



Canadian Nuclear  
Safety Commission

Commission canadienne  
de sûreté nucléaire

## Record of Proceedings, Including Reasons for Decision

In the Matter of

Applicant Ontario Power Generation Inc.

Subject Application to Request Removal of a Hold Point  
for the Pickering Nuclear Generating Station

Public Hearing Date May 7, 2014

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Canada

## RECORD OF PROCEEDINGS

Applicant: Ontario Power Generation Inc.

Address/Location: 700 University Avenue, Toronto, Ontario, M5G 1X6

Purpose: Application to request a removal of the hold point for the Pickering Nuclear Generating Station.

Application received: February 3, 2014

Date of public hearing: May 7, 2014

Location: Canadian Nuclear Safety Commission (CNSC) Public Hearing Room, 280 Slater St., 14th. Floor, Ottawa, Ontario

Members present: M. Binder, Chair  
R. J. Barriault                      D. D. Tolgyesi  
A. Harvey                              R. Velshi  
M. J. McDill

Secretary: M.A. Leblanc  
Recording Secretary: S. Dimitrijevic  
General Counsel: L. Thiele

<b>OPG Represented By</b>			<b>Document Number</b>
<ul style="list-style-type: none"> <li>• B. Phillips, Senior Vice President</li> <li>• M. Elliott, Chief Nuclear Engineer</li> <li>• K. Dehdashtian, Manager of Pickering Public Affairs and Regulatory Affairs</li> <li>• K. Powers, Director of Public Affairs</li> <li>• L. Swami, Vice President, Nuclear Services</li> <li>• C. Lorencez, Director, Nuclear Safety</li> <li>• J. Coles, Director, Emergency Management and Fire Protection</li> <li>• R. Manley, Director, Nuclear Regulatory Affairs</li> <li>• P. Spekkens, Vice President of Science and Technology Development</li> <li>• C. Mathias, Legal Counsel</li> </ul>			CMD 14-H2.1 CMD 14-H2.1A CMD 14-H2.1B CMD 14-H2.1C
<b>CNSC staff</b>			<b>Document Number</b>
<ul style="list-style-type: none"> <li>• G. Rzentkowski</li> <li>• M. Santini</li> <li>• P. Elder</li> <li>• J. Jin</li> </ul>	<ul style="list-style-type: none"> <li>• R. Jammal</li> <li>• S. Yolaoui</li> <li>• G. Frappier</li> <li>• P. Thompson</li> </ul>	<ul style="list-style-type: none"> <li>• L. Sigouin</li> <li>• Y. Akl</li> <li>• C. Purvis</li> </ul>	CMD 14-H2 CMD 14-H2.A CMD 14-H2.B CMD 14-H2.C
<b>Intervenors</b>			<b>Document Number</b>
See appendix A			
<b>Others</b>			
<ul style="list-style-type: none"> <li>• Office of the Fire Marshal and Emergency Management: D Nodwell</li> <li>• Kinectrics: P. Lawrence</li> </ul>			

**Hold point:** Removed

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## 1.0 INTRODUCTION

1. Ontario Power Generation Inc. (OPG) has applied to the Canadian Nuclear Safety Commission<sup>1</sup> to request the removal of the regulatory hold point pursuant to Licence Condition 16.3 of the Power Reactor Operating Licence PROL 48.00/2018 and associated Licence Conditions Handbook (LCH), issued for the Pickering Nuclear Generating Station (NGS). The facility is located in Pickering, Ontario and consists of eight CANDU pressurized heavy water reactors and their associated equipment. The current operating licence expires on August 31, 2018.
2. The Pickering NGS Power Reactor Operating Licence was renewed by the Commission after a public hearing held on February 20 and May 29 to 31, 2013<sup>2</sup>. In its decision, the Commission did not accept CNSC staff's proposed delegation of authority to remove the regulatory hold point to allow OPG to proceed with Pickering NGS operation beyond 210,000 Equivalent Full Power Hours (EFPH). Instead, the Commission decided to consider this matter in a future proceeding of the Commission with public participation. The milestone limit of 210,000 EFPH was the assumed design life of the pressure tubes and was expected to be reached on Pickering NGS Unit 6 in June 2014.
3. As part of its decision, the Commission directed OPG to provide the following, before the removal of the hold point could be approved:
  - the revised Probabilistic Safety Assessment (PSA) for Pickering A that meets the requirements of CNSC Regulatory Standard S-294<sup>3</sup>;
  - an updated PSA for both Pickering A and Pickering B that takes into account the enhancements required under the Fukushima Action Plan (FAP); and
  - a whole-site PSA or a methodology for a whole-site PSA, specific to the Pickering NGS site<sup>4</sup>.
4. In addition, the Commission directed OPG to report, at the time of OPG's request to remove the hold point, on its analysis on filtered containment venting, as a future enhancement to protect containment through OPG's Fukushima Action Items.
5. The Commission further directed OPG to ensure, by the end of June 2014, the production of an emergency management public information document that would be distributed to all households in the Pickering area.
6. The Commission also directed CNSC staff to review the Pickering PSA methodology,

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<sup>1</sup> The *Canadian Nuclear Safety Commission* is referred to as the "CNSC" when referring to the organization and its staff in general, and as the "Commission" when referring to the tribunal component.

<sup>2</sup> CNSC *Record of Proceedings, Including Reasons for Decision*, "Ontario Power Generation Inc. – Application to Renew the Power Reactor Operating Licence for the Pickering Nuclear Generating Station", Public Hearing Dates: February 20 and May 29 to 31, 2013.

<sup>3</sup> Regulatory Standard "Probabilistic Safety Assessment for Nuclear Power Plants", CNSC, Ottawa, 2005.

<sup>4</sup> Ref. 2, paragraph 361.

and provide its recommendation for the Commission's consideration at the time of OPG's request for the release of the hold point.

### Issue

7. In considering the application, the Commission was required to evaluate whether OPG had met all necessary pre-requirements and additional requirements associated with licence condition 16.3, including the Commission's requests for additional information as directed in the *Record of Proceedings* for the Pickering NGS licence renewal.

### Public Hearing

8. Pursuant to section 22 of the NSCA, the President of the Commission established a Panel of the Commission to review the application. The Commission, in making its decision, considered information presented for a hearing held on May 7, 2014 in Ottawa, Ontario. The public hearing was conducted in accordance with the *Canadian Nuclear Safety Commission Rules of Procedure*<sup>5</sup>. During the public hearing, the Commission considered written submissions and heard oral presentations from CNSC staff (CMD 14-H2, CMD 14-H2.A, and CMD 14-H2.B) and OPG (CMD 14-H2.1, CMD 14-H2.1A, and CMD 14-H2.1B). The Commission also considered written submissions from 55 intervenors (see Appendix A for a detailed list of interventions). The hearing was webcasted live via the CNSC website, and video archives are available for a three-month period following this decision.
9. Following the public hearing, further to a request for ruling, the Commission provided a further opportunity to hearing participants to submit supplementary comments on the following documents:
  - Pickering A Risk Assessment Summary Report;
  - Pickering B Risk Assessment Summary Report; and
  - Pickering NGS Probabilistic Safety Analysis to Include Enhancements from the FAP.

The Commission received and considered supplementary submissions from six intervenors, CNSC staff and OPG.

10. *A Summary Record of Proceedings and Decision*, was issued on June 3, 2014.

## **2.0 DECISION**

11. The Commission is satisfied that OPG has met all necessary pre-requirements and

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<sup>5</sup> Statutory Orders and Regulations (SOR)/2000-211.

additional requirements associated with licence condition 16.3, as directed in the *Record of Proceedings* for the Pickering NGS licence renewal, and the Commission's requests for additional information. Based on its consideration of the matter, the Commission is satisfied that OPG 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. Therefore,

the Commission removes the hold point associated with licence condition 16.3 of the Pickering Nuclear Generating Station Power Reactor Operating Licence, PROL 48.00/2018.

12. With this decision, the Commission allows OPG to proceed with Pickering NGS operation beyond 210,000 EFPH, up to 247,000 EFPH.
13. The Commission directs OPG to submit to the Commission a report on the detailed risk improvement plan for Pickering NGS. This report is to be submitted two weeks before the Commission Meeting to be held in August 2014. The Commission also directs CNSC staff to present its review of the detailed risk improvement plan for Pickering NGS, as part of the annual *2013 Integrated Safety Assessment of Canadian Nuclear Power Plants*, at the Commission Meeting to be held in August 2014. The detailed risk improvement plan shall encompass a combination of physical improvements, changes to operating procedures, and improvements to the PSAs, including but not limited to the improvements to plant design and improvements to the methodologies, as specified by CNSC staff and set out in the section 3.1 of the CMD 14-H2.C. The improvements are to include additional Fukushima related actions as well as improvements identified through the PSA.
14. The Commission requests that the *2013 Integrated Safety Assessment of Canadian Nuclear Power Plants* include clear timelines for all aforementioned improvements and related activities. The Commission requests that these improvements be implemented as soon as possible.
15. The Commission requires increased monitoring, inspection and reporting by OPG and CNSC staff on the operation of the Pickering reactor units. The annual *Integrated Safety Assessment of Canadian Nuclear Power Plants* should include, every year, clear descriptions of measures implemented to enable the requested increased monitoring, inspection and reporting. The Commission further requests that this and future annual Integrated Safety Assessments and reports include updates to the Commission regarding enhancements of OPG's ageing management program, status of pressure tubes, feeder pipes and other safety issues, such as evolution of safety margins as the operation approaches the planned end of life of the facility.
16. The Commission expects annual reports to include the status of additional Fukushima related actions and improvements identified through the PSA, as well as a clear timeline for the development and implementation of whole-site based safety goals and

PSA methodology.

### **3.0 ISSUES AND COMMISSION FINDINGS**

17. In making its decision, the Commission considered a number of issues and submissions relating to OPG's response to the Commission's requirements and criteria to be met before the removal of the hold point. The Commission also considered the adequacy of the proposed measures for protecting 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.

#### **3.1 Hold Point Requirement for Fuel Channel**

18. The Commission examined the completion of the eight hold point release criteria described in section 16.3 of the Pickering LCH. These criteria were set to demonstrate whether the pressure tubes would be fit for service and capable of supporting the continued operation of the reactor units beyond 210,000 EFPH, which was the originally estimated design life.
19. OPG informed the Commission about their research and development (R&D) work and inspection data regarding the pressure tubes aging mechanisms, and summarized that all of the aging mechanisms are predictable, well understood and manageable.
20. OPG informed the Commission that a summary of all pressure tube ageing mechanisms and mitigation measures had been provided to CNSC staff in 2012. All the reports had been submitted on time and had included the results that were either favourable or entirely manageable. OPG explained that only one of these ageing mechanisms, relating to deuterium ingress and fracture toughness of the tubes, was the subject of the imposed hold point and required a change in procedures for heating up and cooling down of reactor units.
21. OPG stated that they had completed all activities required to address outstanding confirmatory assessment related to the pressure tubes fitness for service. OPG specified that all release criteria had been met. Based on the confirmatory R & D, ongoing inspections, site modifications, and procedural changes, OPG determined that considerable margins exist for continued safe operations of Pickering NGS pressure tubes beyond 210,000 EFPH. OPG committed to continued inspections and tests to monitor all aspects of pressure tube aging.
22. CNSC staff reported that OPG had met all prerequisites to support the continued operation of the units beyond the 210,000 EFPH and that OPG complies with Canadian

Standards Association (CSA) standard N285.8<sup>6</sup>. This standard provides detailed technical procedures and criteria for pressure tube fitness for service assessments.

23. CNSC staff indicated that the hold point associated with licence condition 16.3 in the Pickering operating licence had been introduced to ensure appropriate regulatory oversight of the activities and commitments required to safely manage all aspects of pressure tube aging before the first Pickering unit exceeds the assumed design life of 210,000 EFPH. CNSC staff indicated that, during the 2013 licence renewal public hearing, it had required additional information only on deuterium uptake and its effect on fracture toughness of the pressure tubes. With respect to ageing management, another licence condition<sup>7</sup> requires that OPG must implement and maintain programs that include engineering capabilities to assess the structural integrity of the pressure tubes and in-situ inspections.
24. CNSC staff noted that these ageing mechanisms might affect the structural integrity of the pressure tubes during a very limited period of reactor operation. The pressure tubes are affected during the transition from the shutdown state to the full-power state and vice versa (heat up and cool down phases). When the reactors are at normal operating power or shutdown, the effects of these ageing mechanisms are negligible.
25. CNSC staff informed the Commission that it had accepted new methodologies and engineering models of degradation mechanisms in materials used for pressure tubes, including delayed hydride cracking as a result of deuterium uptake. OPG has developed these models through an industry joint Fuel Channel Life Management Project. CNSC staff explained that two methods are in place to prevent pressure tube rupture. The first one, “leak-before-break” (LBB), is based on experience that an initial crack results in a small leak that can be detected in time to safely shut down the reactor and cool and depressurize the primary heat transport system before the pressure tube ruptures. The second, “fracture protection” (FP), aims at preventing cracks formation by monitoring hydride in the pressure tubes and ensuring that its concentration has not increased to a level that can render the pressure tubes too brittle.
26. CNSC staff further informed the Commission that OPG had developed refined engineering methodologies and models to conservatively assess the fitness for service of the pressure tubes, and that OPG had developed inspection and maintenance programs to ensure continued validation of the engineering assessments. These programs for inspection and maintenance are based on CSA standard N285.4<sup>8</sup>, and Fuel Channel Life Cycle Management Plan, as required by CNSC Regulatory Document RD-334 *Aging Management for Nuclear Power Plants*. The programs include monitoring of the most limiting parameters such as the equivalent hydrogen concentration.

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<sup>6</sup> CSA Standard N285.8 “Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors”, CSA, Ottawa, 2010.

<sup>7</sup> PROL 48.00/2018, licence condition 7.1.

<sup>8</sup> CSA Standard N285.4 “Periodic inspection of CANDU nuclear power plant components”, CSA, Ottawa, 2009.

27. A large number of intervenors expressed concerns related to fuel channel ageing and fitness for service. The Commission enquired about potential fuel bowing and black deposit formation reported in 2013. CNSC staff responded that all concerns regarding the event of formation of black deposits had been addressed and that detailed inspections had confirmed that there were no heat transfer issues, fuel deformation, or pin deformation in fuel bundles. CNSC staff added that the black deposits were caused by chemical imbalances in the primary system and not by an ageing-related mechanism. An OPG representative added that applied changes in the chemistry in the heat transport system had eliminated the formation of black deposits.
28. Northwatch, in its intervention, noted inconsistencies between OPG's submissions to the Ontario Energy Board (OEB) and to the CNSC, regarding the explanations related to ageing mechanisms. The Commission requested comments regarding these inconsistencies. The OPG representative responded that, following its submission to the OEB, OPG had continued with their research to determine a realistic life span of the pressure tubes. The results obtained by OPG and verified by a third party showed that the tubes can safely operate at least up to 247 000 EFPH.
29. The Commission asked OPG for its views on what the final physical limit for the operation of the facility beyond 247 000 EFPH would be. The OPG representative responded that OPG's business plan comprises the operation of the Pickering NGS until the end of 2020, while the current licence period ends in 2018. The OPG representative explained that the business case for such timeline was made with the operation limit at 247 000 EFPH, and stated that any other scenario and changes that would be contemplated by OPG would have to be approved by the Commission.
30. CNSC staff noted that, from the regulatory standpoint, it is essential that the facility operate in accordance with the regulatory requirements that are clearly stated in the CSA Standards and CNSC regulatory document RD-334. CNSC staff added that OPG was compliant with all requirements in those documents. In the future, CNSC staff stated that it would continue to identify critical parameters, monitor them and make sure that OPG is operating in compliance with all regulatory requirements. CNSC staff further noted that, in case of significantly longer life extension, beyond 247 000 EFPH, some additional requirements would likely be imposed, such as an independent and separate filtered venting system for beyond design-basis accidents at the Pickering station.
31. The Commission sought more information about changes in frequency of monitoring, inspection and other regulatory procedures as a response to the ageing of the facility. OPG representatives responded that, in order to comply with all safety requirements, OPG continues to invest in the facility, implement safety improvements, conduct preventive maintenance, replace components, and install new equipment as needed and regardless of the estimated end of life. CNSC staff added that CNSC has introduced new requirements pertaining directly to ageing of critical components at the nuclear power plants. Licensees have to establish life cycle management programs for all major components of a plant. In addition, a demonstration of safe operation is required every

time a unit goes into outage before it can be returned to service.

32. The Commission sought more information on the aforementioned R&D project regarding estimated limits for safe operation of the pressure tubes, as well as on CNSC's role in this project. CNSC staff responded that the project conducted by OPG had been initiated about five or six years earlier and it had not been driven by the request from the Commission. CNSC staff explained that it looks at the results of this research as one of the elements that demonstrates the continuous enhancement that supports safety case assumptions.
33. The Commission asked if there were different ageing-related requirements for different NPPs. CNSC staff responded that degradation mechanisms affecting the ageing are site-specific, which is reflected in different requirements for different sites.
34. The Commission asked CNSC staff to address a perceived "regulatory loophole", which was noted in the intervention submitted by the Greenpeace Canada, according to which the Pickering NGS was allowed to impose higher levels of risk to the community surrounding this station than around the other stations. CNSC staff responded that they were not aware of such loopholes in regulations and stated that the intervenor did not provide any references to support the statement. CNSC staff added that the statement might be based on a quotation by CNSC staff on PSA calculation methodology, application of simple summation and discussion on the concept of risk aggregation, which was taken out of context. CNSC staff reiterated that the safety goals are designed for a per unit basis to ensure that the designs of different units are as safe as possible.
35. The Commission enquired about the "leak-before-break" (LBB) and its importance for prevention from pressure tube rupture. CNSC staff explained that the LBB is an indicator of pressure tube rupture that is a design basis event in the Pickering Deterministic Safety Analysis and all the systems in place would respond automatically to keep the plant safe. CNSC staff added that LBB could be monitored from the main control room. OPG representatives added that LBB is just one of the many barriers implemented to ensure nuclear safety and protection of the public and the environment.
36. The Commission sought more details regarding improvements made since the 1980's to prevent leakage and pressure tube rupture. OPG representatives responded that the application of modern materials, the improved design and construction of tubes, the use of spacers intended to keep the pressure tubes from touching the calandria tubes, and the carrying out of extensive inspection programs at every planned maintenance outage prevent pressure tubes from the leakage and rupture.
37. Some intervenors questioned assumptions regarding mechanical resistance of materials exposed to neutron irradiation. The Commission sought more information on the capability of spacers to perform their designed function under such conditions. OPG representatives responded that the tests done on the removed spacers that have been exposed to neutron fluxes for a prolonged time did not show deterioration of their

mechanical properties. Tests conducted in both Pickering A and Pickering B, as well as in the Darlington NGS, regardless of the differences in materials used, showed that this matter did not represent a safety concern for the Pickering NGS. OPG representatives added that many intervenors have based their concerns on old information, and stated that the materials currently in use in reactor units have mechanical properties superior to earlier generations of materials. OPG representatives noted that a list of issues with material behaviour under irradiation conditions, which was mentioned in said interventions, does not raise any questions that had not been addressed on numerous occasions. CNSC staff concurred with these statements, and noted that every issue or indication of deficiencies raised by intervenors is considered as operating experience and has been grouped by safety and control areas.

38. The Commission asked how often pressure tubes need to be replaced. The OPG representative responded that OPG removes pressure tubes for surveillance purposes in accordance with CSA standards, and added that this operation is usually done every four years. The OPG representative stated that extensive examinations of pressure tube material properties done so far by OPG had never required a tube replacement as a result of finding a flaw. The OPG representative noted that, except for one tube that had ruptured in Pickering Unit 2 in 1983, OPG had not been required to replace a pressure tube.
39. Some intervenors expressed concerns regarding fitness for service of feeder pipes. The Commission sought more details about degradation of feeder pipes. The OPG representative responded that they have a lifecycle plan for feeder pipes and that their inspection program is quite advanced. The OPG representative added that they had not had to replace feeder pipes and elbows.
40. The International Institute of Concern For Public Health, in its intervention, commented on radiation protection and the extended life of the Pickering NPP, mentioning that the workers may experience additional exposure as a result of allowing pressure tubes to operate beyond expected operating life. The Commission asked OPG and CNSC staff to comment on this concern. CNSC staff stated that OPG has a comprehensive radiation protection program and a long-term *As Low As Reasonably Achievable* (ALARA) plan. Collective doses at OPG are stable, do not depend on the life span of the facility and do not affect the removal of hold points. OPG representatives pointed out that they have several radiation protection levels set well below regulatory limits, and that parts of their radiation protection program deals with the continuous reduction of worker doses.
41. The same intervenor expressed the view that there was no evidence to support OPG's claim that the vast majority of time the reactors are either at full power operation or shut down, at which time fracture toughness behaviour is not an issue. Asked by the Commission to comment on this statement, OPG representatives responded that OPG's performance is a matter of public record that shows how often any unit is online and how often it is in an outage. OPG representatives reiterated that the hydrogen uptake occurs during the transition period and not at full power operation, that the highest

levels of hydrogen in the pressure tube occur near the ends of the tube, and that the most important source of hydrogen is diffusion from the end fitting.

42. The same intervenor also pointed out the variation in deuterium uptake between different tubes, where the values varied by a factor of three. The Commission asked about consequences of this variation. OPG representatives responded that the issue is important, and the main consequence was that OPG is forced to monitor a large number of tubes in order to obtain a representative picture of the deuterium uptake.
43. The Commission asked whether the operating life of CANDU reactors had ever been extended beyond its design life. OPG representatives stated that the Embalse unit in Argentina has been operating for more than 220,000 hours and is expected to continue to operate until 2015, when it will enter a refurbishment outage. OPG representatives added that they were examining two pressure tubes that were removed from the Embalse reactor in order to obtain information on how CANDU pressure tubes behave when they are operated beyond their originally assumed design life.
44. Based on its consideration of the presented information, the Commission is satisfied that OPG has developed the appropriate engineering methodologies, inspection and maintenance programs to demonstrate fuel channel fitness for service beyond 210,000 EFPH and to ensure the continued safe operation of the power reactor. The Commission is of the opinion that the measures presented by OPG, relating to the pressure tubes fitness for service, are adequate for safe operation of the facility up to 247 000 EFPH.

### **3.2 Commission Direction Related to Probabilistic Safety Assessment**

45. At the time of its decision to renew the operating licence issued to OPG for the Pickering NGS, the Commission concluded that it needed additional information regarding the facility risk and safety assessment in the context of the release of this hold point. This additional information included the following:
  - the revised PSA for Pickering A that meets the requirements of CNSC Regulatory Standard S-294;
  - an updated PSA for both Pickering A and Pickering B that takes into account the enhancements required under the FAP; and
  - a whole-site PSA or a methodology for a whole-site PSA, specific to the Pickering NGS site.
46. CNSC staff provided a brief description of PSA and explained that it is a comprehensive and integrated assessment conducted to complement deterministic safety analysis. A PSA considers the probability and consequences of equipment failures, encompassing transient conditions, human errors, and internal and external hazards. The results of a PSA encompass safety goals, such as Core Damage Frequency (CDF) and Large Release Frequency (LRF), which are indicators relating

to the prevention and mitigation of accidents. These safety goals are conservative surrogates that serve to quantify fundamental health effects on the public: early fatalities linked to accident rates, and late fatalities linked to cancer rates. These safety goals were reviewed by CNSC staff and had been explained in more details in the full presentation on PSA and its significance, which was provided to the Commission at its March 27, 2014 meeting<sup>9</sup>.

47. CNSC staff stressed the importance of the fact that the safety goals established through PSA are not the primary means by which nuclear facilities are regulated. The safety goals are formulated in addition to the deterministic design requirements and the dose acceptance criteria, in order to consider the risk to the public originating from accidents outside the design basis. In this way, the safety goals extend the plant design envelope to include the capabilities of the plant to successfully cope with various accidents, as well as the measures to halt the progression of severe accidents.

### *3.2.1 Pickering A PSA*

48. OPG informed the Commission that they had completed and submitted to the CNSC all of the revised Pickering A PSAs by March 7, 2014. OPG had also made available a summary of the results of the PSAs. According to the submitted results, the PSA was prepared in accordance with CNSC Regulatory Standard S-294 and was updated to include the enhancements according to the FAP. Representatives from OPG stated that the individual elements of the conducted PSA meet safety goal limits for both CDF and LRF, and that none of these safety goal limits were exceeded.
49. OPG further informed the Commission that the incorporation of the FAP related enhancements have been limited to those hazards that had significantly contributed to the severe CDF and LRF, such as at-power internal events, fire, floods, high winds and seismic events. OPG added that emergency mitigation equipment (EME) had been incorporated into the event trees, fault trees, and human reliability analysis within the FAP enhancements.
50. CNSC staff confirmed that OPG had submitted the complete updated Pickering A PSA that includes both internal and external events, as well as the enhancements according to the FAP. The updated PSA was aligned with the requirements in CNSC Regulatory Document S-294. CNSC staff noted that OPG and Bruce Power had jointly developed a methodology for incorporating the EME into the PSA by incorporating the use of self-powered pumps to add inventory to the steam generators, the heat transport system and the calandria.
51. CNSC staff informed the Commission that the updated PSAs also incorporate improvements in PSA and operational changes made at the Pickering site. The operational changes included online refueling of the auxiliary power system and make-up to the Pickering A steam generators from the emergency boiler water system in the

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<sup>9</sup> Minutes of the Canadian Nuclear Safety Commission Meeting held Thursday, March 27, 2014.

event of a loss of power at Pickering B.

52. CNSC staff reported that the PSA results showed that CDF and LRF, calculated individually for internal events and for each external events, meet the safety goal limits. CNSC staff further reported that the aggregated CDF, calculated by simple summation from the contribution of both internal and external events, also meets the OPG safety goal limits. CNSC staff noted that the aggregated LRF, calculated by simple summation for Pickering A was slightly above OPG safety goal limit, primarily due to the overly conservative assumptions and simplified methods in the Fire PSA.
53. CNSC staff stated that the application of the Fukushima Action Items (FAI) enhancements have resulted in reduction factors of 1.5 and 2.1 for CDF and LRF respectively. CNSC staff noted that, due to the lack of appropriate validated models, OPG had not yet incorporated all the FAI enhancements, such as Severe Accident Management Guidelines (SAMG) and other emergency actions, in the PSA. CNSC staff stated that it expected that further reduction factor improvements would be achieved once all post-Fukushima enhancements have been credited in the PSA.
54. Several intervenors complained that the results of safety studies and PSA reports had not been presented to the public in a timely manner. The Commission noted that the PSA results had been published as summary reports only about one week prior to the public hearing, and enquired whether the publication of these results had been announced to the public during OPG-held public meetings, such as Pickering Town Council meetings. An OPG representative responded that the publication of the reports had been intended, but had not been advertised at the public meetings. The documents had been released and submitted to CNSC staff with the main intent to submit them in time for the CNSC staff to conduct its technical review before the public hearing. Synopses of various important technical documents had been posted online following OPG's own schedule. The OPG representative added that it takes about two months to prepare a summary report and put it on the OPG website, after the completion of the technical work. The OPG representative noted that this was a unique situation; usually, publication of summary reports is not linked to public proceedings of the Commission.
55. Further to a request for ruling seeking an additional week, after the hearing transcripts are made publicly available, for intervenors to present information on subject-matter relating to this hearing in writing, and an additional week beyond this to OPG and CNSC staff to respond to any questions, the Commission decided to provide one additional week to hearing participants to submit supplementary comments on the summary reports, as well as an additional week to OPG and CNSC staff to prepare their responses to participants' submissions.
56. The Commission asked CNSC staff to comment on the interventions that were asking for annual public meetings with safety analysis updates. CNSC staff responded that its intention was to provide annual updates to the public and to the Commission within CNSC staff's NPP status reports. CNSC staff indicated that the public would have an opportunity to provide written comments on these annual reports.

57. The Commission asked if OPG holds annual meetings with communities in the vicinity of their NPPs. The OPG representative responded that the company conducts open public meetings on an approximately monthly basis, and that the agendas for these meetings are set by the members of the community that attend these meetings.
58. The Commission enquired about actions and action plans stemming from the PSA, and also from other assessment methods, to further reduce major risk contributors. OPG representatives described various actions taken and noted that, based on their PSA, they have developed a comprehensive improvement plan for fire equipment upgrades, procedure improvements and training. OPG representatives stated that OPG had submitted a new action plan for risks reduction. As an example of physical changes, OPG representatives described additional fire protection barriers to be installed in order to further reduce the risk from fire.
59. The Commission enquired about the relationship between PSAs and actual operation as a sort of “reality check” for an assessment. OPG representatives responded that PSAs have to be regularly updated and that the analyses of the actual performance are used for these updates. Large scale events and accidents, such as those of Three Mile Island, Chernobyl and Fukushima, and the associated lessons learned are used to evaluate models and to validate assessments. Changes in the industry caused by these events are also taken into account in the PSA updates following these changes. OPG representatives stressed the importance of the FAP, since the Fukushima event had shown that external events could have consequences far beyond those previously considered. CNSC staff added that only those improvements that had already been implemented were credited in the PSA. This approach was reflected in gradual improvement of the PSA results. CNSC staff stated that this trend is expected to continue for approximately two more years.
60. The Commission stated its expectation that this relationship and the influence of implemented improvements, such as FAI enhancements, on the evolution of PSA results will be clearly documented and presented to the Commission and to the public on a regular basis. CNSC staff committed to transparency and stated that it would present the required information to the Commission within regular annual reports as part of the FAP. The Commission expects the information to include the improvements that will contribute to the enhanced safety of the NPP.
61. Some intervenors expressed concerns that the updated PSAs were not independently reviewed by a third party. The Commission asked OPG to comment on this issue. OPG representatives responded that, after the methodology had been approved by the CNSC and third party experts, the PSA had been conducted by independent engineering experts with international reputation. OPG representatives explained that the considered PSA methodologies had been reviewed by members of the Electric Power Research Institute (EPRI), and that a large engineering company specialized in producing PSAs, ERIN Engineers, had provided support to OPG’s contractors.

62. On the issue of ageing, raised in a number of interventions, the Commission sought more information on the incorporation of ageing effects in the PSA. The OPG representative explained that ageing is taken into account through the most recent data pertaining to equipment failure. This information on the reliability or probability of failure of tens of thousands of components was included in the modelling. At the same time, the ageing effects are mitigated by preventive maintenance and by replacing components so that the equipment is kept in fit-for-service condition.

### 3.2.2 *Pickering B PSA*

63. OPG informed the Commission about the updates to the Pickering B PSA. The introduced enhancements related to the FAP include internal events, fire and high winds at-power, EME and lessons learned from the PSAs, so that modelling assumptions were changed to better reflect plant operation and the use of new analysis. OPG stated that these new modelling assumptions have resulted in a significant reduction for severe CDF estimates for internal events at-power, and by one order of magnitude for the LRF.
64. CNSC staff informed the Commission of its review of the submitted PSA and incorporated enhancements, and stated that the CDF and LRF, calculated individually for internal events and for each external event, met the safety goal limits. The aggregated CDF and LRF, calculated by simple summation from the contribution of both internal and external events, also meet the safety goal limit. CNSC staff added that, based on the aggregation of all risk contributors, the FAI enhancements introduced in the Pickering B PSA have resulted in reduction factors of 3.8 for CDF and 9.3 for LRF.
65. CNSC staff reported that the results show that the FAI enhancement improves the safety related to mitigation of some very rare events that had not been considered earlier in the design of nuclear power plants. CNSC staff stated that it expected to complete the detailed review of the PSAs by June 30, 2015.
66. Referring to the intervention by Greenpeace Canada, the Commission asked why the benefits of the FAP were considered to be greater for Pickering B than for Pickering A. OPG representatives noted the differences in the design of the moderator system and the calandria.
67. The Commission asked about actions taken to demonstrate that risk assessment in the nuclear industry was improving. The OPG representative responded that these actions include shifting the focus from internal events to external ones, including extreme events, which has resulted in these events being assessed against safety goals and new limits that were never applied before. OPG noted that this trend has been evident following the Fukushima event and represents a contribution to safer operation of the NPPs.

### 3.2.3 Methodology for Whole-Site PSA Specific to Pickering NGS Site

68. OPG informed the Commission about their activities related to the Commission's direction that OPG develop a methodology for multi-unit sites PSA. OPG noted that it should be recognized that PSA for multi-unit sites is cutting edge work in progress for the PSA international community and requires a phased approach. It is expected that more work would be carried out in the future to develop a more detailed methodology suitable for implementation consistent with industry best practices.
69. OPG presented an outline of strategies to develop a methodology for a whole-site PSA, a concept-level methodology and an estimated timeline for detailed methodology, as described in the section 16.3 of the Pickering LCH. The concept-level, whole-site PSA methodology was developed through collaboration with other members of the Canadian nuclear industry, and was issued as a CANDU Owners Group (COG) document<sup>10</sup>. Prior to issuance of the document, COG held an international workshop on whole-site risk characterization with more than 60 participants from Canada, USA, Europe, Korea and international organisations including the International Atomic Energy Agency (IAEA). It was also noted that an overall safety case in demonstrating the robustness of nuclear plants should not rely only on PSA, due to its limitations, and that other risk assessment methods should be further considered as a means to complement whole-site PSA methodology and address residual risks.
70. OPG stated that the concept-level methodology was applicable to CANDU plants in general, including the Pickering NGS site, and that all three of the LCH compliance verification criteria had been addressed in the COG document. These criteria include the following:
- consideration of appropriate site-based safety goals for whole-site PSA, as well as a decision on whether or how to aggregate risks across different hazards;
  - description of the basic steps to complete a whole-site PSA; and
  - phased approach leading to closure of the gaps identified for the second criterion above.
71. With respect to the first criterion, OPG stated that the primary focus of site safety goals had been the protection of the health and safety of the public and limiting the potential for extensive long-term relocation. In this sense, the prevention of long-term contamination of the land surrounding the plant by minimizing long-lived radionuclide releases was the most important objective. This kind of objective requires a hierarchy of safety goals rather than a single one. For this reason, a safety goals framework could be structured into multiple levels along with supporting elements and founded on defense-in-depth principles. OPG noted that this approach was applied in the COG paper and further detailed development and rationalization were proposed to be conducted as part of a "road map" of additional work.

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<sup>10</sup> COG-13-9034 R0, "Development of a Whole-Site PSA Methodology".

72. OPG further stated that safety goals may be qualitative or quantitative in nature. Qualitative safety goals were based on the above focus areas of public health and extensive societal disruption, while two quantitative site-based safety goals were proposed with numerical parameters to be assigned during the implementation phase. Such defined safety goals would maintain sufficient safety margin, although different than the current per-unit based goal.
73. OPG explained that the second criterion had also been described, at a concept-level, in the COG paper, and stated that some of the basic steps to complete a whole-site PSA had already been implemented as part of the existing PSA programs. Several steps were not implemented since their viability remains uncertain. The strategy for additional work identifies the major remaining gaps in the areas of the establishment of site safety goals and associated parameters, and in the methodology for aggregation of all risk contributions, including the interpretation of the PSA results and their significance.
74. OPG explained that to address these issues, additional work is necessary to further develop and support risk aggregation concepts, and a number of options were identified in the COG paper. A road map with a strategy for this additional work has been developed to address the phased approach from the third criterion. The details of the hierarchical framework of safety goals and the low-level risk metrics would be developed during phase A. Phase B would include trial applications of different risk aggregation options, and phase C would encompass the application of whole-site PSA for the Pickering NGS site, as a pilot.
75. OPG estimated that the Pickering whole-site PSA pilot would be completed within three years from the start date of the road-map work. That timing would be influenced by the progress made by the international community, where some consensus on the related issues would be desirable in order to establish a consistent international practice.
76. CNSC staff confirmed that the safety goals for whole-site PSAs were still under development and should follow a hierarchical structure that starts with the high level qualitative concepts. CNSC staff also confirmed that, in accordance with the Commission's directions, OPG has submitted an outline of strategies to develop a whole-site PSA concept-level methodology, and an estimated timeline for the detailed methodology and the whole-site PSA.
77. CNSC staff informed the Commission about its initiatives related to multi-unit PSA, which included the establishment of a working group on safety goals to identify and select site risk metrics, and the organization of an international workshop on multi-unit PSA co-organized with the IAEA, United States Nuclear Regulatory Commission (US NRC), and Nuclear Energy Agency/Organization for Economic Cooperation and Development (NEA/OECD). The workshop is planned for November 2014.

78. CNSC staff explained that, as a method to aggregate the PSA results, the simple summation of internal and external events at the unit level would provide an overly conservative result. Simple multiplication of the unit metric by the number of units at the site would result in repeated counting of some of the accident sequences, repeated factoring in of initiating events, and would include some multi-unit events as a result of common mode events (e.g., loss of off-site power, loss of service water, seismic, and high winds). CNSC staff noted that preliminary calculations by CNSC staff, by dividing CDF and LRF into “single unit” and “multi-unit” events and then multiplying “single unit” events by the number of units, indicate that this approach may reduce the “whole-site” CDF and LRF by approximately 60%. CNSC staff expressed its satisfaction with the development of the concept-level whole-site PSA methodology carried out by OPG to date.
79. With respect to the risk reduction factors resulting from the conducted PSAs, the Commission sought more details regarding a discrepancy, mentioned in the intervention by Greenpeace Canada. The discrepancy appeared between the reduction factor of 1.26, estimated earlier, and final, re-estimated, value 1.03 appearing in the supplemental submission by CNSC staff, which was slightly higher than the upper safety goal limit of 1.00. CNSC staff explained that the final, re-estimated, values had been calculated by doing summation for the time at-power only and by incorporating the credits for post-Fukushima EME enhancements.
80. With respect to the reduction factor that was still slightly above the safety goal limit, the Commission asked OPG about next steps related to SAMG. OPG representatives pointed out to the difficulties to quantify human reliability for the activities encompassed by SAMG, which was included in the sum of all contributing factors. OPG representatives noted that OPG had developed a scenario for the model used that would bring the reduction factor below the safety goal limit; however, it was not yet possible to calculate the exact number for this reduction. CNSC staff reiterated its position that simple summation was not the appropriate approach to this issue, and that there were no requirements to apply it to calculate the reduction factor. CNSC staff underlined that a simple summation would bias the result towards overly conservative values, since some of the contributing factors are mutually exclusive.
81. The Commission asked if the reduction factors had been re-estimated for other NPPs in the same manner. OPG representatives responded that, except for PSA calculated for the Pickering A NGS, the PSA for Pickering B NGS and Darlington NGS did not include credits for not operating at 100% full power all the time, i.e. did not include time for outages, and that a station-based, aggregated number had not been calculated in the past. Such a calculation could be done for other stations, but it will have less impact for Pickering B and Darlington due to the differences in construction and reliability, and the obtained reduction factors would be smaller. However, such a calculation would be more realistic, since the actual calculation that does not take into account outage time results in a risk number based upon 120 % of the calendar year, which is an overestimate. OPG representatives added that such calculation would be consistent with the methodology used by the IAEA. CNSC staff concurred with this

statement.

82. The Commission asked OPG and CNSC staff for their comments regarding concerns expressed by Greenpeace Canada and some other intervenors that the presented results of PSA violate the safety limits. These intervenors also questioned the transparency and adequacy of public information about this issue. CNSC staff noted that PSA results were used on a per-event basis in the process of rendering a risk-informed decision, and that, contrary to the views of intervenors, an aggregated number does not represent a safety limit. CNSC staff added that the requirements for new power plants stating that all event frequencies should be aggregated, had been written about 10 years ago when the term “aggregation” referred only to the internal events because there was no methodology for external events. In the current PSA, internal events were aggregated by both OPG and CNSC staff, and there was no concern in meeting the established safety limits. Therefore, there was no violation of safety limits.
83. The Commission asked for comments on the intervention by F. Guilmet, who presented a table with PSA results different from the results presented in the Commission Member Documents submitted by OPG and CNSC staff. CNSC staff responded that the intervenor had seemingly applied double counting, and had counted both shutdown period in operational time and reactor operation 100% of time at full power. The OPG representative concurred with this comment.
84. The Commission enquired about the statement made by some intervenors that OPG did not apply a clear and well defined methodology, described in the LCH, for calculating risk aggregation. CNSC staff stated that the simple summation of the events frequencies is not a correct approach, and that an internationally accepted agreement regarding this issue has not been reached. CNSC staff was of the opinion that for the multi-unit PSA, for which the aggregation would be needed, it would be of essential importance to reach an agreement on an acceptable methodology to aggregate the external and internal events for single units, and then to calculate the value for the whole site. CNSC staff noted that the intervenors were referring to the IAEA document SSG-3 and simple summation; however, it is internationally acknowledged that the simple summation provides biased results.
85. The Commission asked if the whole-site PSA methodology, submitted by OPG to CNSC staff, was publicly available. The OPG representative responded that the concept level methodology, which was requested for the release of the hold point, and roadmap for additional work were included in the COG report that had been posted on the OPG website in March 2014.
86. The Commission asked CNSC staff to explain the differences between CNSC document S-294 and the REGDOC.2.4.2, which supersedes the S-294 and had been approved by the Commission during its March 2014 meeting. CNSC staff responded that the main objective of the changes was to address lessons learned from Fukushima event, so that the REGDOC.2.4.2 addresses issues like PSA for irradiated fuel bays and takes into account multi-units events.

87. The Commission sought clarification regarding OPG's approach to the Commission's request that, if the PSA values fall between the limit and the target, OPG should submit an action plan to address the specific risk. This issue was raised in the intervention by Greenpeace Canada. OPG representatives responded that their understanding of paragraph 25 of the Commission's decision regarding the licence renewal for the Pickering NGS [Ref. 2], was that this particular section did not reference the removal of the hold point and did not use the word "direct", which was seemingly misquoted by the intervenor. Paragraph 25 from the Record of Proceedings was included into the LCH under licence condition 5 related to safety analysis and was not stated as a requirement for the removal of the hold point. OPG stated that they had produced an action plan, and provided it to CNSC staff. CNSC staff stated that its interpretation of the Commission's request was that the action plan was not a precondition of the hold point, so it has been included into licence condition 5 of the LCH because it is part of the safety analysis. CNSC staff noted that all of the conditions set by the Commission as preconditions for release of the hold point had been included under licence condition 16. The Commission is satisfied, for the purpose of release of the hold point, with the explanation provided by CNSC staff. The Commission specified that, while an action plan had been submitted, it will require elaboration and further detail by OPG. The Commission requests to be updated on the improvements and implementation of the action plan as described in paragraphs 115 and 116 of this Record of Proceedings.
88. The Commission asked how extensive the interdependencies between international activities and OPG's work on safety goals, aggregation and site-wide PSAs were. The OPG representative responded that this interdependence was large and pointed out that all international stakeholders were interested in making progress on this note. The OPG representative added that the COG had facilitated a meeting on this matter in January 2014 with participants from Russia, Sweden, United States and representatives from the NRC, CNSC and WENRA. The Commission stated that it expects to be regularly updated on the progress of these activities.
89. The Commission asked for an update on the progress of the FAP and whether it would include SAMG and all associated PSA results. CNSC staff responded that the completion was expected for 2015, as targeted, and stated that SAMG had already been implemented across the Canadian fleet of reactors. The implemented improvements will be successively included in the PSAs across the industry, following revision of PSAs for the NPPs. OPG representatives added that FAP would be completed in 2015 when a majority of physical work on implementation will be completed as well.
90. The Commission enquired about off-site assets available to OPG in case of emergency. OPG representatives responded that they already have adequate on-site resources to deal with a reactor event on any unit and all units at the same time, and that they were currently working on the next phase, which includes an off-site centre to house additional equipment.

*3.2.4 Conclusion on the Commission's Direction Related to Probabilistic Safety Assessment*

91. The Commission is satisfied that OPG has met all necessary pre-requirements and additional requirements for the removal of the hold point related to the PSA. Based on its consideration of the presented information, the Commission concludes that the systematic evaluation of the potential hazards and the preparedness for reducing the effects of such hazards is adequate for the operation of the Pickering NGS.

**3.3 Containment Protection**

92. With its decision to renew the operating licence for the Pickering NGS, the Commission directed OPG to report, at the time of OPG's request to remove the hold point, on their analysis on filtered containment venting and way forward to protect containment through FAI future enhancements.
93. OPG presented to the Commission the results of their assessment of different options to further enhance containment performance at the Pickering NGS under extreme conditions. OPG determined that the existing and planned equipment upgrades to address the FAI were sufficient to address containment integrity challenges under Beyond Design Basis Accident conditions. Consequently, no additional containment filtered venting system would be installed. The performed assessment was based on the results of the probabilistic risk assessment completed to support compliance with CNSC Regulatory Standard S-294 and additional studies conducted to assess the response of containment to a wide range of event sequences.
94. OPG further presented the improvements made at Pickering NGS to prevent accident progression and to protect containment integrity as part of the response to the Fukushima event. During the first phase of these improvements, OPG has implemented additional portable EME to provide core cooling in the case of an extended loss of all power. During the ongoing second phase, OPG has been introducing enhancements to re-power critical station equipment and instrumentation using large portable generators. By re-powering the existing emergency filtered air discharge system equipment, such as valves and ventilation heaters, the system will be able to improve the performance and reliability of the filter media. Improvements to air cooling units would support the pressure control in containment, potentially minimizing containment venting. OPG added that hydrogen control and containment integrity protection for beyond design basis scenarios had been further enhanced by new passive auto-catalytic recombiners for additional hydrogen mitigation capability.
95. CNSC staff reported that it had reviewed the update on OPG's plans to ensure containment integrity as a result of the Fukushima event and concurred with the strategy and the proposed implementation. CNSC staff corroborated OPG's choice to enhance the reliability of existing systems by installing additional sources of cooling water and electrical power, and approved the approach to respond to an event as early

as possible, preventing its escalation to a severe accident.

96. Responding to concerns expressed in the intervention by the Canadian Coalition for Nuclear Responsibility, the Commission asked about the benefits of the installation of a new or an upgraded filtered system. CNSC staff emphasized that there were no regulatory requirements for the installation of a filter venting system for the beyond design basis accident. The regulatory performance objectives that the reactor design has to meet are reflected in the release limits established for the design basis accidents. Although considered to be the design basis accident by the Canadian regulatory framework, a large release is, based on the probabilities calculations, the beyond design basis accident. By introducing enhancements to provide additional power supply so that the filtering system can function in the harsh environment caused by a severe accident, OPG has ensured that the filtered venting of the containment would function under severe accidents. The OPG representative added that OPG had performed a comparison of the various solutions and determined that the proposed option of repowering the fans and the motorized valves, as well as lowering the demand by improving vault cooling was the best choice.
97. Based on its consideration of the presented information, the Commission concludes that the conducted analysis on filtered containment venting and the improvements proposed by OPG are adequate for safe operation of the facility.

### **3.4 Emergency Management Public Information Document**

98. With its decision to renew the operating licence for the Pickering NGS, the Commission directed OPG to produce an emergency management public information document to be distributed to all households in the Pickering area. The document was to summarize the integrated emergency response plan of all involved organizations, including all key roles and responsibilities, and include information on potassium iodide (KI) tablet distribution and information included in CSA Standard N1600<sup>11</sup>. The document was due by June 2014. This Commission direction was not a requirement for the release of the hold point.
99. OPG informed the Commission that it had organized wide consultations in order to assess the level of public knowledge on emergency preparedness and to determine the content of the brochure. The company conducted public consultations involving focus groups in Pickering and Darlington in November 2013 and in March 2014. The results of these consultations were reported to the CNSC, Durham Emergency Management Office (DEMO), and provincial and municipal authorities. The focus groups indicated that they wanted clear information covering what they would need to do in an emergency. As a result, information on the key roles and responsibilities of all the involved organizations were not included in the brochure. Instead, it focused on what the public could expect in an event and what actions they may have to take. OPG had consulted with the Province and Municipalities on language requirements, content and

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<sup>11</sup> CSA Standard N1600, General requirements for nuclear emergency management programs, CSA, Ottawa 2014.

whether to distribute KI at the time of distribution of the document.

100. OPG provided samples of the brochure to all members of the Commission, and informed the Commission that the document was distributed to all homes and businesses in the 10 km primary zone around the Pickering NGS, to coincide with the Emergency Preparedness Week. The document is also available on the OPG and DEMO websites.
101. CNSC staff confirmed that, in developing the brochure, OPG had held focus groups with primary zone residents from Pickering and Darlington, organized meetings with Provincial and Municipal stakeholders to review the focus group findings and to discuss design concepts, and had held additional focus group sessions to review brochure designs.
102. CNSC staff added that the specific requirements regarding the responsibilities for KI procurement and distribution were being addressed in two upcoming publications that were in the process of final revisions and preparation for publication: CSA standard N1600 and CNSC REGDOC 2.10.1 - *Nuclear Emergency Preparedness and Response*.
103. In its intervention, Greenpeace Canada stated that Ontario's detailed off-site nuclear emergency plans were designed to cope only with design-basis accidents or accidents characterized by small radiation releases. The Commission asked about the integration of OPG's emergency plans with the provincial plans in cases of larger events. A representative from Ontario's Office of Fire Marshal and Emergency Management responded that the provincial nuclear emergency response plan goes well beyond design basis events, and is based on a dose of up to 250 mSv (millisieverts) at the station boundary, which significantly exceeds a design basis event.
104. The intervenor also requested that OPG be directed to model a generic large release, similar to one done for the Darlington NGS, and to make public the estimates for the public's radiation exposure. The Commission asked OPG and CNSC staff to comment on this request. OPG representatives responded that additional work at Darlington had been undertaken as a stress test for the emergency plan, and was done as part of the environmental assessment for continued operation of that facility after the refurbishment. OPG representatives noted that the work had not yet been completed and would be presented to the Commission later in 2014. OPG representatives stated that OPG had assessed a potential impact of such generic leaks to the emergency planning, and does not see a need to repeat that work for the Pickering NGS. CNSC staff concurred with this explanation. CNSC staff committed to prepare the presentation and to determine whether the results of the conducted modelling could be useful for the Pickering NGS, at the time when the results of the completed study for Darlington NGS will be presented to the Commission. CNSC staff stated that it would provide its recommendation regarding a need for similar study for Pickering NGS, at that time.
105. The Commission asked about public reaction to the distributed brochure and about

OPG's plans for updates to the brochure. The OPG representative responded that the reactions were positive and that the members of the community that were involved with the focus groups had contributed significantly to the creation of the product.

106. The Commission sought more information regarding KI pills and pointed out that CNSC staff recommended pre-distribution of the pills, while the brochure directs the public to local pharmacists. OPG representatives responded that if the decision is made in favour of distribution of KI pills to the households in the neighbouring communities, OPG would support this and revise the brochure accordingly. CNSC staff noted that the issue of KI distribution is addressed in two documents within the broader CNSC regulatory framework. CNSC staff explained that a specific clause in CSA Standard N1600, which will be made public early in the summer, recommends that KI be available, on hand, in residences. This issue is also addressed in the CNSC's specific regulatory framework, REGDOC-2.10.1, which was in the final stages of public consultation, and would be presented to the Commission in August 2014. The representative from the Office of the Fire Marshal & Emergency Management added that his office had had discussions with the CNSC regarding the changes to REGDOC-2.10.1, and that their position and recommendations had been communicated to the CNSC.
107. Some intervenors raised issue with the lack of instructions in the current City of Toronto Emergency Plan. The Commission sought more information about nuclear emergency plans for the City of Toronto. CNSC staff responded that the City of Toronto has aspects of nuclear emergency planning prepared, with designated reception centres for certain areas, and that the City is making KI pills available to those residents who want to pick them up beforehand. The representative from the Office of the Fire Marshal & Emergency Management stated that the City of Toronto has a nuclear emergency plan that had been recently updated and reviewed by the Office. The conclusion of the review was that the plan conforms with the Provincial Nuclear Emergency Response Plan. The plan outlines the City of Toronto's role with respect to providing reception centres, its involvement in the overall organizational response and managing the response within the Toronto area of the Pickering primary zone.
108. The Canadian Environmental Law Association (CELA), in its intervention, expressed the view that severe accident emergency response had not been evaluated by the Commission during the 2013 public hearing on the Pickering licence renewal. CNSC staff disagreed with this statement and noted that the issue had been discussed at length and addressed by the Commission's direction requesting OPG to prepare and distribute to the public the Emergency Management Public Information Document. OPG representatives added that OPG consolidated nuclear emergency plan is well-integrated with those of other stakeholders including the EMO, the province, the municipalities, and the City of Toronto. OPG representatives further noted that there were two recommendations in the CELA report that touched on severe accidents, multi-unit severe accident planning and resource allocation were discussed at length at numerous occasions.

109. On the basis of the information presented, the Commission is satisfied with the emergency management public information document, prepared and distributed to homes and businesses in the 10 km primary zone around the Pickering NGS. The Commission recommends that OPG facilitate pre-distribution of KI pills within the 10 km primary zone with expectation that it will make emergency management more effective. The Commission will address this issue in more detail during its consideration of the REGDOC-2.10.1 in August 2014.

### **3.5 Other Matters of Regulatory Interest**

#### *3.5.1 Aboriginal Engagement*

110. CNSC staff informed the Commission that, prior to the May 2013 Commission public hearing on OPG's licence renewal, CNSC staff had identified and informed fourteen Aboriginal groups of OPG's application and public hearing. In February 2014, the same groups were informed on OPG's hold-point release request, and on possibilities to participate in the regulatory review process, to submit a written intervention for the Commission's public hearing, and to subscribe to the CNSC website. CNSC staff added that it made follow-up phone calls in March 2014. Based on the information received, CNSC staff concluded that the release of the hold point and continued operation of the Pickering NGS is unlikely to cause adverse impacts to any potential or established Aboriginal and/or treaty rights. Based on the information provided, the Commission accepts this conclusion from CNSC staff.

### **4.0 CONCLUSION**

111. The Commission has considered the information and submissions from CNSC staff, OPG and all participants as set out in the material available for reference on the record, as well as the oral and written submissions provided by the participants at the hearing.
112. The Commission is satisfied that OPG had met all pre-requirements and additional requirements associated with licence condition 16.3 of the Pickering Nuclear Generating Station Power Reactor Operating Licence, PROL 48.00/2018, as directed in the *Record of Proceedings* for the Pickering NGS licence renewal, and the Commission's requests for additional information. The Commission is satisfied that OPG 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.
113. Therefore, the Commission removes the hold point associated with licence condition 16.3 of the Pickering Nuclear Generating Station Power Reactor Operating Licence, PROL 48.00/2018, and allows OPG to proceed with Pickering NGS operation beyond

210,000 EFPH, up to 247,000 EFPH.

114. The Commission directs OPG to submit to the Commission a report on the detailed risk improvement plan for Pickering NGS two weeks before the Commission Meeting to be held in August 2014. This plan shall encompass a combination of physical improvements, changes to operating procedures, and improvements to the PSAs, including but not limited to the improvements to plant design and improvements to the methodologies, as specified by CNSC staff and set out in the section 3.1 of the CMD 14-H2.C. The improvements will include additional Fukushima related actions as well as improvements identified through the PSA.
115. The Commission directs CNSC staff to present its review of the detailed risk improvement plan for Pickering NGS, as part of the annual *Integrated Safety Assessment of Canadian Nuclear Power Plants*, at the Commission Meeting to be held in August 2014. The Commission requests that this document include clear timelines for all aforementioned improvements and related activities. The Commission requests that these improvements be implemented as soon as possible
116. The annual *Integrated Safety Assessment of Canadian Nuclear Power Plants* should include, every year, clear descriptions of measures implemented to enable the requested increased monitoring, inspection and reporting. The Commission further requests that this and future annual Integrated Safety Assessments and reports include updates to the Commission regarding enhancements of OPG's ageing management program, status of pressure tubes, feeder pipes and other safety issues, such as the evolution of safety margins as the operation approaches the planned end of life of the facility.
117. The Commission expects annual reports to include the status of additional Fukushima related actions and improvements identified through the PSA, as well as clear timeline for the development and implementation of whole-site based safety goals and PSA methodology



Michael Binder  
President,  
Canadian Nuclear Safety Commission

JUL 31 2014

Date

## Appendix A – Intervenors

Intervenors	Document Number
Jerome Joseph	CMD 14-H2.2
Anna Wrona	CMD 14-H2.3
Tim Seitz	CMD 14-H2.4
Kathleen Chung	CMD 14-H2.5
Josefine Singh	CMD 14-H2.6
Monica Whalley	CMD 14-H2.7
Fanny Guilmet	CMD 14-H2.8
Marilyn McKim	CMD 14-H2.9
Chris Barry	CMD 14-H2.10
Pat Reed	CMD 14-H2.11
Frank Greening	CMD 14-H2.12 CMD 14-H2.12A CMD 14-H2.12B
Kelly Clune	CMD 14-H2.13
Tania Szablowski	CMD 14-H2.14
Linda Heron	CMD 14-H2.15
Brenda Thompson	CMD 14-H2.16
Klaus Dohring	CMD 14-H2.17
Jill Lennox	CMD 14-H2.18
The Society of Energy Professionals	CMD 14-H2.19
Robert C. Azzopardi	CMD 14-H2.20
Ivan Gallegos	CMD 14-H2.21
Dan Holtl	CMD 14-H2.22
Susan Holtz	CMD 14-H2.23
Mike Darmon	CMD 14-H2.24
Durham Nuclear Awareness	CMD 14-H2.25 CMD 14-H2.25A
Sarah Sherman	CMD 14-H2.26
Sheila-Marie Richardson	CMD 14-H2.27
Rachel Gldstone-Gelman	CMD 14-H2.28
Albert Pietersma	CMD 14-H2.29
Nonie French	CMD 14-H2.30
Canadian Environmental Law Association	CMD 14-H2.31
Gail Cockburn	CMD 14-H2.32
Ontario Clean Air Alliance	CMD 14-H2.33
Graham Lodge	CMD 14-H2.34
Michel A. Duguay	CMD 14-H2.35 CMD 14-H2.35A CMD 14-H2.35B

New Clear Free Solutions	CMD 14-H2.36 CMD 14-H2.36A CMD 14-H2.36B CMD 14-H2.36C
Colleen McLaren	CMD 14-H2.37
Louis Bertrand	CMD 14-H2.38
Linda Hicks and Family	CMD 14-H2.39
Zach Ruiter	CMD 14-H2.40
International Intitute of Concern For Public Health	CMD 14-H2.41 CMD 14-H2.41A
Parkcrest Tenants' Association	CMD 14-H2.42
Jeff Brackett	CMD 14-H2.43
Pickering West Shore Community Association	CMD 14-H2.44
Northwatch	CMD 14-H2.45
Carrie Lester	CMD 14-H2.46
Greenpeace Canada	CMD 14-H2.47 CMD 14-H2.47A
Corine Psarrou-Rae	CMD 14-H2.48
City of Pickering	CMD 14-H2.49
David Collacutt	CMD 14-H2.50
Jacque Allen	CMD 14-H2.51
David Skripac	CMD 14-H2.52
Canadian Coalition for Nuclear Responsibility	CMD 14-H2.53 CMD 14-H2.53A CMD 14-H2.53B
A.J. Kehoe	CMD 14-H2.54
Ad Hoc Committee Against Industrial Nuclear Facilities in Ontario and Canada	CMD 14-H2.55
Louissette Lanteigne	CMD 14-H2.56