

**REFURBISHMENT AND
CONTINUED OPERATION OF PICKERING B
NUCLEAR GENERATING STATION
ENVIRONMENTAL ASSESSMENT**

NK30-REP-07701-00002

Prepared for:

Ontario Power Generation

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

Pickering A and Pickering B Nuclear Generating Stations (PNGS A and PNGS B) are located on the Pickering Nuclear (PN) site in the City of Pickering, Ontario. They are owned and operated by Ontario Power Generation (OPG).

PNGS B is a CANDU pressurized heavy water generating station with four reactors which have a combined power output of 2064 MW(e). PNGS B has operated continuously since 1983.

Pressure tube refurbishment of CANDU nuclear generating stations is an element of the plant design assumed to be required at some point in the life of the plant, generally after 25 to 30 years of operation. Refurbishment would allow PNGS B to continue to operate safely and efficiently for another 25 to 30 years (to approximately 2060 for the last of the four units). Consequently, the proposed project is called the “Refurbishment and Continued Operation of Pickering B Nuclear Generating Station” (hereafter called the “PNGS B Project” or “Project”).

PNGS B has produced base-load electrical power for distribution through the provincial grid since 1983. The continued operation of PNGS B will be an important contribution to stable electricity supply for industrial, commercial and residential consumers in Ontario.

Regulatory control of the PNGS B Project is exercised by the Canadian Nuclear Safety Commission (CNSC) by means of the operating licences for PNGS B and the on-site Pickering Waste Management Facility (PWMF). Activities associated with the PNGS B Project constitute some changes in these existing licences for which the CNSC may require amendments of the licences. Therefore, approval by the CNSC, under the *Nuclear Safety and Control Act (NSCA)*, is necessary before OPG may proceed with the Project. Amendments to these licences constitute one of two requisite triggers for an environmental assessment (EA) under the *Canadian Environmental Assessment Act (CEAA)*. In addition, the Project involves several activities that relate to a physical work. As such, they would be considered a project under *CEAA*, the second requisite trigger for an EA. The CNSC cannot grant requisite licence amendments until the EA is satisfactorily completed and the CNSC is satisfied that the Project will not likely cause significant adverse environmental effects taking into account the implementation of mitigation measures. The CNSC has determined that a screening level assessment is to be conducted.

As the licensing body, the CNSC is the Responsible Authority (RA) under the *CEAA* for the purpose of this assessment. As is normal practice, the CNSC has delegated the preparation of an EA Study Report to OPG and the report is to be based on Guidelines provided by the CNSC.

Once accepted, the EA Study Report will be used by the CNSC as a basis for the preparation of the required Screening Report.

As part of its planning process, OPG is proceeding with the EA study for the PNGS B Project as early as practicable. As the decision to refurbish one or more of the PNGS B reactors has not been made, the EA study will make an important contribution to OPG's business decision on whether or not to refurbish the PNGS B reactors.

The EA Study Report is organized into 14 chapters. The highlights of Chapters 2 to 12 are provided in the following sections of this Executive Summary. Chapter 1 is an Introduction to the Project, Chapter 13 provides References and Chapter 14 provides Abbreviations and Acronyms. The CNSC's EA Guidelines are included as Appendix A of the EA Study Report.

ES.2 DESCRIPTION OF THE PROPOSED PROJECT (CHAPTER 2)

This chapter gives an overview of existing facilities and activities associated with PNGS B and a detailed description of the proposed Project. An outline of the key elements of the PNGS B Project is provided below.

Project Works and Activities

Should OPG decide to extend the life of PNGS B, a number of major components in each of the units may need to be refurbished or replaced during planned outages. During these outages, after the reactors have been defuelled and dewatered, the fuel channel assemblies, calandria tubes feeder pipes, and steam generators would be removed and replaced in each unit. Used nuclear fuel will continue to be stored in the station's Irradiated Fuel Bay (IFB) for a minimum of ten years before being transferred to dry storage at the PWSMF. Refurbishment waste may be stored at expanded facilities at the PWSMF or it may be transported to the Western Waste Management Facility (WWMF) on the Bruce site near Kincardine, Ontario. Following each planned outage, the refurbished unit will be refuelled and returned to full power operation. Continued operation after refurbishment will include routine scheduled maintenance activities and inspections.

Project Works and Activities are divided into four principle stages: preparation for refurbishment; refurbishment; refuelling and restarting; and operations and maintenance. For the purposes of the EA Study, the first three stages are collectively referred to as the "Refurbishment Phase" while the fourth comprises the "Continued Operation Phase".

Refurbishment Phase

Site and facility preparation for refurbishment: includes preparation of contractor procedures and plans, including an Environmental Management Plan; mobilization of contractor workforce; procurement of equipment and components; relocation of buildings and structures; construction of construction-related facilities such as change rooms, restrooms, and shop facilities; possible construction of building and tank facilities for storage of heavy water; possible construction of laydown areas; construction of waste storage structures or buildings; defuelling and dewatering of the reactor, including management of the removed heavy water and used fuel; and creation of an “islanded” configuration for the unit to be refurbished.

Refurbishment: for each reactor unit this includes replacement of fuel channels and calandria tubes; replacement of the inlet and outlet feeders from the end fittings to the reactor inlet/outlet headers; removal and replacement of the steam generators; refurbishment of various systems including reactor auxiliary systems and feedwater systems; and normal upgrade and maintenance activities.

Refurbishment waste management activities: includes management of refurbishment (nuclear) waste (interim storage of waste at PWMF); transfer of low and intermediate level refurbishment waste on the PN site; transportation of low and intermediate level refurbishment waste off-site to the WWMF for storage; and management of non-nuclear waste.

Refuelling and restarting: Refuelling refers to the initial loading of the reactor fuel channels with new fuel following major refurbishment activities. Restarting comprises the activities associated with starting up plant systems and raising reactor power to generate electricity. For each reactor unit, this includes refilling the moderator with heavy water; refilling the heat transport system with heavy water; startup and testing of plant systems; achieving criticality in the reactor core; raising reactor power; admitting steam to the turbine; and reconnecting the unit to the electrical grid.

Continued Operation Phase

Operation of the refurbished reactors will be similar to current operation. For EA purposes, it is conservatively assumed that all units at PNGS B will operate at a reactor power of 100% throughout their extended operational life, using natural uranium fuel. The project works and activities comprise all the systems, components and activities of the existing PNGS B operations. During operation, it is expected that three general areas of maintenance will be performed; namely, preventative maintenance, corrective maintenance, and improvement or upgrade activities.

Shutdown of one or more reactors may occur prior to 2060. The preparation of the reactors for safe storage involves defuelling and dewatering, as will occur during the Refurbishment Phase.

Continued operation: includes works and activities related to the reactor core; reactor process systems; turbine/generator and auxiliaries; electrical power systems; fuel and fuel handling; auxiliary systems, and maintenance and repair.

Waste management activities: includes interim storage of refurbishment waste at PWF; management of operational low and intermediate level waste; transport of operational low and intermediate level waste to the WWMF; interim storage of used fuel at PWF; construction of additional storage structures at PWF for additional used nuclear fuel; and management of non-nuclear waste.

Project Target Dates

The earliest start date for the site and facility preparation for refurbishment is estimated to be 2010. Refurbishment of the first unit is assumed to begin between 2012 and 2014. Refurbishment of each unit could take approximately 2 ½ to 3 years to complete. Therefore, it is expected that refurbishment activities would be completed between 2024 and 2026. Scheduling of each unit's refurbishment outage will depend upon several factors such as contracting strategy, resource availability, generation planning, and unit performance. However, depending on these factors, OPG may delay the beginning of the refurbishment outages by up to several years. In this case, systems and components (including individual life-limiting components) on the units will be maintained on an as-needed basis until the refurbishment outages begin. This is a normal maintenance activity at PNGS. Refurbishment outages may proceed on two units at a time, or the outages may proceed sequentially.

Operation of all four refurbished reactors is anticipated to continue to the new end of life. For EA purposes only, the new end of life has been conservatively assessed to be 2060 for the last of the four units (i.e. approximately 30 years after all units are refurbished).

Decommissioning

Decommissioning of PNGS B will begin after a decision is made to cease operating the station. Assuming that the PNGS B Project is approved and implemented, then decommissioning of PNGS B will occur after 2060, when the last of the four reactors is expected to shut down. However, shutdown of one or more reactors may occur prior to 2060 when a reactor reaches its end-of-life during the Continued Operation Phase. Similarly, decommissioning of PWF will occur after all the used fuel and intermediate level waste have been removed to a long-term

waste management facilities and a decision is made to shut down the facility. Although PWF is located on the same site as PNGS B, the life cycle management plans of these facilities are separate from one another, and as such, decommissioning of each facility will occur as required.

The preferred decommissioning strategy for PNGS B is one of deferred dismantling. This occurs when the reactors and stations are safely stored for several decades after shutdown to allow radiation levels to decay prior to dismantling and site restoration. Deferred dismantling minimizes both the occupational radiation dose to workers, and the potential exposure of the public and environment. It includes three phases: preparation for safe storage; safe storage and monitoring; and dismantling, disposal and site restoration.

Existing Security, Safety and Environmental Programs

Programs established by OPG such as the Conventional Safety Program, Radiation Protection Program, and Occupational Health and Safety Program (non-radiological), will be applied to the PNGS B Project. In addition, the Environment, Safety and Health Program established by the Nuclear Waste Management Division (NWMD) will be applied to the part of the Project related to nuclear waste management (i.e., PWF).

Environmental programs under the Environmental Management System as well as environmental monitoring programs currently in place at the PN site will also apply to both phases of the Project.

As a Class 1 Nuclear Facility, PNGS B has appropriate security systems to comply with CNSC's security requirements. OPG has extensive fire protection and emergency response systems and plans in place at the PN site.

ES.3 ASSESSMENT METHODOLOGY (CHAPTER 3)

The assessment methodology follows the requirements of *CEAA* and is reflected in each chapter of the report. This methodology requires that the project works and activities be considered to determine how each one may interface with, and affect, the environment. This is done by establishing temporal and spatial boundaries relevant to the project, identifying applicable environmental components and selecting the Valued Ecosystem Components (VECs) that represent important features of the environment as a focus of the EA study.

The temporal boundaries for the proposed project are defined by the start date of site preparation, which is 2010 to 2014, and the beginning of the decommissioning phase expected to take place

after 2060, after the last of the four units is shut down and starting with a safe storage period of approximately 30 years.

The spatial boundaries include a **Site Study Area** – corresponding to the entire PNGS B facility and the area within the 914 metre exclusion zone for the site which encompasses both land surface and part of Lake Ontario water surface; a **Local Study Area** – comprising an area which lies outside of the Site Study Area out to approximately 10 km from PNGS. It includes lands within the City of Pickering, the Town of Ajax, and the eastern part of the City of Toronto (Scarborough) as well as a portion of Lake Ontario abutting the property; and a **Regional Study Area** – which extends beyond the Local Study Area from approximately 20 km east of the Darlington NGS in the east (i.e. the eastern boundary of the Region of Durham), to the eastern part of the City of Toronto (Scarborough) in the west and includes the municipalities in the Regional Municipality of Durham north of the PN site.

The study areas outlined above represent the general spatial framework for assessing environmental effects. The application of these study areas varies within each environmental component to allow the full extent of likely effects to be considered.

ES.4 DESCRIPTION OF THE EXISTING ENVIRONMENT (CHAPTER 4)

Environmental Components and Valued Ecosystem Components (VECs)

Baseline environmental conditions relevant to the Project were evaluated for each of the three Study Areas. Several environmental assessments have been previously undertaken for the PN site, and a wealth of baseline data is available. Components of the existing environment (i.e. baseline conditions) are described for the atmospheric environment including climate, meteorology, air quality and noise; surface water resources including hydrology, surface water quality and sediment quality; the aquatic and terrestrial environments; geology, hydrogeology and seismicity; radiation and radioactivity; visual setting and transportation; physical and cultural heritage resources; socio-economic conditions; and aboriginal interests.

Taking these baseline conditions into account, VECs were identified for each environmental component. The list of VECs was refined based on comments from stakeholders. The selected VECs and their corresponding environmental components are summarized in Table ES-1.

TABLE ES-1
EVALUATED ENVIRONMENTAL COMPONENTS AND SELECTED VECs

Environmental Components	Relevant VECs	
Atmospheric Environment	<ul style="list-style-type: none"> • closest residential receptors at Bay Ridges Neighbourhood and Liverpool Road sub-division; • pathway to Terrestrial Environment VECs. 	
Surface Water Resources	<ul style="list-style-type: none"> • members of the Public; • pathway to Aquatic Environment VECs; • pathway to Terrestrial Environment VECs. 	
Aquatic Environment	<ul style="list-style-type: none"> • emerald shiner; • lake trout; • northern pike; • round whitefish. 	<ul style="list-style-type: none"> • smallmouth bass; • walleye; • white sucker.
Terrestrial Environment	<ul style="list-style-type: none"> • midland painted turtle; • northern leopard frog; • black-crowned night heron; • common tern; • gray catbird; • trumpeter swan; • bufflehead; • red-winged blackbird; • red-tailed hawk. 	<ul style="list-style-type: none"> • muskrat; • woodchuck; • red fox; • chokecherry; • New England aster; • eastern hemlock; • narrow-leaved cattail; • red ash; • sandbar willow.
Geology, Hydrogeology & Seismicity	<ul style="list-style-type: none"> • members of the Public; • pathway to Aquatic Environment VECs; • pathway to Terrestrial Environment VECs. 	
Radiation & Radioactivity	<ul style="list-style-type: none"> • populations of non-human biota; • members of the Public; • workers at PN. 	
Visual Setting and Transportation	<ul style="list-style-type: none"> • members of the Public; • pathway to Aquatic Environment VECs; • pathway to Terrestrial Environment VECs; • pathway to Socio-economic Environment VECs. 	
Physical & Cultural Resources	<ul style="list-style-type: none"> • aboriginal structural remains or subsurface features; • aboriginal artefacts; • historic architecture or structural remains; • historic-period artefacts; • historic cemeteries; • agricultural landscapes. 	

TABLE ES-1 (Cont'd)
EVALUATED ENVIRONMENTAL COMPONENTS AND SELECTED VECs

Environmental Components	Relevant VECs
Socio-Economic Conditions	<ul style="list-style-type: none"> • community-wide population levels; • direct, indirect and induced employment; • business activity; • visitation to tourist attractions; • housing prices; • closest recreational and community features; • attractiveness of closest recreational and community features; • closest educational facilities; • tax revenues; socio-economic and physical dimensions of community; • closest residential receptor.
Aboriginal Interests	<ul style="list-style-type: none"> • community characteristics; • hunting and fishing for subsistence; • fishing, trapping and other for economic purposes; • prehistoric archaeological resources, ceremonial sites, burial mounds or petroglyphs; • aboriginal structural remains, • artefacts or subsurface features.

Human Health

The health and safety of humans (workers and members of the public) were considered directly or indirectly in the discussion of baseline conditions and selection of VECs. The overall assessment of human health and safety in this EA Study Report incorporates the World Health Organization's definition of health which includes physical, mental and social well-being.

Physical well-being refers to the state of a person functioning without disease, illness or injury. For this assessment physical well-being was evaluated with respect to radiation and radioactivity; non-radiological worker health; air quality and noise; surface water quality; groundwater quality; and malfunctions and accidents.

The mental well-being aspects of health are those which may affect the psychological behaviour of workers or members of the public. Certain socio-economic conditions were assessed with respect to the mental well-being of residents in the Local and Regional Study Area; this was based extensively on public attitude research. Aspects of mental well-being include stress related to increased traffic; community satisfaction; sense of health, safety and well-being; and use and enjoyment of property.

The social well-being aspects of health are those which may affect the social behaviour of workers or members of the public in the context of their community. Socio-economic conditions were examined in the context of social well-being and included components such as economic factors; land use; community infrastructure and services; municipal finance; and residents and communities.

ES.5 ASSESSMENT OF LIKELY ENVIRONMENTAL EFFECTS AND MITIGATION (CHAPTER 5)

Project-Environment Interactions

Using the description of project works and activities, and the baseline information provided for each environmental component, all relevant project-environment interactions were screened to identify effects that may be produced by the Project. Effects determined to be likely and potentially measurable were carried forward for further assessment. This involved quantification (where possible) of the effects and identification of appropriate mitigation measures to reduce or eliminate any adverse effects generated by the project. Effects remaining after mitigation are referred to as residual effects.

The evaluation of non-radiological environmental components determined that the following adverse residual effects may arise:

- For the aquatic environment, loss of biota due to impingement and entrainment of fishes (including a very limited number of VEC species) during both phases of the Project. Both non-native and native species are impinged. However, based on current and historic records, no population level effects to fishes are predicted. No effect on aquatic habitat is likely to occur as a result of the Project.
- For transportation in the Local Study Area, increased traffic congestion at intersections near the PN site due, in part, to additional traffic related to contractors working on the PN site during the Refurbishment Phase. However, the predicted increase in traffic congestion is mostly a result of the expected population growth in the Region of Durham, and not a direct result of the PNGS B Project. Also, the affected intersections are currently operating at capacity; hence, the additional traffic due to refurbishment activities is predicted to make conditions only marginally worse.
- For the socio-economic environment (population and economic base), change to regional labour market during the Refurbishment Phase. However, it is not

- anticipated that this will contribute to sustained shortages of workers or affect contractors' schedules and activities in Ontario.
- For the socio-economic environment (community services), reduced use and enjoyment of the Waterfront Trail nearest the PN site resulting from increased traffic and traffic noise during the Refurbishment Phase, and reduced use or enjoyment of the community and recreational features in the vicinity of the PN site as a result of changes in attitude about PNGS during the Continued Operation Phase.
 - For the socio-economic environment (community services), additional involvement of local fire, police and related services (health and safety) resulting from refurbishment activities and temporary work force are likely during the Refurbishment Phase.
 - For the socio-economic environment (residents and communities), decreased use and enjoyment of property during the Refurbishment Phase resulting from increased traffic and traffic-related noise along access routes to the PN site and/or changes in public attitudes about PNGS.

The evaluation of the radiation and radioactivity environment indicated that the following adverse residual effects may arise:

- For the hydrogeological environment, slightly elevated concentrations of tritium in groundwater may occasionally occur under the foundations of the plant as a result of minor seepage of tritiated water. When elevated tritium was detected in groundwater near the PNGS B Irradiated Fuel Bay through OPG's ongoing groundwater monitoring program, measures were taken to mitigate the release. Although this type of seepage may occasionally occur during both phases of the Project, OPG is taking steps to minimize this risk. OPG's groundwater monitoring and tracking program will continue, allowing prompt detection and mitigation of further small seepages. In addition, the tritium in groundwater is located below buildings and paved surfaces; hence, no effects on biota are likely. On-going groundwater monitoring at the perimeter of the site indicates that existing on-site tritium contamination is not migrating off site.
- For the radiation and radioactivity environment, collective dose to workers (Nuclear Energy Workers – NEWs) carrying out refurbishment activities will be higher than that associated with normal operations. Individual worker doses will remain within regulatory limits. No residual radiological effects on the workers (NEWs) are anticipated as a result of the Continued Operation Phase. No

distinguishable changes to dose levels from baseline conditions to members of the public are expected during the Project.

The evaluation of the environmental components determined that several positive residual effects, related to the socio-economic environment, will arise as a result of the Project:

- Increased proportion of the populations associated with, or directly dependent on PNGS B related employment during the Refurbishment Phase, resulting in maintenance of the social structure and stability of the Local Study Area communities and those across the Regional Study Area.
- The creation of new direct, indirect and induced employment opportunities and the maintenance of existing jobs within the study areas during the Refurbishment Phase, resulting in improved employment stability and maintenance of the existing economic base.
- The creation of new business activity due to increased consumer spending associated with households, directly or indirectly dependent on PNGS B related expenditures during the Refurbishment Phase.
- Increased attractiveness of the Regional Study Area to leading-edge industry and research organizations involved in the energy sector during the Refurbishment Phase and Continued Operation Phase.
- Improved financial status (e.g. building permit fees, taxes) for the City of Pickering resulting from the construction of additional buildings and structures on the PN site, and the continued operation of PNGS B to 2060.

Human Health

The potential effects of the Project on the environment were evaluated, in part, with respect to the health and safety of Nuclear Energy Workers (NEWs), non-NEWs and members of the public. The only potential effect to the physical well-being of humans is the higher collective radiation dose to workers carrying out refurbishment activities. The individual worker doses will remain within regulatory limits. The PNGS B operating licence requires OPG to operate PNGS B in accordance with established radiation and environmental protection procedures and practices which ensure the health and safety of workers and members of the public.

The potential effects of the Project on the mental and social well-being of humans were also considered. Only one aspect of the Project was identified as having the potential to

adversely affect the mental well-being of members of the public. This relates to the projected increase in traffic levels in the Local Study Area, resulting in a decrease in the level of service at certain signalized intersections. However, this projected increase is mostly a result of expected population growth in Durham Region; the additional traffic due to contractors working on the PN site during the Refurbishment Phase is predicted to make conditions only marginally worse.

The social well-being of members of the public may be enhanced as a result of the positive residual effects noted for the socio-economic environment. It is likely that the Project may serve to reinforce the view that the City of Pickering and the Region of Durham as a whole is an economically stable and desirable place in which to invest and conduct business, particularly in the energy sector. Also, the continued presence of PNGS B for the life of the Project to approximately 2060 will continue to be a source of revenue for the City ensuring that a wide variety of services and facilities are available to the community. This, in turn, contributes to the public's sense of social well-being and satisfaction.

ES.6 ASSESSMENTS OF OTHER LIKELY EFFECTS (CHAPTER 6)

Likely Effects of the Project on the Sustainable Use of Resources

Overall, the proposed PNGS B Project is not expected to cause a substantive reduction in the availability of renewable resources to present or future generations. The assessment found that there are no adverse effects from this aspect of the Project on any environmental component.

Regarding non-renewable resources, refurbishment of the PNGS B reactors will generate metallic waste that cannot be recycled and must be stored at the PWWF or WWMF prior to future disposal. However, this waste will not measurably affect the availability of ferrous scrap as input in steel production in Canada. Similarly, the use of uranium as fuel is unlikely to significantly affect the supply of uranium in Canada or elsewhere. The use of aggregate materials in the construction of the storage structures will be negligible in the context of the abundance of aggregate resources. The use of other non-renewable resources, such as zirconium metal and various oils, chemicals and lubricants during continued operation and construction of storage structures will not measurably affect their availability in Ontario or elsewhere.

Likely Effects of the Environment on the Project

The scope of the EA Study included the assessment of likely effects of the environment on the project. Events that could lead to effects include conditions that arise from the physical environment such as severe weather, seismic events, and climate change as well as conditions that arise from the biophysical environment such as aquatic plants and zebra and quagga mussels. It was concluded that no significant effects of the environment on the Project are anticipated; PNGS B is designed such that systems important to nuclear safety would continue to operate if any of the environmental conditions were to occur.

The PNGS B Project could potentially be affected by increased severity or frequency of storm events, a possible effect of climate change. These storm events could cause the following effects:

- Possible overflow of the stormwater management system at the PN site, thereby causing localized soil erosion;
- Potential for increased shore erosion due to greater intensity of waves, which could affect stability of the shoreline; and
- Greater disturbance of algae leading to greater quantities of algae becoming detached, potentially affecting the intake water flow.

Lake Ontario water temperature may increase due to climate change unrelated to plant operation; this increase could lead to warmer intake water temperature and increased algal and zebra mussel growth in Lake Ontario. Temporary reactor power reductions could be required to prevent the maximum permitted temperature being exceeded. There could be increased zebra mussel infestation and algal impingement.

None of the potential effects associated with climate change are expected to pose any risk to workers, members of the public or the environment. Also, the effects can be managed effectively through mitigation measures already in place or planned, and OPG's commitment to develop an adaptive management strategy.

ES.7 DESCRIPTION OF CREDIBLE MALFUNCTION AND ACCIDENT SCENARIOS (CHAPTER 7)

The proposed Project elements are conservatively designed and include safety systems to assure safe operation. Quality assurance programs, operating policies and procedural controls are in place to consistently attain the required level of safety. The effectiveness of these measures is demonstrated by the fact that in more than 30 years of PNGS

operations, there have been no significant fires, and no incidents resulting in doses to members of the public above a small fraction of the regulatory limit.

Each project work and activity was evaluated to develop credible conventional and radiological malfunction and accident scenarios. Each credible event was screened to establish if it could result in an environmental consequence that should warrant further consideration. These scenarios were reviewed against similar events to define the bounding scenarios for further evaluation.

Refurbishment Phase

Credible malfunctions and accidents that were evaluated included material handling accidents, worker accidents and construction equipment malfunctions. Evaluation of conventional malfunctions and accidents during refurbishment concluded that adverse effects on the environment or human health are unlikely. Evaluation of radiological malfunctions and accidents concluded that adverse effects on the environment or human health are unlikely.

Continued Operation of PNGS B

Credible malfunctions and accidents that were evaluated included material handling accidents, worker accidents, fire and natural and human-induced hazards. Evaluation of conventional malfunctions and accidents revealed two postulated events involving spills that required assessment. It was determined that an accidental hydrazine spill would not affect fish populations in the long term, and it was also determined that such an event has a low probability of occurrence. With respect to the release of oil to Lake Ontario during a transformer fire, effects on the aquatic environment would be limited to within a few days of the release. No human health effects are predicted, and no long-term effects on non-human biota (e.g. fish) are expected. All other conventional accidents and malfunctions would not result in adverse effects on the environment or human health.

Evaluation of radiological malfunctions and accidents revealed only one postulated event at PNGS B requiring assessment: the potential spill of tritium to land or water. No adverse effects on the environment or human health were identified. All other radiological accidents and malfunctions would not result in adverse effects on the environment or human health.

Waste Storage at PWWF

Evaluation of conventional malfunctions and accidents concluded that adverse effects on the environment or human health are unlikely during construction, waste transfer and facility operation. Evaluation of radiological malfunctions and accidents revealed only one postulated event requiring assessment: the loss of containment of a waste container due to accidental dropping. However, an evaluation determined that no adverse effects on human health or on the viability of populations of non-human biota are expected. It was concluded that all other radiological malfunctions and accidents associated with the construction, transfer of waste and facility operation during refurbishment and low and intermediate level waste storage would not result in adverse effects on the environment or human health.

Nuclear Accidents

Along with conventional and radiological malfunctions and accidents, nuclear accidents¹ were also evaluated. Two credible nuclear accidents were identified for further evaluation; one involved a release to water and one to air. The bounding dose to a member of the public would be above background and thus would be measurable. This dose is predicted to be below Health Canada and International Atomic Energy Agency (IAEA) Guidance for Sheltering, but within the range for consideration of sheltering specified by the Province of Ontario. Therefore, it was further evaluated for significance. Doses to non-human biota were estimated to meet appropriate guidelines.

A third nuclear accident called Ex-Plant Release Category 5 (EPRC5), a release to air, was also evaluated in response to stakeholder and agency comments. This accident has a very low probability of occurring and thus is considered to be highly unlikely (i.e. not credible). The maximum predicted individual dose to a member of the public is well below the Siting Guide Limits for design-basis accidents. However, this predicted dose would be within the range for consideration of sheltering and evacuation by the Province of Ontario. Therefore, it was further evaluated for significance.

It is important to note that the risk of nuclear accidents would not change as a result of the PNGS B Project; that is, the risk is no different today than it would be during continued operation.

Human Health

¹ Nuclear accidents are those malfunctions and accidents which are assumed to involve the operation of the reactor and may involve damage to the fuel bundles and/or the reactor core and which could result in an acute release of radioactivity to the environment.

Potential health effects arising from a malfunction or accident are three-fold. In the context of the WHO definition of health, a health effect can be related to physical well-being (potential for health effects per se) or social and mental well-being (public concern over the possible occurrence of a malfunction or accident with health implications).

PNGS B is designed and operated in accordance with strict safety standards to ensure that station personnel, members of the public, and the surrounding environment are protected from the effects of abnormal events that might occur during the life of the station. Facilities are governed by and operated according to licensed regulatory requirements. Design of the station accommodates all abnormal events that might reasonably be postulated to occur. Operation and maintenance of the station within the confines of the 'safe operating envelope' ensures a high level of safety. Since it is not possible to guarantee that abnormal events will never occur, an on-site emergency plan and an organization to implement that plan have been developed and maintained.

The PN site has emergency response capabilities that are initiated to deal with many differing emergency situations. These can include conventional emergency incidents or radiological-based incidents. The response required for radiological events originates in the Provincial Nuclear Emergency Plan (PNEP) and is implemented through the OPG Consolidated Nuclear Emergency Plan. The safety of the public and the environment outside the boundaries of the facility is the primary responsibility of the Province with support from OPG and local municipal organizations. A number of Ministries, including Environment, are represented at the Provincial Operations Centre (POC). Provincial decisions regarding emergency response are coordinated with Emergency Operations Centres in Durham Region, City of Pickering, Town of Ajax, and City of Toronto, as well as with OPG through its Corporate Emergency Operations Facility (CEOF).

ES.8 ASSESSMENT OF CUMULATIVE ENVIRONMENTAL EFFECTS (CHAPTER 8)

The adverse residual effects from the PNGS B Project were assessed to determine whether or not they have the potential to act cumulatively (overlap spatially and temporally) with the effects of other projects and activities, either past, existing or future within the study areas for the Project. Nineteen other projects were identified, and were selected, in part, as a result of a stakeholder workshop that was held in November 2006 to discuss cumulative effects and significance. Those projects or activities that have potential similar effects to the residual effects were forwarded for the cumulative effects assessment.

Likely adverse residual effects identified for the PNGS B Project and evaluated for cumulative environmental effects include: fish impingement from an additional 30 years of operation; tritium in groundwater; higher collective radiation dose to workers carrying

out refurbishment activities; increased local traffic due, in part, to additional workers during refurbishment phase activities; changes to regional labour market; reduced use and enjoyment of the Waterfront Trail; additional involvement of local fire, police and related services; and decreased use and enjoyment of property. In response to comments received from the public during the preparation of the EA Study Report, the scope of the cumulative effects assessment was broadened to include the following: radiation dose to humans and non-human biota under normal operating conditions; and the continued presence of the thermal plume for the life of the station. After screening these residual effects with respect to the other project works and activities to determine the potential for overlap in space and time, only those related to radiation and radioactivity and to the socio-economic environment were further evaluated.

Based on the assessment for all adverse residual effects from the PNGS B Project and other existing or planned project and activities taken together, there are no residual adverse cumulative effects of radiation doses on members of the public, workers on the PN property or on non-human biota anticipated. Sustained shortages of workers, potentially causing delays in construction activities, is considered an adverse residual cumulative effect. Further reductions in the use and enjoyment of the Waterfront Trail during the Refurbishment Phase, and further reductions in the use and enjoyment of community and recreational features near the PN site during the Continued Operation Phase are also considered adverse residual cumulative effects.

ES.9 SIGNIFICANCE OF RESIDUAL ADVERSE EFFECTS (CHAPTER 9)

Using criteria such as magnitude, duration and frequency or probability, the residual adverse effects resulting from an evaluation of the environmental effects of the Project (ES.5), credible malfunction and accident scenarios (ES.7), and cumulative effects (ES.8) were evaluated to determine their significance. Based on this evaluation of eight residual environmental and socio-economic effects, two conventional and radiological malfunction and accident scenarios, three nuclear accidents, and three cumulative socio-economic effects, it was concluded that with the identified mitigation measures in place, the residual effects are considered to be minor and not significant. Five positive socio-economic residual effects were also assessed and deemed to be minor effects.

ES.10 COMMUNITY AND STAKEHOLDER CONSULTATION (CHAPTER 10)

A Community and Stakeholder Consultation and Communication Plan (CSCCP) was developed for the PNGS B Project. Stakeholders were identified, and communication was maintained with ongoing committees such as the Pickering Community Advisory Council and the Durham Nuclear Health Committee. As part of the Aboriginal Consultation Program, communication was established with the following groups: Alderville Ojibway First Nation, Chippewas of Georgina Island First Nation, Curve Lake First Nation, Mississaugas of Scugog Island First Nation, Ojibway of Hiawatha First

Nation, the Kawartha Nishnawbe First Nation, the Mississaugas of the New Credit First Nation, the Oshawa chapter of the Métis Nation of Ontario, the Ontario Métis Aboriginal Association, and the Huron Wendat Nation (Quebec, this latter group only in 2007).

Various forms of communications were maintained with stakeholders and organizations including: a notification letter introducing the Project, and regular update letters; four Project newsletters circulated to approximately 154,000 households and businesses in the communications focus area, and meetings and interviews. Interested parties also had the opportunity to learn more about the Project and provide input through the Project website and a drop-in Information Centre. A toll free number was set up to receive calls and questions. Three rounds of Open Houses have been held (in September and December 2006, and May 2007). Each round consisted of four Open Houses held in Pickering, Ajax, Toronto and Whitby. An additional session was held in May 2007 to accommodate the interests of the residents of Toronto. The local community was informed of each round of Open Houses through local media advertisements and mailed invitation cards to the communications focus area. All those on the Project mailing list also received information. Two workshops were held for key stakeholders with a high level of interest in the Project. As part of the CSCCP, a comprehensive issue management strategy was developed for the PNGS B Project to track key comments and issues raised by the public.

Key issues raised by stakeholders included human health; nuclear waste management; Valued Ecosystem Components; effects on the environment; tritium; traffic; climate change; cumulative effects; seismicity; malfunctions and accidents; safety and security; and emergency response capability. Other areas included the thermal plume and algae; fish impingement; assessment methodology; EA scope and process; temporal and geographic boundaries; project cost; the project description and monitoring programs. Responses to questions were provided directly to the individuals who raised them (in person or through follow-up phone calls and e-mails), and in detailed reports of Open Houses and Workshops. Also, to the extent possible, these issues have been addressed in the EA Study Report.

ES.11 PRELIMINARY PLAN FOR MONITORING AND FOLLOW-UP PROGRAM (CHAPTER 11)

The purpose of the follow-up and monitoring activities is two-fold: to assist in determining if the environmental and cumulative effects of the Project are as predicted; and to confirm that the proposed mitigation measures are effective, and thus to determine if new mitigation strategies are required.

Potential adverse effects of the Project would be mitigated in two ways:

- *Mitigation measures which are part of the basic project design.* These in-design mitigation measures were taken into account at the outset of the EA study and are identified in the various assumptions made in the context of assessing the various Project Works and Activities. They include such measures as shielding for storage structures, adherence to the As Low As Reasonably Achievable (ALARA) principle, and continuation of environmental monitoring programs at the PN site.
- *Additional feasible mitigation measures identified during the EA study.* The goal of these measures is reducing or avoiding likely adverse effects of the Project. These include such measures as timing of site clearing activities to avoid breeding bird nesting season, and use of standard stormwater management measures.

All of the existing monitoring requirements of the licences and Certificates of Approval for PNGS B and PVMF will be applied to the PNGS B Project. Specific updates to procedures and plans or follow-up elements likely will be incorporated into PN's environmental management system. Details of the program will be developed at a later date in consultation with the CNSC and other stakeholders as appropriate. Preliminary elements of the program are as follows:

- Undertake a fish impingement mortality assessment and entrainment sampling program to evaluate the effect of fish impingement and compare results to the baseline study;
- Conduct an overview evaluation of technologies for reducing fish impingement/entrainment to determine whether there are economically achievable technologies that warrant further consideration at PNGS B;
- Undertake a creel census in vicinity of PNGS discharges (e.g. Frenchman's Bay) to confirm use of these habitat areas by VEC fish species, such as northern pike;
- Collect temperature data near the substrate at possible whitefish spawning areas, between PNGS B and Duffins Creek, potentially affected by the thermal plume, and at control locations offset several km from the discharge;
- Develop a traffic monitoring program to assess Level of Service at nearby signalized intersections during the Refurbishment Phase to verify predicted effects;
- Review with officials from City of Pickering and Town of Ajax that traffic management and parking can safely accommodate the refurbishment workforce;
- Develop an Impact Management Program in consultation with the City of Pickering, associated with Sandy Beach Road residents, to ensure that if any issues arise regarding traffic disruption they can be dealt with in a timely manner;

- Undertake public attitude research to verify public attitudes at various stages in the Project;
- Develop a follow-up Communication Plan to ensure the public is informed about the progress of the Project;
- Prepare and implement a strategy to reduce the already low probability of occurrence of an EPRC5-type event; the strategy would focus on potential physical modifications and may also include reassessment of safety analysis; and,
- Develop an adaptive management strategy to confirm adequacy of existing monitoring programs for effects on water systems due to algae impingement, zebra mussels, or changes to lake water temperatures; and to monitor any redefinition of the Regional Storm Event and review adequacy of the stormwater management system.

ES.12 CONCLUSIONS OF THE ASSESSMENT

Taking into account the findings of the EA Study Report, including the identified feasible mitigation measures, it is OPG's conclusion that the project will not result in any significant adverse environmental effects, including effects from accidents and malfunctions, effects of the environment on the project and cumulative effects. Accordingly, OPG recommends that the CNSC accept these conclusions as a basis for the preparation of its Screening Report under the *Canadian Environmental Assessment Act*.