Development And Implementation Of A Construction Environmental Protection Program At A Solid Radioactive Waste Management Facility

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Abstract

Refurbishment of ageing nuclear stations has great economic and environmental benefits, including reduced greenhouse gas emissions. The Government of New Brunswick (NB) decided in 2005 to refurbish the Point Lepreau Generating Station with Atomic Energy of Canada Limited (AECL) as the general contractor. The project includes construction of additional radioactive waste management facilities.

AECL developed, for the construction project, an environmental protection program to comply with commitments made during the environmental assessment process, and regulatory requirements. The program covers detailed environmental plans, training courses, and engagement of consultants to provide training and conduct monitoring of the construction activities. Construction related environmental effects have been successfully mitigated and the monitoring results indicate compliance with all environmental requirements.

1. Introduction

NB Power's Point Lepreau Generating Station (PLGS) is a CANDU 6 nuclear station, which has been in commercial operation since early 1983. The reactor has been ranked among the "Top Ten" nuclear reactors worldwide for more than half its service life and has proven to produce reliable low-cost power at high-capacity factors of 82.7% as of December 2004.

As part of ageing management, certain critical components, structures, and systems at the PLGS are considered to be near the end of their design life. Many assessment studies have been completed for the station on economic benefits and contribution to reduce greenhouse gas emissions in the province. The station produces 25-30% of the province's energy needs and creates a total of about 1,800 jobs of direct, indirect and induced employment. The operation of PLGS contributes significantly towards the goal of limiting CO_2 / greenhouse gas emissions in New Brunswick, avoiding 3.7 million tonnes of CO_2 emissions. If these were not avoided, they would increase the province's total CO_2 emissions annually by about 15%.

In 2003, NB Power submitted an environmental assessment [1], and received environmental approval, for the modifications to the waste facilities at PLGS. The Government of New Brunswick decided in July 2005 to refurbish the station with AECL as the general contractor. After refurbishment, the station can continue operation for another 25 to 30 years.

2. Solid radioactive waste management

Refurbishment projects generate low- and intermediate- level radioactive wastes, such as the scrapped pressure tubes, calandria tubes, and end fittings; these wastes require storage at a waste management facility. Continued operation of the plant after the refurbishment will generate additional quantities of low- and intermediate- level radioactive wastes as well as spent fuel. PLGS has planned to store such wastes at its existing Solid Radioactive Waste Management Facility (SRWMF) site which is located within PLGS exclusion zone, approximately 1,200 m northeast of the reactor building (see Figure 1). However, the current operating SRWMF structures cannot meet the storage requirements of the additional waste from the refurbishment project and the extended operation of the station. Thus PLGS has planned expansion of the SRWMF [1]; the extension areas (see Figure 2) consist of:

1. Phase I Extension - Construction of two new waste storage vault structures for storage of additional ongoing operational wastes, with space for two additional vaults in the future;
2. Phase II Extension – Site preparation, including clearing and grading, of an extension area for a future spent fuel dry storage facility; and
3. Phase III Facility – Construction of a new storage facility for low- and intermediate- level radioactive waste arising from the retubing/refurbishment activities, e.g., removal of existing feeders and fuel channel components.

This paper focuses on the environmental protection program for the SRWMF extension construction activities.

3. The construction environmental protection program

AECL, as the general contractor, had developed a Construction Environmental Protection Program (CEPP) to comply with the federal Canadian Nuclear Safety Commission (CNSC) [2] and New Brunswick [3] approval conditions for the SRWMF modification project, and to ensure that the construction activities were carried out in an environmentally responsible manner and in compliance with other applicable federal, and New Brunswick Provincial regulations. In addition, the project was required to meet both NB Power and AECL project environmental requirements, and to comply with PLGS ISO 14001 Environmental Management System registration conditions.

3.1 Project management

Under the CEPP, a Construction Environmental Protection Committee (CEPC) was established to oversee the CEPP implementation during the project construction period. This committee (see Figure 3) was chaired by AECL's site construction manager, and had representatives from the construction contractor, AECL and PLGS. Representing the construction contractor was the site superintendent; representing NB Power was a senior staff member from PLGS. Reporting to the

Figure 1 Aerial view of Point Lepreau Generating Station and SRWMF before expansion

Figure 2 The SRWMF expansion project

CEPC was a qualified and experienced environmental professional, contracted by AECL, to serve as the Senior Environmental Inspector who was responsible for site visual observations, and coordinating environmental and archaeological monitoring activities.

The CEPC regularly reviewed the CEPP requirements and results of the environmental monitoring and inspection programs, and reported monthly on environmental status to the Project.

AECL members of the CEPC worked closely with the project Health, Safety and Environment Department at the AECL Saint John Office.

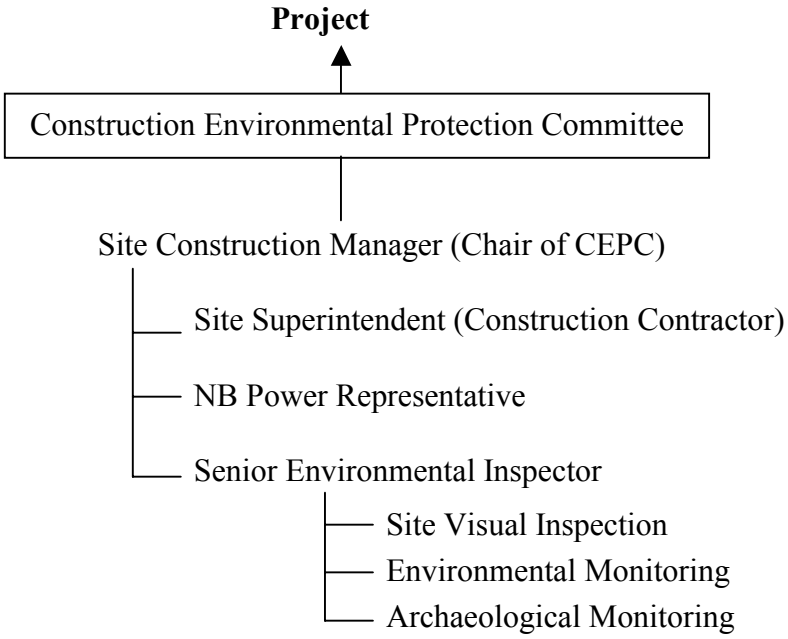

Figure 3 CEPC Management Organization

3.2 Environmental protection plans

The main theme of the environmental protection program was based on mitigation by design and planning to avoid or reduce potential adverse impacts during the construction phase. AECL identified the environmental concerns that could be associated with construction activities as shown in Table 1. These environmental concerns cover: site disturbance (erosion and sedimentation), emissions to air, discharges to water, releases to land, use of raw materials and natural resources, use of energy, energy emitted (e.g. fire and vibration), and waste and by-products generation. AECL then established the environmental objectives and targets, from which 10 environmental protection plans (EPPs) were developed as shown in Table 2.

These EPPs provide direction, mitigation measures for environmental protection/prevention, methods to measure the construction environmental conditions, roles and responsibilities of site staff, and reporting requirements. Best management practices on pollution control had been emphasized and state of the art equipment had been accentuated. Project construction activities had to conform to the appropriate EPP requirements. For each EPP, special forms were developed for recording monitoring and visual inspections. All these forms, monitoring and

recording results, and environmental status reports have all been stored in AECL's data management system.

4. Training program

The training needs for the SRWMF construction project were addressed in the Point Lepreau Generating Station EA Follow-up Program [4] and outlined in the CEPP. The objectives of the training program were to ensure that all staff involved in the construction project received proper environmental training before they started the construction activities. AECL had defined two non-radiological environmental protection training courses, one for the management staff and one for the construction crew members.

The Management Level course was designed for all construction site management and environmental staff. The course covered regulatory requirements, NB Power's corporate environmental policy and Environmental Management System (EMS), construction environmental concerns, the CEPP environmental protection plans and procedures (e.g., soil

Table 1

Construction Activities and Environmental Concerns

Construction-related Activities	Environmental Concerns
Preparation of the SRWMF site • Clearing and grubbing • Excavating, including possible controlled blasting, de-watering and grading • Foundation installation, including cast-in-place concrete • Construction of permanent drainage channels	Change in air quality: emission of dust and combustion gases
	Change in noise and vibration levels
	Generation of waste materials
	Change in ground water/surface water quality
	Loss and avoidance of habitat and direct mortality of terrestrial biota
	Contamination of soil
	Fire
	Erosion and sedimentation
	Loss or damage of archaeological and heritage resources
Construction of the SRWMF structures • Rebar installation • Concrete form work • Cast-in-place concrete • Paving • Fencing and Security • Installation of Utilities and Ancillary Facilities	Change in air quality: emission of dust and combustion gases
	Change in noise and vibration levels
	Generation of waste materials
	Change in ground water/surface water quality
	Avoidance of habitat by terrestrial biota
	Fire
	Erosion and sedimentation
Storage, use and handling of hazardous materials (e.g., fuels and oils) at the SRWMF	Change in air quality
	Direct mortality of terrestrial biota
	Fire
	Generation of hazardous wastes
Transportation activities on the SRWMF site, and to and from the site	Change in air quality: emission of dust and combustion gases
	Change in noise and vibration levels
	Avoidance of habitat by and direct mortality of terrestrial biota

Table 2

Environmental Objectives, Targets and Protection Plans

Environmental Concerns Related to Construction Activities	Environmental Objectives	Environmental Targets	Environmental Protection Plans
Erosion and sedimentation	To minimise soil erosion and sedimentation	• The concentrations of suspended solids within effluent released to aquatic receptors shall not exceed 25 mg/L for a weekly composite and 80 mg/L for a grab sample • Re-establish vegetation in disturbed areas	**EPP No. 1** *Erosion and Sedimentation Control*
Noise and vibration	To minimize noise and vibration disturbance to the flora and fauna, and to the public	Noise levels in adjacent residential areas limited to less than 65dBA	**EPP No. 2** *Noise and Vibration Control*
Soil contamination	To control contaminated soil excavated on site	Comply with applicable remediation and/or disposal requirements	**EPP No. 3** *Soil Contamination Control*
Fire	To reduce the potential of fires and to ensure emergency response procedures are implemented in the event of fire	No fire accidents	**EPP No. 4** *Fire Prevention*
Air pollution	To minimize degradation of air quality	Comply with federal National Ambient Air Quality Objectives / Clean Air Act for New Brunswick Air Quality Regulation, Schedule B – Maximum Permissible Ground Level Concentrations	**EPP No. 5** *Air Pollution Control*
Water pollution	To minimize the environmental effects of stormwater flows and de-watering operations on natural water courses and to control and dispose of wastewater generated on site	• Comply with NB Clean Water Act requirements • The concentrations of suspended solids within effluent released to aquatic receptors shall not exceed 25 mg/L for a weekly composite and 80 mg/L for a grab sample	**EPP No. 6** *Water Pollution Control*
Loss and avoidance of habitat or direct mortality	To minimize the effect of construction on the habitats of terrestrial biota surrounding the SRWMF site	• Habitat is protected • Wildlife disturbance is minimized	**EPP No. 7** *Flora and Fauna Protection*
Disturbance and damage of heritage and archaeological areas	To prevent damage to heritage and archaeological resources	No unplanned damage or alteration	**EPP No. 8** *Heritage and Archaeology Protection*
Generation of wastes	To minimise and control all waste materials generated on site, to encourage recycling, to ensure contaminants do not pollute surrounding areas	Comply with applicable disposal requirements and ensure no contaminants, except as permitted, leave the site	**EPP No. 9** *Waste Management and Handling*
Generation of hazardous wastes	To control the removal and disposal of hazardous materials	Comply with applicable storage, handling and disposal requirements	**EPP No. 10** *Hazardous Materials Management*

erosion, waste management, and hazardous materials management), environmental monitoring, visual observations, and contingency response plans as detailed in the CEPP. The course also covered a review of the Construction Environmental Protection Committee organization structure and roles and responsibilities of different parties.

The Contractor Level course was designed to address construction activities that might lead to environmental concerns. Emphasis was placed on environmental protection measures under the CEPP implementation programs, spill prevention control, and countermeasures approach.

Staff arriving at the SRWMF to perform short-term work were briefed with adequate orientation of the CEPP before entering the construction site as a means for training on their job-specific responsibilities.

A local consultant firm was hired to develop the materials and to deliver the courses. NB Power had informed the CNSC of the training materials in advance of the proper training course presentations. The Senior Environmental Inspector, as a CEPC member, oversaw the training program, monitored the training process, and presented orientation briefing to short term staff.

The Management Level training course was 6 hours in duration, given three times to accommodate a total of 22 persons. Course materials were provided to the participants. Case studies, and "what-if" scenarios were designed around group discussion sessions and the session results were presented in class discussions. Assessments based on a passing mark of 75% were expected of all the participants.

The Contractor Level course of 3-hour duration was provided on-site to sub-contractors on 7 occasions, resulting in training of 69 staff. This level of training concentrated on the ten EPPs including issue identification and mitigation measures. Roles and responsibilities were also described in a first-contact framework. Handouts were given to the students, and assessments based on a passing mark of 75% were expected of all participants.

Occasional short term contractors, totaling 40 visitors, received the CEPP briefing provided by the project Senior Environmental Inspector before entering the SRWMF construction site. When time permitted, handouts of the contractor level training material were provided to them for further clarification.

5. EPP monitoring activities

Environmental monitoring and site inspection activities were undertaken by the Project Environmental Monitoring Consultant, Project Archaeologist and Senior Environmental Inspector. The inspections were to ensure compliance with the CEPP, identify non-conformances and initiate any corrective or preventative measures as required. Each of the environmental protection plans included a form for recording monitoring and visual inspections. The project Environmental Monitoring Consultant was responsible for conducting monitoring or visual observations, and filling out the forms which included:

- *Surface water quality monitoring for total suspended solids - EPP No. 1 Form*
- *Noise and vibration survey – EPP No. 2 Form*
- *Soil Quality Monitoring – EPP No. 3 Form*

- *Fire prevention visual monitoring record - EPP No. 4 Form*
- *Air pollution control visual monitoring record – EPP No. 5 Form*
- *Stormwater and groundwater quality monitoring for total suspended solids and hydrocarbons – EPP No. 6 Form*
- *Waste management and handling visual monitoring record - EPP No. 9 Form*
- *Hazardous materials management visual monitoring record - EPP No. 10-1 Form*
- *Inventory of hazardous waste at the SRWMF - EPP No. 10-2 Form*

On the above noted EPPs, the frequency of monitoring/inspections varied according to the conditions of visual observation or monitoring results. Overall, there were 18 sampling locations used in these EPPs throughout the CEPP implementation, starting from April 2006 and ending in December 2006. The targets, mitigation measures, responsibilities, and reporting criteria had been determined based on municipal, provincial, and federal legislation.

Heritage and archaeology protection (EPP No. 8) was performed by the project Archaeologist during the excavation period. Similar to the other EPPs identified, EPP No. 8 also contained a form for recording the visual monitoring results. The frequency of this activity was daily.

The Senior Environmental Inspector, with oversight of all EPPs, also performed Self Assessments for environment at the SRWMF site. Together with the Project Environmental Monitoring Consultant, the Senior Environmental Inspector issued a monthly environmental status report summarizing the monitoring results, all non-conformance incidents, and contingency measures if initiated.

6. Mitigation measures and contingency responses

Mitigation measures were identified in the CEPP for all the EPPs. Table 3 outlined the mitigation measures for each EPP and the associated contingency actions triggered during the CEPP implementation. For the 9 month (April to December 2006) construction period, only a few incidents resulted in contingency actions with insignificant effects on the environment.

Minor oil spills occurred on May 12 and July 14, 2006 (EPP No. 3 in Table 3). In both instances, the oil spill contingency response plans were triggered, the construction crew cleaned up the areas, resulting in no environmental risks. These incidents were documented and reported to the Project.

A few heavy rainfalls occurred in 2006 during the construction period as detailed under EPP No. 6 in Table 3. These events resulted in the exceedance of the CEPP targets. However, the Senior Environmental Inspector, Project Environmental Monitoring Consultant, and Contractors on site took contingency measures and actions during these heavy rainfall events. Their coordinated efforts in contingency responses helped to reduce the extent and duration of the unforeseen natural events and reduce the risk to the environment.

7. Communication and reporting

The CEPC maintained good communications on environmental issues with Project management, the Construction Contractor and PLGS. The CEPC met once monthly and reviewed

Table 3

EPPs Mitigations and Contingency Actions Triggered

EPP No.	Mitigation Measures	Contingency Actions Triggered
1 *Erosion and Sedimentation Control*	Maintaining natural vegetation; stabilizing all areas of loose surface soils by back-blading or grading; seeding; installing drainage works early, diverting clean water around the construction site and minimizing flow velocities by using sediment ponds, energy dissipaters and scour protection; and installing sediment fences, bunds and staked/geotextile wrapped straw bales.	Nil
2 *Noise and Vibration Control*	Ensuring all equipment on site was to be serviced and maintained to manufacturer's standards; and noise-producing activities scheduled to minimize exterior noise between 19:00 to 7:00 hours, upon receipt of public concerns.	Nil
3 *Contaminated Soil Control*	Monitoring and sampling where appropriate; and disposal of contaminated soil, if found on site, followed by compliance verification.	• May 12, 2006- a minor hydraulic oil spill occurred. The visible puddle was cleaned up using absorbent pads. The contaminated soil was excavated and removed from site. Soil and nearby water samples were tested resulting to no further remediation needs. • July 14, 2006- a minor spill from a concrete truck hydraulic hose. No environmental risks and report filed.
4 *Fire Prevention*	Training and awareness programs for all construction staff; first aid fire fighting appliances available on site; locations of fire-fighting equipment clearly posted; and fuel free zones established.	Nil
5 *Air Pollution Control*	Minimizing the areas of disturbance; preserving natural vegetation where possible; undertaking rehabilitation and revegetation as early as possible; applying dust suppressant on unsealed construction roads; and ensuring all equipment be serviced and maintained to manufact-urer's standards, including emission control devices.	Nil
6 *Water Pollution Control*	Monitoring and sampling surface water and groundwater; disposing of non-radiologically contaminated surface water and groundwater; diverting de-watering flows back onto existing ground; collecting wastewater derived from concrete cutting, concrete washing and dust suppression; making available spill response kits and posting their locations; ensuring ready mix concrete be supplied from a licensed, offsite concrete batch plant; ensuring asphalt be supplied from a licensed, offsite asphalt plant; and ensuring refueling operations prevented leaks.	• April 15, 2006- heavy rainfall event occurred, and a weekend visit was made to site. Water was seen to be flowing around the second check dam in Phase III (Figure 1), which was repaired. • May 10, 2006- heavy rainfall event occurred and sedimentation was visible in the ditch up to check dam "C" (Figure 1). Increased levels of sedimentation were observed. Actions were taken to excavate a series of cross-ditches/cross-drains to redirect the flow. Confirmatory water samples were collected and results were within CEPP requirements. • May 11, 2006- heavy rainfall even occurred causing sedimentation of water in the ditch along the main road. Immediate action was taken to cut a swale to help re-direct the sediment-laden waster to a vegetated area. Water was also pumped out of check damn "C" (Figure 1) to a vegetated area to alleviate the heavy water flow. Temporary straw bales, to act as filters, were also installed along the main road to the ditch. Confirmatory water samples were collected and results were within CEPP requirements. Subsequent to this heavy rainfall

EPP No.	Mitigation Measures	Contingency Actions Triggered
		event, a rock-filled trench was installed to redirect water flow to a vegetated area. • June 4, 2006- heavy rainfall even occurred where sediment-laden water was visible in the ditch along the main access road. The heavy rainfall continued through June 4, 2006. Grab samples were taken, and the results were within the CEPP requirements. The extreme rainfall caused several erosion and sediment control measures to fail. The high water levels and soft ground prevented some controls from being repaired immediately. Repairs were prioritized following discussions with the Senior Environmental Inspector. • October 12, 2006- heavy rainfall event occurred where the sediment exceeded the TSS limit set in the CEPP (80 mg/L). Erosion control measures were found to be functioning normal, however the heavy rainfall temporarily overwhelmed most. A post-rainfall inspection by the Senior Environmental Inspector indicated that the level of TSS was significantly reduced. • November 1, 7, 9, 16, 23, 30; December 7, 14- heavy rainfall events occurred. Grab samples were taken and results were within CEPP requirements. Minor actions were required to repair silt fencing.
7 *Flora and Fauna Protection*	Minimizing the disturbance to, and the clearing of existing habitats; scheduling clearing to avoid sensitive biological periods, especially during the breeding and migration season; the use of native species in revegetation; installation of erosion controls; and observing posted speed limits to reduce vehicle collisions with wildlife.	Nil
8 *Heritage and Archaeology Protection*	Insuring all mechanized vehicles and equipment remained within the existing site roads except where required for clearing and other construction activities; and ensuring a qualified archaeologist be present when work took place on previously undisturbed areas during excavation operations.	Nil
9 *Waste Management and Handling*	Ensuring all excess materials used for construction be recycled or disposed of off site; organic waste and excess rock be removed from the site during clearing and grubbing and be stockpiled and disposed of at a designated area within the PLGS boundaries; trash, including recyclable products, be removed from site at the end of each workday.	Nil
10 *Hazardous Material Management*	No bulk storage of hazardous materials at the site; hazardous materials handled, stored, prepared, installed and cured to the manufacturer's written instructions and regulatory requirements; handled only by staff trained and qualified in the handling of the material; proper labeling in compliance with WHMIS requirements with material safety data sheets available; deliveries, removal and disposal of hazardous materials off site by an approved and licensed contractor; and greasy, oily rags or materials subject to spontaneous combustion kept in an appropriate fire-safe receptacle.	Nil

environmental compliance and protection issues related to the construction activities. The CEPC reported monthly on environmental status of the project directly to NB Power.

8. Summary of program results and conclusion

The SRWMF expansion construction project was successfully completed in December 2006, a year ahead of the original schedule and on budget, despite the less than ideal weather (heavy rainfalls) conditions experienced at Point Lepreau during the construction period.

During heavy construction activities, ambient noise levels were measured on 5 days at three locations: a nearby residence road, PLGS Main Gate and East Gate; all the results indicated background noise levels and were well within the CEPP target of 65 dBA. Surface water quality was measured on 47 days at 12 sampling locations around the SRWMF site and nearby watercourses: results of the total suspended solids were within the CEPP targets of 80 mg/L for grab samples, except for 3 days during heavy rainfall events. Two minor oil spills occurred, resulting in no significant environment effect. All other EPPs were successfully implemented with pre-planned mitigation measures in place to eliminate environmental concerns.

Contingency measures used during the construction period helped to reduce the extent and duration of the unforeseen natural events and minimize the effect on the environment. The CEPP implementation had ensured that the construction project did not cause any environmental degradation.

9. Acknowledgements

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