019, *Records and Document Management* provides direction to ensure that records in the custody or control of OPG are consistently managed, protected, and accessible throughout their life cycle.

OPG has robust processes in place to establish record retention periods, security and access control. OPG-MAN-08133-0001, Sheet 01-03-01, *Records Retention*, provides the requirements of a records retention program including how to establish retention periods.

The security of records is documented in OPG-STD-0030, *Protecting OPG's Information and Intellectual Property*, which provides instructions for the protection of information and intellectual property owned by or entrusted to OPG. This standard covers protection of information through: the use of classifications; release of information by defining a set of criteria to assist in determining if the information should be released; requirements for storing information to ensure information is not left exposed to unauthorized persons during the workday or after work hours; and critical data protection which is an ongoing initiative to protect OPG's most critical/sensitive information.

OPG-PROC-0178, *Controlled Document Management* defines a process for managing the life cycle of Controlled Documents (CD) across OPG in order to: ensure latest applicable revision of CD is identified and available, including minor revisions; minimize risk of inadvertent use of obsolete and superseded documents, ensure approved document change requests (DCR) are maintained, dispositioned, and available; and perform quality checks (QC). OPG's QC Program is a programmatic self assessment completed by an independent organization on a sampling of documents indexed in the records repository and on controlled copies in the plant locations. The assessment is focused on ensuring the documentation is available, retrievable, and is at correct revision number. This assessment is performed twice a year using the instructions provided in OPG-MAN-08133-0003, *Quality Check Process for QA Records*.

OPG-PROC-0179, *Nuclear Quality Assurance Records* is specific to submissions, access control and maintenance of both paper and electronic records. This procedure provides instructions for consistent management, throughout the life cycle, of Nuclear QA records that are generated or collected by or for OPG, including quality checks. This procedure ensures that nuclear QA records and QA vaults are managed to protect records against damage by fire, flooding, environmental deterioration, theft, and misuse by unauthorized personnel.

2.9 Human Performance Program [Item #15]

Human Performance is one of Pickering's top 3 station priorities. Human Performance (Hu) is integrated into our culture. Human Performance training is provided to all new employees, and a refresher course is provided to every nuclear employee annually through the Nuclear General Employee Training (NGET) computer based training. It is also embedded into initial and continuing training for operations, maintenance and engineering staff and the associated behaviours are reinforced by peers and supervision, in day to day work activities. Supervisors are given supplementary Hu training during the leadership training. The training is based on the supervisory perspective of reinforcing standards.

The initial human performance training is also reinforced by incorporation into the pre-job briefing process. Applicable human performance tools (e.g. Event Free Tools) are discussed as part of the preparation for every task. Correct use of the tools is ensured through field observations by peers and supervisors.

Observations are summarized by crew supervision, and monitoring of trends is done by line management, as part of the crew Management Review Board (MRB) process. These meetings

are held at regular intervals to maintain a continuous feedback loop on the crew's performance. Each department then incorporates all of their crew observation data, and will present their findings on a rotating schedule at the Human Performance Steering Committee Meeting, where input and feedback can be obtained by other department managers, and the Human Performance Department. The department will follow up the next month and provide an update on corrective actions, and whether further action is required for their findings.

The role of the Hu department is to monitor for trends in Human Performance across the site, and provide assistance and guidance to departments and the site to reinforce standards, as well as monitor for improvements in Hu techniques throughout industry.

Paired Observation training is used to maintain high standards in observations that the supervisors complete for these MRBs. The focus is on having an engaging conversation between supervisors and their workers. The approach of "Ask, don't tell" is used to allow the worker to be more engaged in understanding the need for maintaining high standards.

Managers and supervisors are required to complete an 8-hour course on the requisite skills that are applicable to paired observations, and all observations in general. These skills are required to enable managers to develop their direct reports as leaders. This is followed up by a graded field observation to complete the qualification. They are also required to complete an 8-hour course on the requisite skills that are applicable to Observation and Coaching. These skills are required for supervisors to be able to coach their staff, for performance improvement.

The objectives of the training is for Leaders to learn to:

- Recognize that observation and coaching supports Human Performance (Hu) and continuous improvement through a visible and active leadership presence in the workplace; assess the effectiveness of their current coaching skills;
- Distinguish between coaching and correcting;
- Learn how to acknowledge and reinforce positive behaviours;
- Learn how to engage in a coaching conversation and ask questions when it appears as though standards aren't being met;
- Obtain commitment on what the person being coached will do in the future to change behavior;
- And take detailed notes and share organizational learning.

The overall metric for Human Performance is the Site Event-Free Day reset total for the year. The hierarchy of Event Free Day Resets (EFDR) from highest consequence to lowest is: Site, Department, and Crew. The Station Condition Record (SCR) program is used to capture these events as they happen, and then Site, Department, and higher consequence Crew level resets are analysed using the process described in N-INS-09030-10001, *Human Performance Event Communication and Analysis*. This instruction is used to determine how the event occurred, and what Hu barriers failed, in an effort to prevent recurrence of events. Lower level trends are recognized from SCR frequency, and site wide communications are used to refresh the standards, expectations, or good behaviour in order to reverse the trend.

Lower level Hu events are also monitored and used as opportunities for learning, and being proactive at recognizing the behaviours that could contribute to significant events. This

provides the opportunity to stop negative trends through communication, education and focused observations in the area.

2.10 Training [Items #16 and 17]

2.10.1 Personnel Training

Personnel training is discussed in Section 2.2.2 of the Pickering licence renewal application, and states that the training program for regular staff, contractors, temporary personnel and other staff assigned work at OPG is defined by N-PROG-TR-0005, *Training*.

The training program provides the structure, processes, and tools for defining, developing, implementing, documenting, assessing, and improving the training required to ensure staff have the appropriate knowledge, skill, and attitudes for safe and efficient plant operation.

The training program is in compliance with regulatory document REGDOC-2.2.2, version 2 (2016), *Personnel Training*.

2.10.2 Certification Table [Item #17]

The initial training programs are in accordance with N-PROC-TR-0008, *Systematic Approach to Training*. As shown in Table 2, there are adequate numbers of individuals for each position that requires CNSC certification. As well, there are on-going training programs preparing trainees to move into these positions.

Training programs are in accordance with CNSC regulatory document RD-204, *Certifications of Persons Working at Nuclear Power Plants.*

Certified Position	Pickering 1 & 4		Pickering 5 to 8	
	Shift Manager and Control Room Shift Supervisor	Authorized Nuclear Operator	Shift Manager and Control Room Shift Supervisor	Authorized Nuclear Operator
# of Certified Staff	15	36	19	58
Minimum # of Certified Staff Required	10	20	10	30
# of Trainees for Certified Position	16	22	9	24
Certified Position	Pickering 1 & 4 and 5 to 8			
	Responsible Health Physicist			
# of Certified Staff	4			
Minimum # of Certified Staff Required	1			

Table 2- Number of Pickering Certified Staff (October 30, 2017)

2.11 Fitness for Duty [Item #18]

2.11.1 Limits of Hours of Work

Effective August 2017, the procedure, N-PROC-OP-0047, *Limits of Hours of Work* replaced the previous governance, N-PROC-HR-0002, *Limits of Hours of Work*. This procedure identifies the expectations and the process for monitoring and controlling hours worked and documents the regulatory limits pertaining to hours of work and shift assignments in order to control the effects of fatigue of OPG staff in support of safe reactor operation.

All OPG nuclear employees whose hours are input into the *TEMPUS* time reporting tool, are included in the hours of work monitoring and compliance.

As an exception to N-PROC-OP-0047, those employees who conduct work in a location which is outside of the protected area of the nuclear plants are subject to the applicable restrictions of the Employment Standards Act.

Additional personnel who are exceptions in N-PROC-OP-0047 are as follows:

- Workers not employed by Ontario Power Generation,
- Decommissioning and Nuclear Waste Management staff,
- Nuclear Refurbishment Employees working on units that have been fully defueled are exempted from the restrictions in N-PROC-OP-0047, Section 1.2.
- Casual Construction Trades Persons

As well, OPG has submitted an implementation plan for meeting the requirements of REGDOC-2.2.4, *Fitness for Duty: Managing Working Fatigue* in Reference 4. It is the intention of OPG to complete implementation by January 1, 2019.

2.11.2 Regulatory Documents RD-204 and RD 363

Regulatory document RD-204 requires that a fitness for duty program be established for certified staff. This program is implemented as follows:

Section 1.5.2 of N-CHAR-AS-0002, *Nuclear Management System*, identifies expectations for all staff in OPG Nuclear. The expectations are communicated to all staff through adherence to the Corporate Safety Rules (under Common Safety Rule 1.2). These expectations are also reinforced through the security access and control process.

All supervisors in OPG Nuclear including supervisors of certified and security personnel are required to complete a training course on the "Continuous Behaviour and Observation Program" (CBOP) followed by refresher training every three years. The CBOP trains supervisors to detect insider threats, by developing awareness to recognize and respond to behaviours, including drug and alcohol abuse that may include a risk to the security, safety or health of employees, facilities and the public.

In addition, Pickering Instruction, P-INS-09110-00005, *Operations Manager Expectations* documents the expectations for Shift Managers, Control Room Shift Supervisors, and Authorized Nuclear Operators to monitor the performance of staff. Shift Managers and Control Room Shift Supervisors are also provided additional training regarding the application of the Fitness for Duty Program as per training objective, N-OBJ-60630-00001, *SM/CRSS Personnel Module 3 - Fitness for Duty*.

Certified staff performance is also observed during simulator training. Instruction, N-INS-09110-10059, *Simulator Performance Observation and Crew Critiques* provides certified staff performance expectations during simulator training. Team and individual performance feedback is provided and documented during this training.

OPG has been in compliance with RD-363, Nuclear *Security Officer Medical, Physical, and Psychological Fitness* since 2008. Compliance to the requirements of this regulatory document is established within (OPG Confidential - Security Protected) N-INS-61400-10044, *Nuclear Specialized Training, Weapons and Equipment*. To ensure CNSC objectives and criteria for regulatory evaluations of training, licence conditions, and applicable standards are met, RD-363 was utilized in the development of the managed system for security training outlined in N-INS-61400-10044. OPG has implemented the requirements of this regulatory document by retaining medical, physical, and psychological certificates on file for each Nuclear Security Officer and has made these available for review, inspection, or audit purposes when required to do so.

2.12 Operations [Items #19 – 23]

2.12.1 Operational Focus

An Operational Focus Oversight Committee has been established at Pickering to ensure that operational focus is maintained within station processes. A key function of the oversight committee is to monitor the unavailability of equipment that is important to the safe and reliable operation of the station and to ensure that deficiencies are being addressed through approved work management processes with the correct priority. Two examples of these work processes are the Emergent Work and Fix-It Now Centre of Excellence (FINCOE) processes, both of which ensure that high priority work is addressed in a timely fashion while the FINCOE process identifies and resolves barriers to execution of new incoming and long standing deficiencies. By maintaining this operational focus, the number of unavailable important equipment has decreased in 2017 and is expected to continue to decrease in 2018.

The Operational Focus Oversight Committee also monitors the station response to operational challenges. Operational challenges constitute deviations from an intended state that may challenge Operations. Operational challenges are classified as operator workaround, operator burden, or control room equipment. An operator workaround requires operating staff to take compensatory actions to comply with procedures during a plant transient. An operator burden requires compensatory operator action or a response that is different from normal practice outside of transient conditions. A control room equipment deficiency affects control panels such that the performance of indications, switches or controllers is degraded. There are

currently no operator work arounds at the station and the remaining number of operator burdens and control room deficiencies is below target.

	Unit 1	Unit 4	Common Services	Unit 5	Unit 6	Unit 7	Unit 8	Target per unit	Status
Operator Burden	3	0	2	1	0	1	0	3	At or Below Target
Control Room Equipment Deficiency	0	1	0	1	2	0	2	3	Below Target
Operator Work-Around	0	0	0	0	0	0	0	1	Below Target

Table 3 - Number of Operator Challenges (as of October 2017)

2.12.2 Plant Status Control

Plant status control is implemented by the use of Temporary Change Records per procedure, N-PROC-OP-0027, *Temporary Change Records,* and the use of Plant Status Tags per N-PROC-OP-0008, *Use and Control of Plant Status Tags.*

Two performance indicators are used to measure the effectiveness of plant status control:

The primary indicator is Misposition Index Value (MIV). A misposition is declared when a component is found to be off its baseline position without documented approval; or a component is incorrectly operated; or the incorrect component is operated. The MIV incorporates the risk level associated with each misposition by assigning increased weight to higher level events to provide an indication of the extent of compliance of the plant with its analyzed state. This indicator is reported to the CNSC quarterly under REGDOC-3.1.1.

The secondary indicator is Plant Alignment Index (PAI), which monitors approved deviations from the station design configuration greater than 90 days. This is a lagging indicator that monitors off base devices that are still within an analyzed state and are procedurally controlled.

These parameters are reviewed monthly by station management to ensure standards are maintained or improved and opportunities for improvement identified.

2.12.3 Work Protection

Pickering maintains a constant focus on Work Protection (WP) performance as a key safety program. The current continuous improvement initiatives in this area include:

- Passion for work protection: which includes supervisory oversight, oral review boards, escalated responses to work protection events, engagement of field staff for solutions,
- Process drivers; which includes verification practices improvement, and
- Training enhancements for operations and maintenance staff.

A primary focus has been to ensure staff are aware of their roles and responsibility. This focus has resulted in improvement in work protection performance at Pickering as indicated by the Work Protection Performance Index (WPPI) and the six month rolling WPPI as shown in Figure 5.

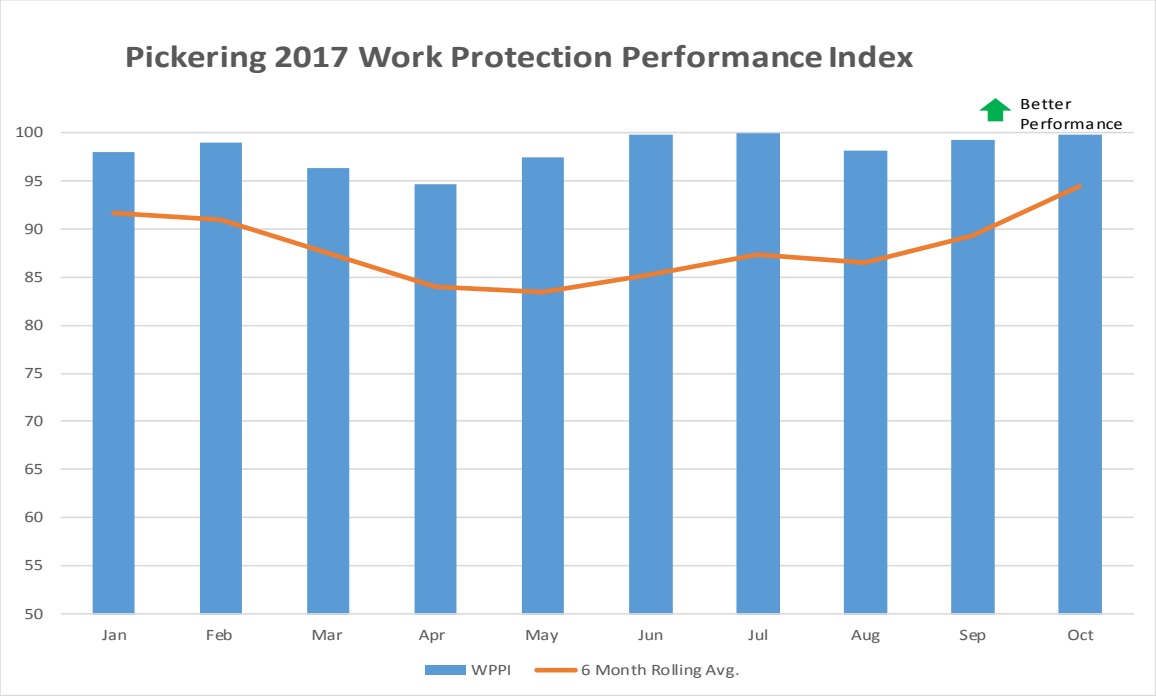


Figure 5 - Work Protection Performance Index

All work protection events are reviewed to identify trends and develop actions to improve performance and ensure that operating experience is used to inform improvement strategies.

2.12.4 Operating Procedures

The control measures for ensuring the adequacy of technical procedures prior to being issued for use are documented in the following OPG governance documents:

OPG Standard, N-STD-AS-0014, *Requirements for Technical Procedures*. The Standard specifies the requirements for the structure, content and format of technical procedures.

OPG Procedure, N-PROC-AS-0028, *Development, Review, Validation & Approval of Technical Procedures.* The procedure establishes the requirements for development, review, validation, approval and issue of Technical Procedures. For procedures that have been issued, a history docket with all relevant forms are maintained for future use/reference/audit.

Operating Memos (OPMs) are issued to provide temporary operating instructions, for example, during planned outages, and Technical Procedure Action Requests (TPARs) are issued when a new procedure is required or an existing procedure needs to be updated. The number of OPMs and TPARs are tracked to ensure that the plant configuration is controlled and consistent with station documentation thereby minimizing error likely situations and to ensure the best possible set of procedures is available to station staff.

Performance in this area is tracked using the following two metrics:

1) Number of OPMs. The target for active OPMs is ≤ 27. Performance is shown in Figure 6, and has met or bettered the target generally for the last 24 months. The increase in number of active OPMs in August and September 2017 is due to outage work and Pickering expects to reduce the number below target by the end of 2017.

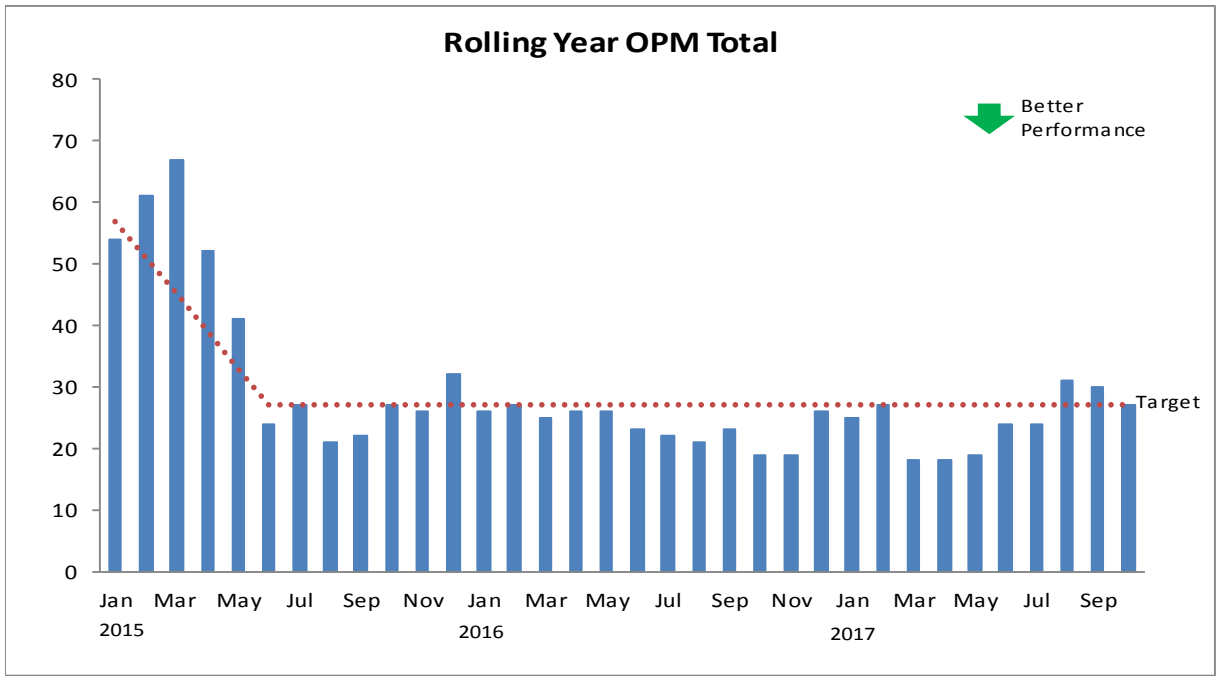


Figure 6- Operating Memo Totals

2) Number of operationally significant procedure changes (T-type TPARs) that are open greater than 90 days. The target for this metric is less than five outstanding procedure changes. As seen in Figure 7, once the target was reached, Pickering has met or bettered the target for all months except November 2016.

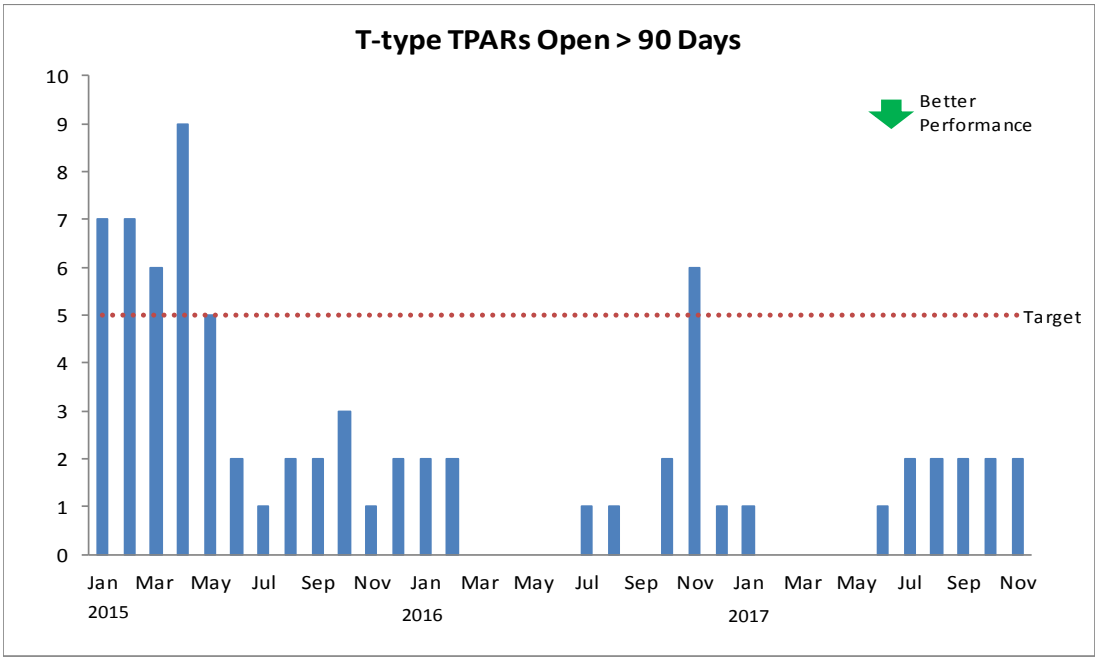


Figure 7- Open Procedure Change Requests

2.13 Engineering Change Control (Items #24-25]

The Engineering Change Control program ensures that all modifications to systems, structures and components are planned, designed, installed, commissioned, place in service, or removed from service to be compliant with applicable codes and standards and the licensing basis. All modifications are reviewed prior to approval to ensure they improve or maintain operability, maintainability, radiological and conventional safety, and regulatory or licence compliance. The risks and impacts of a proposed modification are documented and reviewed by stakeholders, subject matter experts and approved by the facility Design Authority.

OPG program document, N-PROG-MP-0001, *Engineering Change Control* and implementing procedures and forms document the required reviews and evaluations to be undertaken for each engineering change.

Human Factors Engineering (HFE) is explicitly considered in all engineered changes to the nuclear design basis. OPG program document, N-PROG-MP-0001, *Engineering Change Control* and implementing procedures and forms require identification of any HFE scope in the modification and an assessment of the HFE scope of a modification to determine the level of HFE effort that is required. The program will be compliant with the requirements of standard

CSA N290.12-14, *Human Factors in Design for Nuclear Power Plants*. Minor revisions of the documents are in progress, for compliance by the end of 2017.

Temporary modifications are defined in the Engineering Change Control process, and are generally minor in scope and of short duration. OPG has implemented key points of industry best practice for control and implementation of temporary modifications. These key points involve ensuring that the scope of what defines a temporary modification is aligned with other utilities and focussing on minimizing both the use of temporary modifications and the duration when used. OPG's target is to keep temporary modifications installed for less than 6 months or one outage cycle, per industry practice. Benchmarking of the temporary modification process was performed and OPG's process is aligned with other similar utilities.

The average age of temporary modifications has been reduced by 60% over this licensing period while the number of temporary modifications remained relatively constant. During the current licensing period, efforts were made to reduce the backlog of modification closeouts to maintain a robust configuration management program. The number has decreased by 75% over the licensing period and further progress is planned into the next licensing period.

2.14 Procurement Engineering [Item #26]

The following Table 4 provides the governance associated with the procurement engineering process at OPG.

Control Measure Requested	Document	Program Area
Procurement engineering process.	N-PROC-MP-0098, Procurement Engineering Activities	N-PROG-MP-0009, Design Management
Qualification of suppliers of items and services.	N-PROC-MM-0010, Establishing and Maintaining Ontario Power Generation Approved Suppliers List	OPG-PROG-0009, Items and Services Management
Procurement process for ensuring obsolescence replacement parts in a timely manner.	N-STD-MA-0024, Obsolescence Management covers proactive obsolescence management. Note: OPG's Procurement Process for items and services does not change regardless of an item's obsolescence solution.	N-PROG-MP-0008, Integrated Aging Management OPG-PROG-0009, Items and Services Management
Assessment process for ensuring fit form and function of item.	N-INS-08173-10048, Item Equivalency Evaluation	N-PROG-MM-0001, Engineering Change Control

Control Measure Requested	Document	Program Area
Examination process of received items and verification of services.	Examination process of received items: N-PROC-MM-0021, Supply Inspection Verification of services: OPG-PROG-0009, Items and Services Management	OPG-PROG-0009, Items and Services Management

Table 4 - Procurement Engineering Governance

2.15 Software [Item #27]

Software Engineering Tools, pertaining to items used in production of software, are covered under the *Software* program, N-PROG-MP-0006 and identified during software classification. Software is classified to determine the set of applicable standards and procedures for the development, maintenance, acquisition, qualification, use and retirement.

Software is defined as a software engineering tool if it consists of computer programs used in development, testing, analysis, or maintenance of Real-Time Process Computing (RTPC) or Scientific, Engineering or Safety Analysis (SESA) software. The *Software* program imposes software engineering tools requirements on developers and maintainers of RTPC and SESA systems in the associated RTPC and SESA sections accordingly. An example of a software engineering tool is software used to support the production of the Digital Control Computer (DCC) software.

2.16 Reactor Components and Structures [Item #28]

Specific additional technical information was requested by the CNSC on an item in the following document: N-PLAN-01060-10003, *Reactor Components and Structures Life Cycle Management Plan.*

The primary conclusion of the calandria vessel integrity assessment is that changes in material properties due to irradiation do not represent a credible threat to the integrity of the vessels.

Due to the temperatures, fluences, materials and chemical conditions, the calandria vessels are not at sufficient risk of degradation by helium embrittlement, hydrogen embrittlement or stress corrosion cracking, to require inspection. The risk of irradiation-assisted stress corrosion cracking is also considered to be very low and does not justify inspection of the calandria vessel welds. Routine monitoring of moderator chemistry provides assurance that this degradation is highly improbable.

Evaluation of end-of-extended life properties results in a definition of a threshold fluence, and the conclusion that irradiation embrittlement is not of concern for which the estimated end-of-extended life is below the threshold.

Furthermore, the Pickering A and B fluence estimated values were derived with an intended 425,000 EFPH and 475,000 EFPH respectively, and as such, the estimated fluence values provide additional conservatism. The conclusion of the OPG calandria vessel integrity assessment is that the changes in material properties due to irradiation do not represent a credible threat to the integrity of the vessels within their respective extended operating years.

2.17 Fitness for Service [Item #29]

2.17.1 Aging Management

The condition of the plant has been reviewed under OPG's Integrated Aging Management Program (IAMP), which ensures that appropriate maintenance, testing and monitoring is ongoing at Pickering.

Over a half million components and supporting Fitness for Service (FFS) programs (including the relief valve testing program and balance-of-plant pressure boundary component inspections) covering all plant SSC's were reviewed through a defined process; findings and recommendations were documented in respective Life Cycle Management Plans (LCMPs) and over 1000 Condition Assessment (CA) reports. The findings and recommendations have been rationalized and actions to be taken documented.

The remaining condition assessment work relating to the extended operations period has been captured by the Periodic Safety Review (PSR) and documented as actions in the Integrated Implementation Plan (IIP). The goal of these IIP actions is to confirm the completeness of the Pickering Aging Management Program for the extended operating period and the effective tracking and status reporting of any further actions to be taken.

A review element of a PSR is to assess the performance and effectiveness of station programs. External inspections and internal audits of the IAMP implementation at Pickering were conducted in 2015 and 2016. These reviews and resulting corrective action plans were further evaluated by the Pickering PSR2 which concluded that the corrective action plans were adequate and that additional actions are not required to assure effectiveness. The remaining corrective actions are included in the Pickering PSR2 IIP to track them to completion.

With respect to future updating of the IAMP, OPG reviews all of its programs for comprehensiveness and effectiveness on an ongoing basis and concluded that the IAMP implementation at Pickering is robust.

2.17.2 Periodic Inspection Program [Item 30]

The Periodic Inspection Program (PIP) requires that components essential to the safe operation of the plant are inspected in order to provide assurance that equipment inspected under this program will continue to be fit for service.

Table 5 summarizes the status of execution of N285.4 and N285.5 inspections during the current licensing period. Included is the number of inspections completed and required for

each unit under both codes, as well as the last year in the current 10-year cycle. The number of completed inspections does not include the ongoing online N285.5 2017 inspection campaign, nor the inspections ongoing during the 2017 Unit 1 planned outage campaign.

Unit	Completed N285.5 Inspections	Total N285.5 Inspections	Percentage of N285.5 Inspections Remaining	N285.5 Cycle End	Completed N285.4 Inspections	Total N285.4 Inspections	Percent of N285.4 inspections remaining	N285.4 Cycle End
Unit 0	261	1093	76.1%	2023	N/A	N/A	N/A	N/A
Unit 1	64	369	82.7%	2023	30	261	88.5%	2021
Unit 4	155	396	39.1%	2023	94	318	70.4%	2023
Unit 5	174	676	25.7%	2023	420	437	3.9%	2017
Unit 6	213	485	56.1%	2023	286	346	17.3%	2018
Unit 7	38	404	91.6%	2023	222	252	11.9%	2019
Unit 8	86	210	29.5%	2023	112	214	47.7%	2020

Table 5 - N285.4 and N285.5 Inspections

All remaining inspections are scheduled in the Periodic Inspection Program (PIP) Databases/Schedule documents. These inspections are planned to be completed prior to the end of their respective inspection interval. Any potential deferral beyond 10-year interval is reviewed and assessed and is subject to CNSC approval.

All inspections findings requiring corrective actions are addressed before the unit is restarted if the inspection is performed during a planned maintenance outage. Further, when an unacceptable condition is found there are extent of condition inspections performed on similar/identical components, as per code requirements. Similar extent of condition inspections are completed for unacceptable conditions found during on-line inspections, with repairs scheduled through the on-line scoping process according to their priority.

There have been no major issues found under the PIP inspection program, the inspections results are almost entirely comprised of minor in nature, such as nut tightening jobs on supports.

An example of one indication that was found, was a weld crack found in the boiler room during the most recent CSA N285.5 Unit 4 planned outage inspection campaign. This weld crack opened up a flow path through the containment boundary that needed to be corrected. This condition was communicated to the CNSC through an official correspondence, as well as the N285.5 Inspection Report. This indication was repaired during the same Unit 4 planned outage wherein it was identified. A Station Condition Record (SCR) was also filed to document this condition and to perform an investigation into the cause of this crack, as well as the required corrective actions moving forward.

Challenges such as overall outage scope and priorities, accessibility and dose exposure, and resources affect the execution of the inspection programs, including the completion of planned inspections and repairs. These are tracked through bi-annual health reports created by

Pickering site engineers for the execution of the CSA N285.4 and CSA N285.5 PIPs. Regulatory compliance is tracked in the program health reports. As well, the program health is assessed to ensure regulatory requirements are met, backlog reduction is monitored, and also to ensure that a strong program governance/structure in place. Included in these health reports are corrective actions required to complete any outstanding inspections or repairs.

Further, efforts are made to schedule inspections such that the scope is minimized near the end of an inspection cycle. This is done to ensure that any execution issues (i.e. access, dose, etc.) can be understood and addressed ahead of time so all the required inspections can still be completed within the inspection cycle. Meetings are also held with the inspection team on a yearly basis to review for lessons learned from previous campaigns and to discuss upcoming campaigns. These activities help inform the scoping and scheduling of PIP inspections, which is governed both by the station PIP documents and the station work management process, by identifying issues that must be addressed.

2.18 Radiation Protection [Items #31 – 37]

2.18.1 Radiation Protection Program

The *Radiation Protection* (RP) program, N-PROG-RA-0013, includes the requirement to implement and maintain a program to maintain doses to persons as low as reasonably achievable, social and economic factors being taken into account.

Management control over work practices is demonstrated through the documentation of the radiation protection program via governing procedures and standards implemented by the RP program and associated governance support documents, and the inclusion of key activities in other interfacing procedures and standards. Workers are required to comply with the RP procedures and standards or stop work if the worker believes following the procedure will result in an unsafe condition, in accordance with document N-STD-AS-0002, *Procedure Use and Adherence*.

All personnel working at a nuclear site are assigned an RP qualification level based on successful completion of training. Personnel maintain their qualification through the successful completion of periodic retraining and testing. Maintenance of qualification is also contingent on ongoing demonstrated ability to perform appropriately at the qualification level. Training is in sufficient detail that workers can carry out their obligations as specified in the CNSC regulations. Qualified trainers, using approved training packages designed to meet approved training objectives, deliver RP training, in accordance with the training program, documented in N-PROG-TR-0005, *Training*.

Personnel with access to the site are limited as to the areas they may enter independently and the radiation protection activities they may perform without assistance, based on their qualification level. Personnel performing radioactive work are either qualified to perform the associated activities or an individual who is qualified is assigned to the work to provide radiological protection.

Key positions in the radiation protection program organizations are given additional radiation protection related training to become qualified to perform in their specialized positions within

the program. Specialized training includes initial and continuing training delivered in accordance with N-PROG-TR-0005, *Training*. The training program includes initial and requalification training, examinations and tests for the certified position of Senior Health Physicist, in accordance with Regulatory Document RD-204, *Certification of Persons Working at Nuclear Power Plants*. The role of the Senior Health Physicist is documented in N-MAN-08131-10000-CNSC-031, *Responsible Health Physicist.*

Control of occupational exposure to radiation is addressed through established dose limits in accordance with N-PROC-RA-0019, *Dose Limits and Exposure Control*. Control of public exposure to radiation is addressed through N-PROG-OP-0006, *Environmental Management*. Planning for unusual situations is addressed through N-PROG-RA-0001, *Consolidated Nuclear Emergency Plan*. The ascertainment of the quantity and concentration of any nuclear substance released as a result of the licensed activities is addressed via N-STD-OP-0031, *Monitoring of Nuclear and Hazardous Substances in Effluents* and N-STD-OP-0042, *Controlling Radiation Exposure to the Public and the Environment to as Low as Reasonably Achievable*.

Where OPG collects personal information related to the administration of the Act and these regulations, persons document their consent in writing for OPG to collect, use and disclose dose records for the purpose of fulfilling its legal rights and obligations and those of the workers employer, if other than OPG, under Federal and Provincial laws, including, without limitation, the Radiation Protection Regulations, the General Nuclear Safety and Control Regulations and Ontario's Occupational Health and Safety Act as amended, replaced or restated from time to time.

As part of the RP program, persons designated as nuclear energy workers are informed that they are nuclear energy workers, of the risks associated with radiation exposure to which they may be exposed during the course of work, and the associated dose limits prescribed in the CNSC regulations as documented in N-PROC-RA-0019, *Dose Limits and Exposure Control*. Written acknowledgement is obtained to demonstrate that a worker has been informed that they are a nuclear energy worker and of the risks of radiation exposure, and the obligation of females to notify the licensee in writing upon becoming aware they are pregnant.

Further, OPG complies with the requirement to report doses to workers to the National Dose Registry, and reports in accordance with Regulatory Document, REGDOC-3.1.1. The system of dose limitation has been successful as no exposures in excess of CNSC regulatory dose limits have occurred.

In accordance with N-PROG-RA-0013, RP program performance is monitored and non-compliances with the Radiation Protection Regulations are documented and investigated as per N-PROC-RA-0022, *Processing Station Condition Records*. Such events are reported to the CNSC in accordance with Regulatory Document, REGDOC-3.1.1.

2.18.2 Application of ALARA

In accordance with N-STD-RA-0018, *Controlling Exposure as Low as Reasonably Achievable (ALARA)*, senior leadership support of the ALARA program is demonstrated through participation in the Site ALARA Committee. The committee is chaired by the facility Site Vice President, and the functions include review and approval of facility dose targets and ALARA plans, and review of ALARA program performance. Quorum members include representatives from the Operations and Maintenance, Engineering, Work Management, Chemistry, and Radiation Protection departments. Worker representatives are also invited to participate.

ALARA plans are prepared for activities where collective dose exceeds 30 mSv. Plans are also approved by line managers and Radiation Protection staff. Dose performance is monitored through the year, and for each ALARA plan, and station condition records are raised for ALARA plans where performance is worse than target.

Annual collective radiation exposure targets are established based on the planned scope of work, including planned maintenance outages and dose associated with the operation and maintenance of running units; anticipated radiological conditions and accounts for dose savings as a result of the planned implementation of ALARA initiatives. Each year, three planned maintenance outages are scheduled for execution; each unit is on a two year outage cycle. Note that in 2013, only two outages were executed, which explains the significantly lower dose performance versus target that year. Collective radiation exposure performance has been better than target each year since 2013 as a result of the successful implementation of source term mitigation, work methods improvements and improvements in radiation worker practices. This performance is attributed to the successful implementation of initiatives to mitigate radiation source term, including: custom shielding developed for reducing doses to workers on the reactor faces during planned maintenance outages; leveraging technology to provide real time monitoring of radiation hazards, to provide workers with timely information on current radiation hazards; use of robotics to perform tasks in radiation areas to avert dose to workers; improvements in vapour recovery dryer efficiency. A dose reduction initiative was introduced in 2016 to establish dose goals for radioactive work tasks. This results in an opportunity for the worker and supervisor to discuss the job dose goal and identify any opportunities to reduce individual exposure.

Multidisciplinary teams have been successful in implementing dose reduction initiatives, such as: the deployment of an ion exchange resin with improved radionuclide removal capabilities in Unit 1, implementation of modifications to vapour recovery dryers to allow operation when containment is isolated, and improvements to vapour recovery dryer desiccant management to improve efficiency, which demonstrates the management support for the ALARA program.

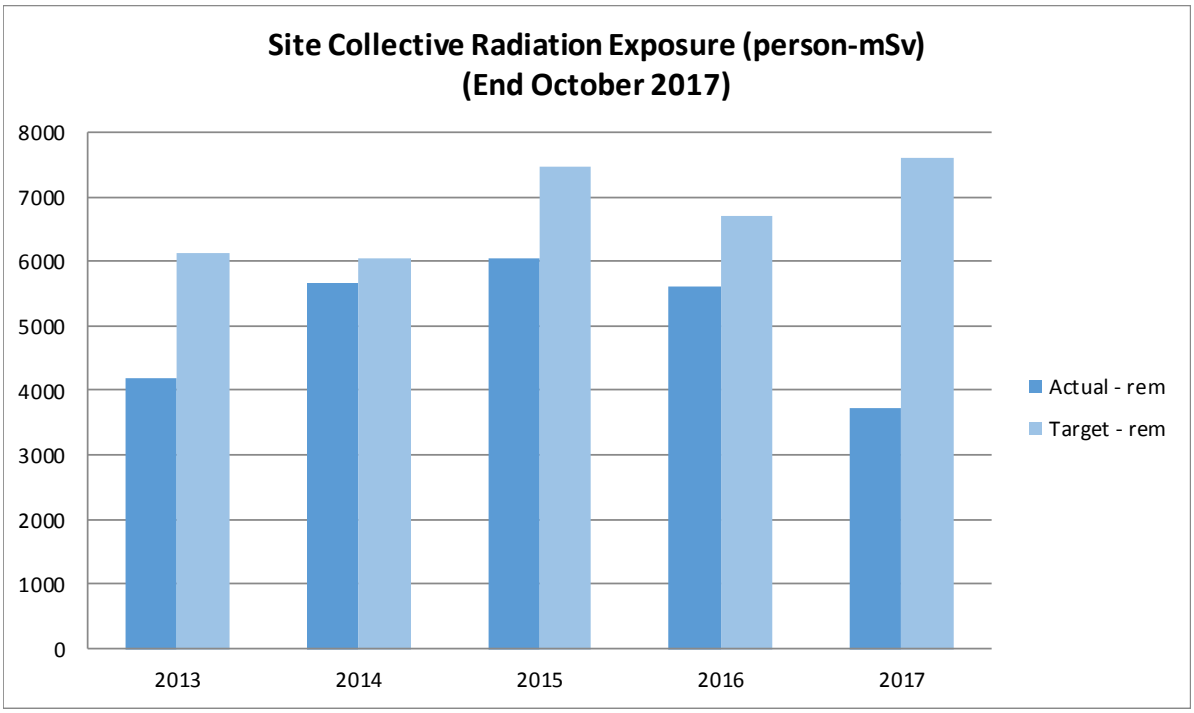


Figure 8 - Collective Radiation Exposure (CRE)

Pickering has been successful at keeping Collective Radiation Exposure (CRE) below targets. This has been achieved through the implementation of increased line accountability for dose improvements driven through lessons learned during planned maintenance outages.

For example:

1. Collective exposure improvements were realized for the removal and reinstallation of reactor face insulation panels on Unit 5. In 2013, the dose associated with this job was 67 mSv. By identifying work efficiencies and incorporating operating experience and lessons learned, the dose for this job was reduced to 49 mSv in 2017.

2. Exposure reduction improvements for fuel channel reconfiguration were realized on a dose per channel basis. In 2015, the average dose per channel reconfigured for Unit 1 was 0.72 mSv per channel during the Unit 1 planned maintenance outage; the average dose was reduced to 0.24 mSv per channel reconfigured in the 2016 Unit 4 planned outage. When the radiation hazard conditions were normalized across the two units, a 30% dose reduction was realized. The reduced dose is attributed to improved reactor face shielding, improved worker experience and incorporation of operating experience and lessons learned.

3. Continual outage over outage improvements have been realized for the opening and closing of steam generators. This is attributed to the use of a dedicated crew, incorporation of lessons learned and improvements in tooling.

2.19 Environmental Management System [Items #38 – 42]

2.19.1 REGDOC-2.9.1 Compliance

OPG conducted a clause-by-clause analysis for compliance with regulatory document, REGDOC-2.9.1 (2013), *Environmental Protection Policies, Programs and Procedures* against the existing environmental protection program for the Pickering Nuclear Generating Station including the Pickering Waste Management Facility. There are no compliance gaps, therefore Pickering NGS is compliant and this regulatory document can be included in the licensing basis.

2.19.2 Protecting the Public

As part of Environmental Management governance (N-PROG-OP-0006), N-STD-OP-0031, *Monitoring of Nuclear and Hazardous Substances in Effluents* addresses monitoring criteria for station streams. Both performance and control monitoring requirements are outlined based on the Maximum Probable Emission Rates (risk based) requiring either direct or indirect/estimation monitoring.

P-PLAN-03480-00001, *Pickering Nuclear Radioactive and Hazardous Emission Monitoring Plan* documents station points of release, maximum probable emission rates and concentrations and reference volume and flow rates for both radioactive and hazardous substances. This document demonstrates compliance to N-STD-OP-0031, *Monitoring of Nuclear and Hazardous Substances in Effluents*.

Control of releases of nuclear hazardous substances are governed by N-STD-OP-0031, *Monitoring of Nuclear and Hazardous Substances*. Performance and control monitoring requirements are documented in P-PLAN-03480-00001, *Pickering Nuclear Radioactive and Hazardous Emissions Monitoring Plan.*

Additional measures include control of Active Liquid Waste (ALW) system through authorized pump outs as referenced in P-OM-018-79210-03, *Radioactive Liquid Waste Management*; and installed exhaust ventilation control filters (HEPA/CA) which are performance tested as defined in N-PROC-OP-0042, *Contaminated Exhaust Ventilation Control Filter Testing*.

2.19.3 Category C Spills

Category C spills are listed in the Pickering licence renewal application (Reference 1) and the following description is offered here as a more complete description of the June 13, 2017 event that was reported to the Ministry of the Environment and Climate Change and the CNSC:

125 L of lubricating oil was accidentally spilled to the floor. The majority of this oil (75 L) was recovered from the floor. An estimated 50 L of the product entered bermed floor drains which lead to the Condenser Cooling Water Discharge Duct with a lake outfall (outfall P014).

2.20 Emergency Preparedness Program [Item #43]

OPG confirms that Pickering is fully compliant with REGDOC-2.10.1 (Version 1, 2014), *Nuclear Emergency Preparedness and Reporting*. This CNSC regulatory document requires that licensees ensure that their emergency planning basis consider all hazards that could have an adverse impact on the environment and the health and safety of the public and onsite personnel. OPG is in compliance with this requirement, as the analysis of the risks and hazards the EP program addresses existed within several documents. As an enhancement, OPG compiled the applicable documentation of the planning basis considerations and referenced it in OPG's Consolidated Nuclear Emergency Plan (CNEP) N-PROG-RA-0001 in order to demonstrate full compliance. OPG continues to work closely with regional and provincial authorities to ensure that they are provided the necessary information to maintain effective emergency plans.

Licensees are required to have real time radiological detectors around the perimeter of their nuclear facilities, and communicate the results to the offsite authority and CNSC. OPG has had real time fixed radiological detection and monitoring devices operating around the perimeter of the Darlington and Pickering nuclear facilities since 2012. These devices are equipped with appropriate backup power. Previously the offsite authority and CNSC would have received this information hourly from OPG on a form. In order to improve the timeliness of communicating the results, OPG developed a process for real time access to the offsite monitoring data for the offsite authority and CNSC. This process provides real time access to key plant information and is referenced in the CNEP.

OPG has existing agreements with the applicable offsite agencies and organizations which are outlined in Memorandums of Understanding (MOU) and other types of agreements. OPG formally compiled those agreements and referenced them in the CNEP.

Public evacuation time estimates were previously completed for the Pickering and Darlington areas using 2006 census data. Both studies were updated in 2015-2016 with the most recent census data and population growth estimates for 2015 and each decade thereafter. The study assumptions were based on REGDOC-2.10.1 and best international practices using US NRC approved methodology. The firm contracted to update the ETE studies had completed the previous OPG ETE studies and more than 50 studies for US nuclear facilities. Throughout the process, there was consultation between the firm, OPG, and key stakeholders to gather information, present results and elicit feedback. Both documents are publicly available on OPG's website. OPG's CNEP includes the requirement to develop and maintain public evacuation time estimates based on current census data, and future population growth projections on a per-decade estimation.

Although changes to the emergency plan and its implementing documents already followed a formal process that included mandatory reviews by position holders and subject matter experts, and use in drills and exercises with revision based on feedback to ensure continued effectiveness; OPG further developed a validation process in compliance with REGDOC-2.10.1, which is referenced in the CNEP.

In 2015 OPG supported distribution of potassium iodide (KI) pills to all homes and businesses within the primary zone, as well as developing a process for people within 50 km to obtain the pills. OPG participated in the Provincial Working Group which oversaw distribution and

communication strategies. In addition, OPG formed a local working group with Durham Emergency Management Office (DEMO), Toronto Office of Emergency Management (TOEM) and Durham Health to develop and implement a program that would fit the needs of the communities surrounding Pickering Nuclear.

At the same time, a communication campaign was developed, beginning with focus groups established in the primary zones. A two-part communications strategy for pre-distribution and distribution campaigns was implemented, with the pre-distribution campaign being a focused intensive education campaign that raised public awareness of KI distribution by explaining why it's taking place, and what it meant.

As part of the overall campaign, a website was created (www.preparetobesafe.ca). The website's purpose was to provide an online site for people within 50 km of Pickering NGS to order KI pills and provide information using FAQs (Frequently Asked Questions).

On-going public awareness campaigns by the local health department and OPG remind residents of pill availability and other preparedness information. New neighbours, (including households and businesses), are identified 3 times per year by Canada Post and sent information packages. All information distributed (including website content) met Provincial Working Group guidelines and was approved by OPG, City of Toronto and Region of Durham. To assist in answering questions from the public, KI pill fact sheets were distributed to operators at local and provincial health help lines and local physicians.

OPG's CNEP reflects the requirement (in consultation with the designated municipalities) to procure stable iodine tablets and maintain them within expiry dates; and also to establish and maintain a program that ensures continued availability and ensure information is available to the general public.

In 2015, OPG implemented a program at Pickering NGS to ensure that in the event of an extreme external event that requires essential staff to be sequestered at site, there are adequate supplies to sustain them. 72 hour emergency supplies provide minimum food, water, hygiene and sleeping requirements until outside aid can be brought in. In addition, Radiation Personal Protective Equipment (RPPE) is stocked and maintained at both sites in quantities that consider a response to an emergency with no off-site aid for up to 72 hours. The RPPE is located in regular inventory locations, and maintained in accordance with OPG's existing inventory control procedures and processes. Distribution of 72 hour supplies is intended for extreme emergency situations only.

2.21 Waste Management [Items #44 – 45]

The most effective aspect of the waste minimization program has been the phased introduction of washable products over several years, whereby previously disposable Radiation Protection Equipment (RPE) was replaced with washable, reusable products. They include items such as Anti-Contamination suits, mop heads, rubber gloves and cotton liners, tool bags, scaffold bags, booties, and micro fibre wipe cloths. As a result Pickering has been successful in reducing Low Level and Intermediate Level Radioactive Waste (LILRW) significantly. To date, more than thirty different products have been implemented into the washable / reusable program. Most recently, washable wet mops have been introduced. This washable program represents approximately 1000 m^3 of savings per year of solid radioactive

waste for Pickering Nuclear that would have been generated if not implemented. A significant trend over this licensing period is the decrease in the average yearly waste. For the previous licensing period, the average yearly waste generated was 2015 m^3/yr. In this licensing period (2012-2017 with projected year end this year of 1710 m^3), the average waste generated is 1676 m^3/yr**.** That represents a 17% reduction in waste generated.

During the licensing period, a conscious effort has been made to drive improvement to annual targets. This goal has been achieved over the past several years. Waste volume reduction includes initiatives such as: reducing packaging at Pickering warehouse/stores prior to items being delivered to the shop floor; communication packages to station personnel on methods of minimizing generation of radioactive waste; reduction of size of zone 3 areas, thus minimizing risk of radioactive contamination.

Waste performance is influenced by the amount of work in the station planned from year to year. More planned outage work with will likely generate more waste. The objective is to educate the workers on the necessary waste minimization strategies during that work, so that LILRW is kept to a minimum and established targets are met. Expectations for implementing these waste minimization strategies is also considered during the planning stages of outages and projects, which include waste minimization strategies in the assessment of work .

OPG continues to meet federal and provincial requirements in processing and disposing of hazardous and chemical wastes. The following governing documents are used for managing hazardous waste at Pickering NGS:

N-PROC-OP-0043, *Waste Management*

P-PROC-WM-0001, *Disposal of Oil and Chemical Waste*

2.22 Appendix E [Item #46 and #47]

Appendix E in the Pickering licence renewal application (Reference 1) gives a description of the Periodic Safety Review (PSR) and the major deliverables for licence renewal.

In the description of the global assessment, OPG stated that, “In some cases, the development of resolutions/dispositions to the global issues will be part of an OPG or industry initiative underway or planned. Or, the resolution and development of options may require more detailed analysis and assessment, extending beyond the timelines for submission of PSR2. In these instances, the status of the initiative and plans will be included in the disposition. The work will be included in the global assessment to facilitate continued tracking”. The CNSC has requested clarification on whether the anticipated results of this work will be included in the global assessment or some other form.

OPG would like to clarify that where there are instances where activities are underway or planned and are documented in the disposition of the global issues, these are either tracked internally or will be part of the Integrated Implementation Plan (IIP).

Also, the wording in Appendix E stated that, "as a final step in the assessment process, the team confirms the overall acceptability of operation of the plant over the period considered in the PSR2". The CNSC requested a clarification on the word 'team' in this statement.

The senior leadership team at OPG have overall responsibility for continued safe operation of all of OPG facilities. In the context of the Pickering PSR2, the reference to a team in Appendix E, Section E.6 of the application was meant to represent the team preparing the Pickering PSR2 in conjunction with the senior management team at OPG.

3 List of Activities under the Operating Licence

3.1 Amended List of Activities under the Operating Licence

OPG applied for a licence amendment to allow the import and export of nuclear substances consisting primarily of contaminated laundry. This licence amendment was approved on October 26, 2017 as PROL 48.04/2018. OPG requests that these amended licence activities be continued in the renewed licence in 2018.

LICENSED ACTIVITIES:

This licence authorizes the licensee to:

(i) Operate the Pickering Nuclear Generating Station (hereinafter "the nuclear facility") units 1, 4, 5, 6, 7 and 8, for power production, and operate units 2 and 3 in the safe storage phase at a site located in the City of Pickering, in the Regional Municipality of Durham, in the Province of Ontario.

(ii) Possess, transfer, use, package, manage and store the nuclear substances that are required for, associated with, or arise from the activities described in [i].

(iii) Import and export nuclear substances, except controlled nuclear substances that are required for associated with, or arise from the activities described in [i]. [Added 2017.10]

(iv) Possess and use prescribed equipment and prescribed information that are required for, associated with, or arise from the activities described in [i].

(v) Possess, use, manage and store enriched uranium as required for fission chambers for the Pickering Nuclear Generating Station units 1 and 4 Shutdown System Enhancement, including spares.

(vi) Possess, produce, manage, transfer and store Cobalt-60.

(vii) Possess, manage and store Cobalt-60 sealed sources.

(viii) Possess, transfer, manage and store heavy water from other nuclear facilities. [Added 2016.06]

(ix) Possess, transfer, package, manage, store and export nuclear substances, except controlled nuclear substances, from the Western Waste Management Facility. [Added 2017.10]

3.2 Import and Export of Nuclear Substances

Pickering NGS has been licensed to import and export nuclear substances other than controlled nuclear substances as defined in the *Nuclear Non-Proliferation Import and Export Control Regulations*. The nuclear substances are materials consisting primarily of contaminated laundry originating from Pickering NGS and the Western Waste Management Facility (WWMF).

Under the licence, Pickering NGS is allowed to accept contaminated laundry from WWMF to combine with the Pickering laundry prior to export to the United States for laundering. In addition to contaminated laundry, the licence condition allows for import and export of packaging, shielding or equipment with low levels of contamination similar to laundry.

Import and export of controlled nuclear substances, equipment and information as identified in the *Nuclear Non-proliferation Import and Export Control Regulations* is done in accordance with applicable regulations.

4 References

A-1 OPG Letter, R. Lockwood to M. Leblanc, "Application for Renewal of Pickering Nuclear Generating Station Power Reactor Operating Licence", August 28, 2017, CD# P-CORR-00531-05055.

A-2 CNSC Letter, A. Viktorov to R. Lockwood, "CNSC Staff Completeness Review – Ontario Power Generation (OPG) Application for Renewal of the Pickering Nuclear Generating Station Power Reactor Operating Licence (PROL) 48.03/2018", September 13, 2017, e-Doc 5301022, CD# P-CORR-00531-05152.

A-3 CNSC Letter, A. Viktorov to R. Lockwood, "Pickering NGS: CNSC Staff Technical Sufficiency Review of the Application for Renewal of the Pickering NGS Power Reactor Operating Licence (PROL)", October 17, 2017, e-Doc 5343935, CD# P-CORR-00531-05181.

A-4 OPG Letter, G. Jager to G. Frappier and H. Tadros, "OPG Implementation Plan for REGDOC 2.2.4 Fitness for Duty: Managing Worker Fatigue, Action Item 2017-OPG-9637", September 25, 2017, CD# N-CORR-00531-18759.