Pickering Nuclear Generating Station Licence Renewal

Commission Hearing (Part 1), April 4, 2018
CMD 18-H6.A

CNSC Staff Presentation

e-Doc 5409773 (PPTX)
e-Doc 5492059 (PDF)

PURPOSE AND OUTLINE OF PRESENTATION

Purpose of CNSC Staff Presentation

- Present to the Commission CNSC staff recommendations with regards to:
  - OPG's request for renewal of Pickering NGS Power Reactor Operating Licence
  - OPG's request to approve operation of Pickering Units 5-8 up to a maximum of 295,000 Effective Full Power Hours

Presentation Outline

- Background
- CNSC Staff Licence Evaluation
- Periodic Safety Review
- End of Commercial Operation
- Performance Assessment
  - Safety and Control Areas (SCAs) ratings
- Regulatory Focus Areas
  - Probabilistic Safety Assessment
  - Fitness for service of fuel channels
  - Radiation Protection
  - Environmental Protection
  - Emergency Preparedness
- Other Matters of Regulatory Interest
- Fuel Channel Operation up to 295,000 Effective Full Power Hours (EFPH)
- Proposed Licence and LCH
- Conclusions and Recommendations

BACKGROUND

Pickering NGS

In service within design life

Refurbished and returned to service

Safe storage state

A1	A2	A3	A4
In service 1971/2005 515 MWe	Safe storage state	Safe storage state	In service 1973/2003 515 MWe

B5	B6	B7	B8
In service 1983 516 MWe	In service 1984 516 MWe	In service 1985 516 MWe	In service 1986 516 MWe

Pickering NGS

- Located in City of Pickering
- Generates 14% of Ontario electricity
- Produces Cobalt-60 isotope
- Design developed by AECL
  - Moderated and cooled with heavy water
  - Natural U on-power fueling
  - Inter-connected containment

Important Dates

- Current Pickering NGS Power Reactor Operating Licence expires on August 31, 2018
- OPG has requested the licence to be renewed for a period of 10 years, to August 31, 2028; within the 10-year period:
  - OPG intends to permanently shutdown all reactors by December 31, 2024
  - Following shutdown in 2024, Pickering reactors will begin transition to safe storage

CNSC STAFF LICENCE EVALUATION

Basis for CNSC Staff Recommendations

- Following receipt of OPG application for Pickering NGS operating licence renewal, CNSC staff assessed:
  - Licence application and supporting information
  - OPG's past performance
  - Other matters of regulatory interest

CMD 18-H6 provides CNSC staff conclusions and recommendations regarding the licence renewal application

Basis for CNSC Staff Recommendations

- CNSC staff assessed the licence renewal application for Pickering NGS to confirm that OPG:
  - Meets applicable legal requirements
  - Implements appropriate regulatory documents and standards
  - Has operating strategy which identifies major challenges and initiatives for the next licensing period

CNSC staff follow established processes for consideration of licence applications

Basis for CNSC staff Recommendations

Pickering compliance regulatory oversight (per Fiscal Year)					
Compliance activities effort	2013-14	2014-15	2015-16	2016-17	2017-18 (up to March 2018)
# of Field Inspections	61	71	69	66	65
# of Type II Inspections	32	22	28	26	25
# of Event Report Reviews	139	90	61	59	64
CNSC staff compliance evaluation effort, person-days	***6532***	***6635***	***7257***	***7211***	***5942***
CNSC staff licence evaluation effort, person days	***1032***	***561***	***201***	***639***	***2485***

CNSC staff maintain adequate compliance oversight effort

Basis for CNSC Staff Recommendations

- CNSC staff review of licensing application follows an established process
- This process
  - Considers licensee's performance against established regulatory framework
  - Is based on modern science and factual evidence
  - Has worked well in the past licensing applications

CNSC builds on proven practices and established a modern and robust regulatory framework

PERIODIC SAFETY REVIEW

Periodic Safety Review (PSR)

- Assessment of current state and performance of plant to determine:
- Extent of conformance to modern codes, standards and practices
- Adequacy and effectiveness of programs, structures, systems and components for continued safe operation
- Opportunities to enhance safety through actions scheduled in Integrated Implementation Plan (IIP)

PSR is a comprehensive assessment leading to practical safety enhancements

Four phases of conducting a PSR

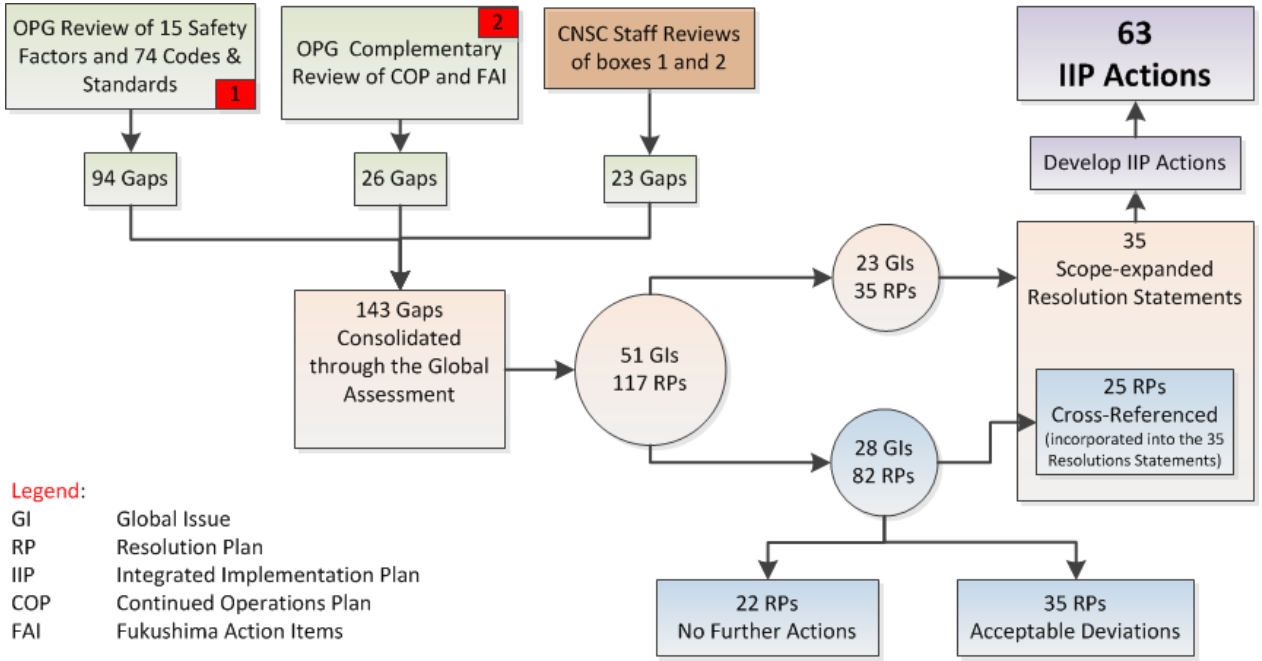
1. PSR Basis Document
2. Safety Factor Reports
3. Global Assessment Report
4. Integrated Implementation Plan

PSR – Integrated Implementation Plan (IIP)

- 63 IIP actions to enhance safe operation, including actions related to
  - Life Cycle Management Plans for the major components
  - Safety analyses impacted by aging
  - Upgrades to ensure containment integrity under severe accidents
  - Condition assessments for piping systems and components for the period of extended operation
- All IIP actions targeted to be completed by end of 2020

CNSC staff thoroughly reviewed and have accepted Pickering IIP

PSR – From 143 Gaps to 63 IIP Actions



PSR – CNSC Staff Conclusions

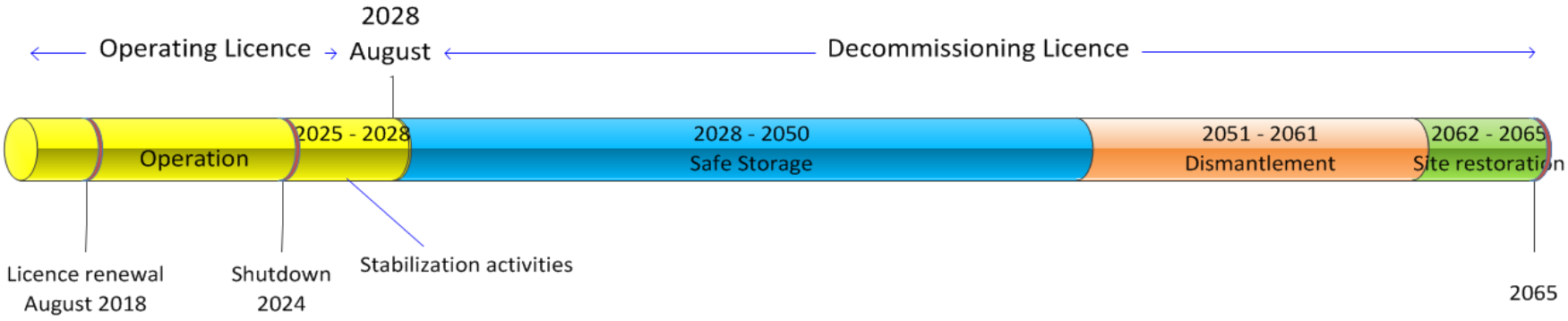
- OPG performed Pickering PSR in accordance with requirements
- Pickering design, operation, processes and management system will ensure continued safe operation of the station until end of 2024
- IIP actions will enhance the safe operation of the reactor units
- Pickering reactor units will be operated only if fitness for service of the structures, systems and components important to safety is assured

OPG's execution of the IIP will be monitored through CNSC staff regulatory oversight activities

END OF COMMERCIAL OPERATION

End of Commercial Operation (ECO)

- The requested 10-year licence period will include three stages
  - Continued commercial operation to the end of 2024
  - Stabilization activities (e.g., post-shutdown defueling and dewatering)
  - Beginning of safe storage with surveillance



End of Commercial Operation (ECO)

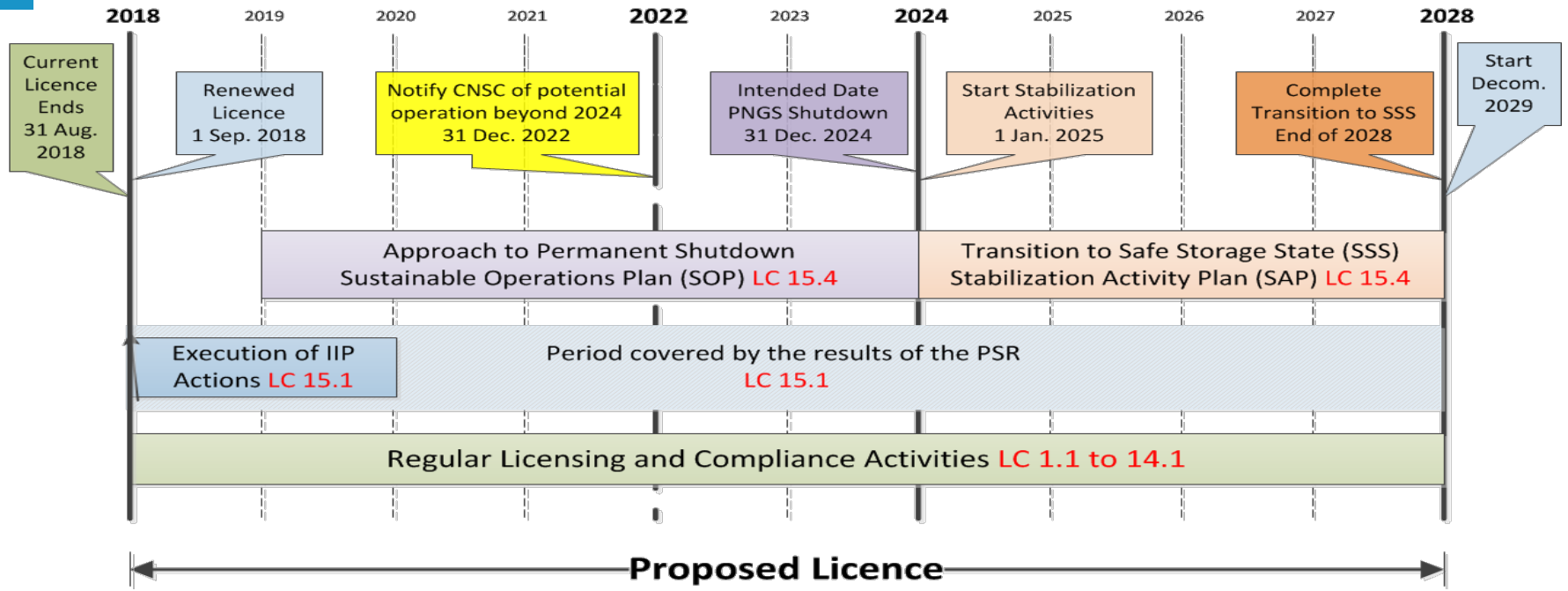
- Regulatory oversight for End of Commercial Operation
- Licence condition LC 15.4 to impose requirements for ECO activities
- OPG must notify the CNSC no later than December 31, 2022, in case it intends to operate any reactor unit beyond December 31, 2024
- Sustainable Operations Plan (SOP) and Stabilization Activity Plan (SAP)
  - identify unique challenges that will require incremental activities
  - provide resolutions, activities and actions for the identified challenges

End of Commercial Operation (ECO)

- Sustainable Operations Plan will be developed and implemented 5 years prior to the permanent shutdown of any unit
- Stabilization Activity Plan will be developed 3 years prior to the permanent shutdown of any unit and implemented immediately after unit is shut down
- Demonstrate how requirements within all 14 SCAs will continue to be met up to the last day of operation, with emphasis on
  - Long-term workforce planning
  - Human performance
  - Fitness for service of safety significant structures, systems and components

Commission Hearing, April 4, 2018
CMD 18-H6.A

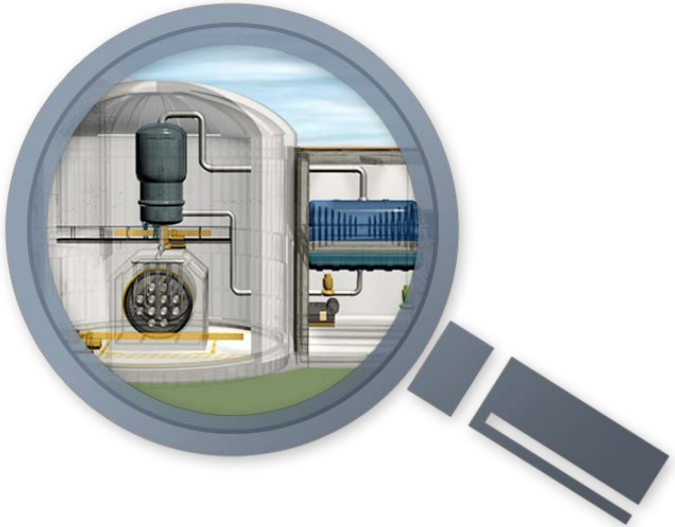
End of Commercial Operation (ECO)



PERFORMANCE ASSESSMENT

Safety Performance

- 14 Safety and Control Areas are part of CNSC regulatory framework
- Allow consistent reporting, identification of requirements across types of facilities
- Staff have been reporting to the Commission on performance across 14 SCA in annual Regulatory Oversight Reports



SCA Performance Assessments

SAFETY AND CONTROL AREA	PICKERING RATING			
	2013	2014	2015	2016
Management System	SA	SA	SA	SA
Human Performance Management	SA	SA	SA	SA
Operating Performance	SA	SA	FS	FS
Safety Analysis	SA	SA	FS	FS
Physical Design	SA	SA	SA	SA
Fitness for Service	SA	SA	SA	SA
Radiation Protection	FS	FS	FS	SA
Conventional Health and Safety	SA	SA	FS	FS
Environmental Protection	SA	SA	SA	SA
Emergency Management and Fire Protection	SA	SA	SA	SA
Waste Management	SA	SA	FS	FS
Security	FS	FS	SA	SA
Safeguards and Non-Proliferation	SA	SA	SA	SA
Packaging and Transport	SA	SA	SA	SA
INTEGRATED PLANT RATING	**SA**	**SA**	FS	FS

Overall Pickering NGS Safety Performance

- Pickering NGS performance has been satisfactory to fully satisfactory
- OPG implemented and maintained effective programs in all required safety areas
- OPG demonstrated commitment to continuous safety improvements
- Pickering NGS staff is qualified to conduct licensed activities safely

Pickering NGS met or exceeded regulatory requirements

REGULATORY FOCUS AREAS

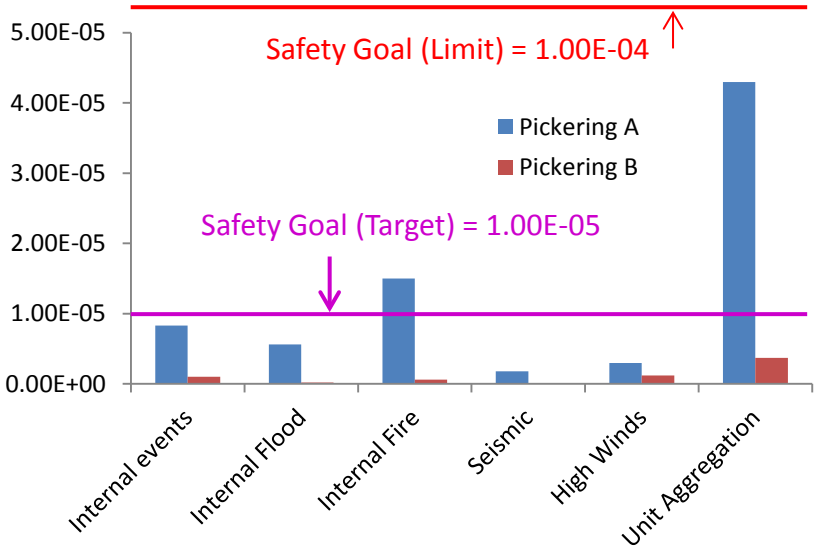
Probabilistic Safety Assessment (PSA)

- Pickering A and Pickering B compliant with S-294 *Probabilistic Safety Assessment (PSA) for Nuclear Power Plants,* since 2014
- OPG completed implementation of the Risk Improvement Plan, requested by the Commission
- Pickering whole-site PSA completed with accepted concept-level methodology

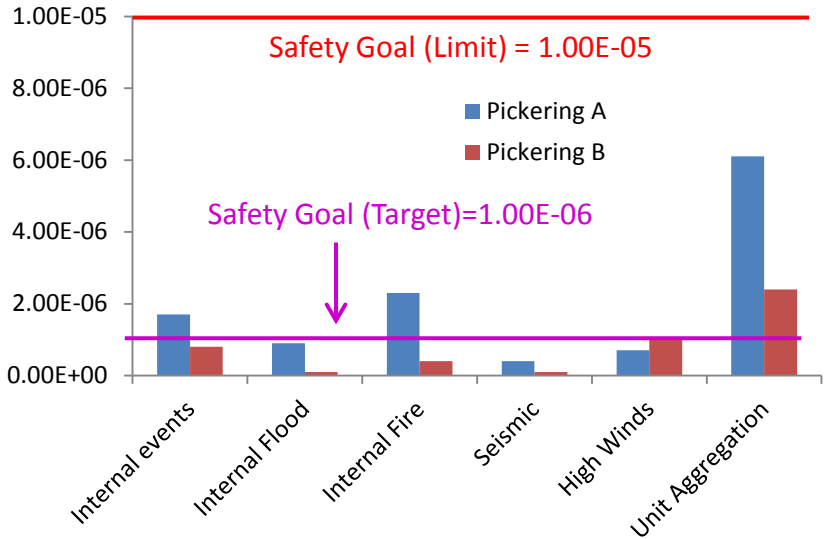
Pickering PSA results demonstrate positive impact of safety enhancements on predicted risk

Pickering A and B PSA Results

Core Damage Frequency (CDF) Results



Large Release Frequency (LRF) Results

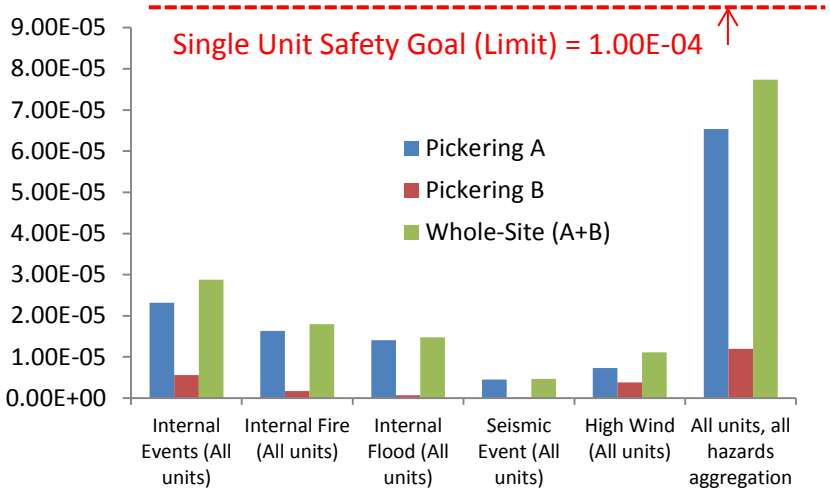


Pickering A & B PSA results meet CDF and LRF Safety Goal Limits of 1 in 10,000 and 1 in 100,000 years respectively

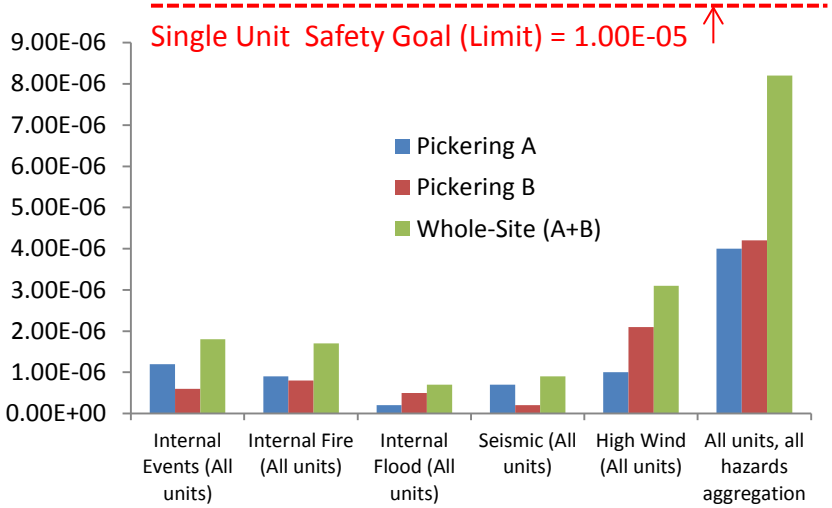
Pickering B PSA results also meet CDF and LRF Targets of 1 in 100,000 and 1 in 1,000,000 years respectively

Pickering Whole-site PSA

Whole Site CDF Results



Whole Site LRF Results



Whole site CDF is less than the single-unit Safety Goal of 1 in 10,000 years

Whole site LRF is less than single-unit Safety Goal of 1 in 100,000 years

Fitness for Service – Aging Management

- Pickering NGS has Life Cycle Management Plans (LCMPs) for all major components
  - Feeders, steam generators and preheaters, fuel channels, civil structures
- LCMPs identify activities to continuously assess component condition and fitness for service
- Aging management of fuel channels discussed under OPG request to operate Units 5-8 fuel channels up to 295,000 EFPH

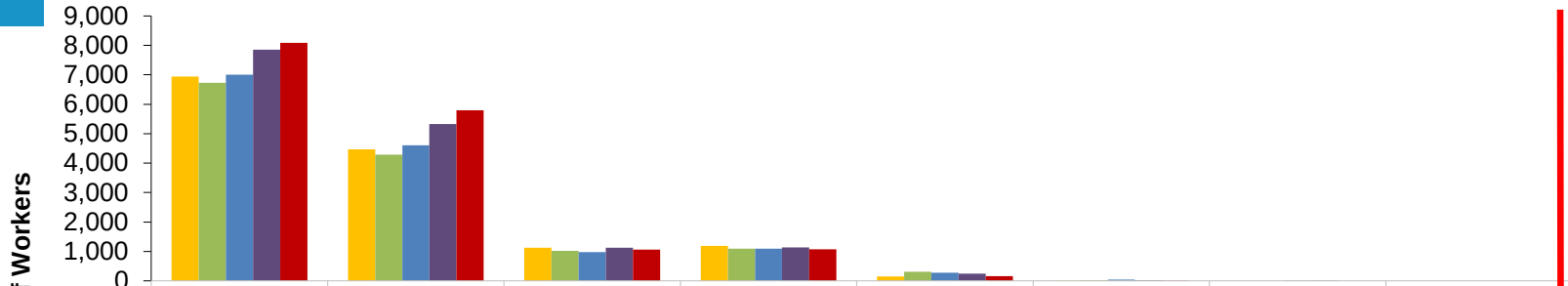
CMD 18-M4 provides generic information on fuel channel fitness for service

Radiation Protection

- Pickering NGS's performance rating decreased in 2016 due to non-compliance with requirements for calibration of radiation instruments
- Nevertheless, CNSC oversight activities confirm that OPG
  - Maintains an effective ALARA program
  - Controls doses to workers
  - Effectively manages radiological hazards
- Dose to public from Pickering NGS remained well below regulatory limits

OPG acted on identified instances of non-compliance with requirements

Radiation Protection – Dose Distribution Data



	Number of Workers Monitored	< 0.01 mSv (Reportable Level)	0.01 - 1 mSv	1 - 5 mSv	5 - 10 mSv	10 - 15 mSv	15 - 20 mSv	20 - 50 mSv	> 50 mSv
2013	6,946	4,465	1,122	1,189	154	16	0	0	0
2014	6,728	4,287	1,018	1,088	312	23	0	0	0
2015	7,002	4,601	976	1,098	280	46	1	0	0
2016	7,854	5,323	1,130	1,134	242	21	4	0	0
2017	8,089	5,793	1,059	1,072	157	8	0	0	0

Individual worker doses at Pickering NGS well below limits

CNSC Environmental Assessment

- CNSC Environmental Assessment concluded that public and environment are protected from releases from the facility
  - OPG environmental protection program meets regulatory requirements
  - Pickering Environmental Risk Assessment and Predictive Effects Assessment are consistent with CSA methodology
  - Findings of CNSC and regional independent monitoring programs consistent with OPG results

Environmental Assessment Report considered the following sources of information

Pickering environmental protection program	Pickering Environmental Risk Assessment
Results of CNSC's Independent Environmental Monitoring Program	Results of Other Regional Monitoring
Annual Compliance Reports	Preliminary Decommissioning Plan

OPG Pickering Environmental Risk Assessment (ERA)

- In April 2017, OPG submitted updated Pickering site-wide ERA report
- ERA included risk assessments for radiological and non-radiological (hazardous) contaminants of potential concern and physical stressors
- CNSC staff review found the ERA to be consistent with the requirements of CSA standard N288.6-12, *Environmental risk assessments at class I nuclear facilities and uranium mines and mills*
- Meaningful adverse ecological and human health effects due to releases to air and water from Pickering NGS are unlikely

Emergency Preparedness

- OPG undertook numerous emergency response enhancements
  - Implemented portable emergency mitigation equipment, on-site and off-site
  - Distributed potassium iodide pills
  - Installed automated near boundary gamma monitoring system
  - Implemented real-time automatic data transfer to CNSC
  - Developed new computer code for accidental dose projections
  - Installed new radio system
  - Updated public evacuation time estimates

Emergency Preparedness

- Exercise Unified Control, December 6-7, 2017
  - Test of capacity of on-site groups and off-site agencies to respond to a nuclear emergency
  - Response to a severe accident, including the use of portable emergency mitigation equipment added post-Fukushima accident
  - CNSC staff evaluated OPG's performance during the exercise
- OPG annually conducts emergency drills and exercises
- Full-scale integrated exercises required every 3 years

Emergency Preparedness

- Provincial Nuclear Emergency Response Plan (PNERP) revised December 2017
- Included public consultation period
  - CNSC and OPG provided comments to the Province
  - CNSC assisted the Province with simulation of accident scenarios
  - OPG will enhance its emergency plan to align with new PNERP
- Revised PNERP aligns well with the current international recommendations and best practices
- Province targeting to update its Pickering Implementation Plan by end of March 2018

Province taking steps to enhance emergency response

Emergency Preparedness

- CNSC and Canadian Industry, along with the international community took lessons from Fukushima accident to heart, to make sure that such an event would be extremely unlikely at Canadian facilities
- Multiple modifications made to make the probability of severe events very low
- Nevertheless, capability to respond to such events is also made more robust

OPG continues to maintain a robust emergency preparedness program at Pickering NGS

OTHER MATTERS OF REGULATORY INTEREST

Commission Hearing, April 4, 2018
CMD 18-H6.A

Other Matters of Regulatory Interest

OUTREACH, PUBLIC CONSULTATION AND PARTICIPANT FUNDING PROGRAM

FIRST NATIONS AND MÉTIS ENGAGEMENT

IAEA OSART MISSION

FISHERIES ACT AUTHORIZATION

FUKUSHIMA FOLLOW UP

Outreach, Public Consultation and Participant Funding Program

- Communication via written and electronic notifications, feature articles, graphic updates to web, open houses and social media
- Notice of Public Hearing and Participant Funding issued September 2017
- Up to $100,000 made available through the Participant Funding Program (PFP)
- Ten recipients awarded up to $112,962.35 based on recommendations from an independent Funding Review Committee

First Nations and Métis Engagement

- Pickering NGS lies within traditional territories of the seven Williams Treaties First Nations (WTFN) and is of interest to three other First Nations, three First Nations regional representative bodies and Métis Nation of Ontario (MNO) Region 8
- Letters of information sent October 2017, followed-up with phone calls and emails
- Information sharing meetings held upon request with the WTFN, Mississauga's of the New Credit and MNO Region 8
- First Nations, First Nations regional representative bodies and MNO Region 8 were also invited to the CNSC Open House held on March 8, 2018

CNSC staff continue to engage with First Nations and Métis peoples to build positive long-term relationships

Operational Safety Review Team (OSART) Mission

- On request from CNSC, in 2016 IAEA evaluated Pickering NGS operational safety performance against IAEA safety standards
- OSART mission identified 8 good practices, 11 suggestions and 10 recommendations
- OPG has completed 85% of corrective actions to date, with remainder targeted for Q2 2018
  - Managing alcohol and drug use testing of key staff in safety important roles

CNSC staff confirmed that Pickering NGS remained compliant with Canadian regulatory requirements

Fisheries Act Authorization

- *Fisheries Act* requires offsets for any residual harm caused to fish and fish habitats, after mitigation measures have been put in place.
- In July 2017, OPG submitted an application to Fisheries and Oceans Canada (DFO) for an authorization under paragraph 35(2) of the *Fisheries Act*
- DFO authorization issued for Pickering NGS in January 2018 and is valid until December 2028
  - Specifies mitigating and offset measures

Fukushima Action Plan Follow Up

- All original Fukushima Action Items were closed for Pickering
- Re-assessed during Periodic Safety Review (PSR)
  - With the aim to determine whether closure remained valid in context of extended operation
- PSR identified actions to strengthen provisions for controlled filtered venting
  - Part of PSR Integrated Implementation Plan
  - Will be completed by 2020

Fukushima Action Plan Follow Up

- OPG modifications to protect containment integrity:
  - Interconnections to add water to steam generators, heat transport system and calandria
  - Power and support service connections required to restore functionality of main volume vacuum pump
  - Emergency power and cooling water to air conditioning units
  - Redundant emergency power supply to hydrogen igniters and filtered air discharge system
  - Equipment and procedures to strengthen filtered air discharge system

Fukushima Action Plan Follow Up

- OPG has implemented and will continue to implement physical and programmatic changes to:
  - Strengthen provisions to prevent progression of an initiating event to a severe accident
  - Prevent and mitigate challenges for containment integrity
  - Ensure availability of options for controlled filtered post-accident venting

Pickering will implement additional measures to prevent containment challenges

FUEL CHANNEL OPERATION TO 295,000 EFPH

Units 5-8 operation up to 295,000 EFPH

- OPG is requesting approval to operate Units 5-8 up to a maximum of 295,000 Effective Full Power Hours (EFPH)
  - Current limit is 247,000 EFPH and hydrogen concentration of 120 parts per million
  - Periodic Inspections Program
- OPG implemented measures to maintain Fuel Channel Fitness for Service
  - Periodic Inspections Program
  - Internal and external operating experience
  - Research and Development and Joint industry projects

Units 5-8 operation up to 295,000 EFPH

- Fuel Channel performance can be affected by several degradation mechanisms
  - Some are relatively innocuous (e.g. pressure tube crevice corrosion)
  - Some progress at a predictable rate, with no known cliff-edge effect (e.g. fuel channel elongation)
  - Some could be life limiting (e.g. reduction in pressure tube fracture toughness with increasing hydrogen content)

Satisfactory understanding of fuel channel degradation mechanisms for all Pickering Units

Units 5-8 operation up to 295,000 EFPH

- CNSC staff recommend the Commission approve operation of Pickering Units 5-8 up to a maximum of 295,000 EFPH, based on
  - Pickering fuel channels are not expected to reach [Heq] of 120 parts per million before the end of operation at 295,000 EFPH
  - Adequate safety margins will be maintained
  - Strong knowledge of degradation mechanisms
  - Effective inspection and monitoring program
- New licence condition with appropriate compliance verification criteria should predictions of [Heq] be revised to exceed 120 ppm

PROPOSED LICENCE AND LCH

Proposed Licence and Licence Conditions Handbook

- Power Reactor Operating Licence (PROL)
  - Describes the licensed activity
  - Set the licence duration
  - Contains licence conditions
- Proposed Licence Conditions Handbook (LCH)
  - Describes Compliance Verification Criteria for each licence condition
  - Identifies CNSC Regulatory Documents and Canadian Standards
  - Provides Guidance

Standardized Wording of Licence Conditions (LC)

- Standardized wording to allow consistent use of LCs across all Class I Nuclear Facilities
- Requires licensees to implement and maintain programs as approved by the Commission and described in the LCH
- Requires licensees to operate within the licensing basis
- Requires licensees to notify CNSC of any changes which may impact operation within the licensing basis

Standardized licence conditions cover all 14 SCAs

Proposed Licence Period

- CNSC staff are recommending a 10 year licence period based on:
  - Stable safety performance of OPG
  - Outcomes of Periodic Safety Review and resulting Integrated Implementation Plan actions
  - Strategy for managing end of commercial operation and transition to safe storage

Annual presentation of regulatory oversight results to Commission allows for ongoing reporting and public input

Licence Condition Handbook
CNSC Regulatory Documents

25 Regulatory Documents

- 18 unchanged
- 4 updated
- 3 new

No reduction in regulatory requirements

New and Updated Regulatory Documents
New: REGDOC-2.2.4 Fitness for Duty: Managing Worker Fatigue
New: REGDOC-2.3.2 Accident Management (2013)
New: REGDOC-2.3.3 Periodic Safety Reviews
Updated: REGDOC-2.6.3 Aging Management
Updated: REGDOC-2.9.1 Environmental Protection (2013)
Updated: REGDOC-2.10.1 Nuclear Emergency Preparedness and Response (2016)
Updated: RD/GD – 210 Maintenance Programs

Licence Condition Handbook CSA Standards

25 CSA standards

- 9 unchanged
- 5 updated
- 11 new

No reduction in regulatory requirements

Examples of New CSA Standards

New: N290.12-14 Human factors in design for NPPs
New: N287.1-14 and N287.2-08 General /Material requirements for concrete containment structures for NPPs
New: N291-08 Requirements for safety-related structures for CANDU NPPs
New: N289.1-08 General requirements for seismic design and qualification of CANDU NPPs
New: N288.3.4-13 Performance testing of nuclear air-cleaning systems at nuclear facilities
New: N288.5-11 Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills
New: N288.6-12 Environmental risk assessments at Class I nuclear facilities and uranium mines and mills

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

With respect to section 24(4) of the NSCA, CNSC staff conclude:

- OPG is qualified to carry on the activities authorized by the licence; and
- In carrying out the licensed activities, OPG has made, and will continue to make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed

Recommendations (1/2)

CNSC staff recommend that the Commission:

1. Renew the Pickering licence to authorize OPG to carry out the activities listed in Part IV of the licence, from September 1, 2018 to August 31, 2028
2. Authorize OPG to operate Pickering NGS Units 5-8 up to a maximum of 295,000 EFPH
3. Authorize delegation of authority for a person authorized by the Commission for
   - LC 3.2 - restart after a serious process failure

Recommendations (2/2)

4. Accept the station-specific conditions included in proposed PROL requiring OPG to:
   - Implement the Integrated Implementation Plan actions
   - Maintain Units 2 and 3 in a safe storage state
   - Maintain pressure tube fracture toughness sufficient for safe operation
   - Implement and maintain plans for the end of commercial operation
   - Implement and maintain a Cobalt 60 program
   - Limit the activities of import and export of nuclear substances to those occurring as contaminants in laundry, packaging, shielding or equipment

Connect With Us

nuclearsafety.gc.ca