5.9 Decommissioning

The NRC defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use or under restricted conditions and termination of the license. 10 CFR 50.82 specifies the regulatory actions that NRC and a licensee must take to decommission a nuclear power facility. 10 CFR 20, Subpart E identifies the radiological criteria that must be met for license termination. These requirements apply to the existing fleet of power reactors and to advanced reactors such as the GE ABWR.

Decommissioning must occur because NRC regulations do not permit a combined license holder to abandon a facility after ending operations. The NRC prohibits licensees from performing decommissioning activities that result in significant environmental impacts not previously reviewed under 10 CFR 50.82. The NRC has indicated that licensees for existing reactors can rely on the information in the Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities (GEIS) on the environmental impacts of decommissioning for the existing fleet of domestic nuclear power reactors as documented in Supplement 1 to NUREG-0586 (Reference 5.9-1).

The DOE funded a study that compares activities required to decommission existing reactors to those required for advanced reactors, including the GE ABWR (Reference 5.9-2). In addition, STPNOC has estimated the decommissioning cost for each of the two nuclear powered generating plants designated as STP 3&4 , by calculating the formula amount as of December 31, 2006 in accordance with the provisions of 10 CFR 50.75(c) and the guidance provided in NUREG-1307, Rev. 12 dated February 2007 (Reference 5.9-4). STPNOC has concluded that the DOE-funded study provides a basis for concluding that the environmental impacts identified in the GEIS are representative of impacts that can be reasonably expected from decommissioning the ABWR. The following sections summarize the decommissioning GEIS, DOE-funded study, ABWR plant design features for eventual decommissioning, STPNOC cost estimate, and STPNOC conclusions based on its review.

5.9.1 NRC Generic Environmental Impact Statement Regarding Decommissioning

NUREG-0586 describes decommissioning regulatory requirements, decommissioning process, and environmental impacts of decommissioning (Reference 5.9-1). Prior to presenting impacts, the GEIS describes the NRC process for evaluating impacts. Activities and impacts that NRC considered to be within the scope of the GEIS include:

- Activities performed to remove the facility from service once the licensee certifies that the facility has permanently ceased operations, including organizational changes and removal of fuel from the reactor.

- Activities performed in support of radiological decommissioning, including decontamination and dismantlement (D&D) of radioactive structures, systems, and components (SSCs) and any activities required to support the decontamination and dismantlement process such as isolating the spent fuel pool to reduce the scope of required safeguards and security systems so D&D can proceed on the balance of the facility without affecting the spent fuel.

- Activities performed in support of dismantlement of nonradiological SSCs, such as diesel generator buildings and cooling towers.
- Activities performed up to license termination and their resulting impacts as provided by the definition of decommissioning, including shipment and processing of radioactive waste.
- Nonradiological impacts occurring after license termination from activities conducted during decommissioning.
- Activities related to release of the facility.
- Human health impacts from radiological and nonradiological decommissioning activities.

According to Section 5.9 of NUREG-1555 (Reference 5.9-3), studies of social and environmental effects of decommissioning large commercial power generating units have not identified any significant impacts beyond those considered in the GEIS on decommissioning. The GEIS evaluates the environmental impact of the following three decommissioning methods:

- DECON – The equipment, structures, and portions of the facility and site that contain radioactive contaminants are removed or decontaminated to a level that permits termination of the license shortly after cessation of operations.
- SAFSTOR – The facility is placed in a safe stable condition and maintained in that state (safe storage) until it is subsequently decontaminated and dismantled to levels that permit license termination. During SAFSTOR, a facility is left intact, but the fuel is removed from the reactor vessel and radioactive liquids are drained from systems and components and then processed. Radioactive decay occurs during the SAFSTOR period, thus reducing the quantity of contaminated and radioactive material that must be disposed of during the decontamination and dismantlement of the facility at the end of the storage period.
- ENTOMB – This alternative involves encasing radioactive SSCs in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license.

Definitive plans for decommissioning are required by the NRC after a decision has been made to cease operations. The general environmental impacts are summarized in this section, because detailed analyses of decommissioning alternatives are not prepared until cessation of operations.

As discussed in NUREG-0586, decommissioning a nuclear facility that has reached the end of its useful life generally has a positive environmental impact. The air quality, water quality, and ecological impacts of decommissioning are expected to be substantially smaller than those of power plant construction or operation because the level of activity and the releases to the environment are expected to be smaller during decommissioning than during construction and operation. The major environmental impact, regardless of the specific decommissioning option selected, is the commitment of small amounts of land for waste burial in exchange for the

potential reuse of the land where the facility is located. Socioeconomic impacts of decommissioning will result from the demands on, and contributions to, the community by the workers employed to decommission a power plant (Reference 5.9-3).

Experience with decommissioned power plants has shown that the occupational exposures during the decommissioning period are comparable to those associated with refueling and plant maintenance when a plant is operational. Each potential decommissioning alternative will have radiological impacts from the transport of materials to their disposal sites. The expected impact from this transportation activity will not be significantly different from normal operations (Reference 5.9-3).

5.9.2 DOE-Funded Study on Decommissioning Costs

The total cost of decommissioning depends on many factors, including the sequence and timing of the various stages of the program, location of the facility, current radioactive waste burial costs, and plans for spent fuel storage. To ensure that a lack of funds does not result in delays in or improper conduct of decommissioning that may adversely affect public health and safety, 10 CFR 50.75 requires that operating license applicants and licensees provide reasonable assurance that adequate funds for performing decommissioning will be available at the end of operation. To provide this assurance, the regulation requires that two factors be considered: (1) the amount of funds needed for decommissioning, and (2) the method used to provide financial assurance. At its discretion, an applicant may submit a certification based either on the formulas provided in 10 CFR 50.75 or, when a higher funding level is desired, on a facility-specific cost estimate that is equal to or greater than that calculated using the formula in 10 CFR 50.75, consistent with guidance provided by Regulatory Guide 1.159 (Reference 5.9-5).

To support development of advanced reactors for production of electric power and to establish the requirements for providing reasonable assurance that adequate funds for performing decommissioning will be available at the end of plant operations, a study was commissioned by DOE (Reference 5.9-2). The study presents estimates of the costs to decommission the advanced reactor designs following a scheduled cessation of plant operations. Four reactor types were evaluated in this report: the GE ABWR, the GE Economic Simplified Boiling Water Reactor (ESBWR), the Westinghouse Advanced Passive Pressurized Water Reactor (AP1000), and the Atomic Energy of Canada, Limited (AECL) Advanced CANDU Reactor (ACR-700). The cost analysis described in the study is based on the prompt decommissioning alternative, or DECON, as defined in NUREG-0586. The DECON alternative is also the basis for the NRC funding regulations in 10 CFR 50.75 and use of the DECON alternative for the advanced reactor designs facilitates the comparison with NRC estimates and financial provisions.

DECON comprises four distinct periods of effort:

1. Pre-shutdown planning/engineering

2. Plant deactivation and transition (no activities are conducted during this period that will affect the safe operation of the spent fuel pool)

3. Decontamination and dismantlement with concurrent operations in the spent-fuel pool until the pool inventory is zero

4. License termination

Each of the decommissioning activities evaluated in the GEIS is performed during one or more of the periods identified above. Because of the delays in development of the federal waste management system, it may be necessary to continue operation of a dry fuel storage facility on the reactor site after the reactor systems have been dismantled and the reactor nuclear license terminated. However, these latter storage costs are considered operational costs and are not considered part of decommissioning (Reference 5.9-1).

The cost estimates described in the DOE study were developed using the same cost estimating methodology used by NRC and consider the typical features of a generic site located in the southeast, including the nuclear steam supply systems, power generation systems, support services, site buildings, and ancillary facilities. STPNOC considers this to be a valid approach for STP 3 & 4. The estimates are based on numerous fundamental assumptions, including labor costs, low-level radioactive waste disposal costs and practices, regulatory requirements, and project contingencies. The primary cost contributors identified in the study are either labor-related or associated with the management and disposition of the radioactive waste. Overall, the DOE study concluded that with consistent operating and management assumptions, the total decommissioning costs projected for the advanced reactor designs are comparable to those projected by NRC for operating reactors with appropriate reductions in costs due to reduced physical plant inventories (Reference 5.9-2).

5.9.3 ABWR Plant Design Features for Decommissioning

The reduction of personnel exposure during decommissioning depends to a large extent on the same general principles for occupational exposure as for normal operations. The ABWR design emphasizes the use of materials selected to have low corrosion rates and reduced buildup of radioactivity on equipment, resulting in lower radiation fields after plant operations and lower activity rates to contend with during the decommissioning process. Decontamination connections on equipment used for light decontamination prior to maintenance can be successfully used to perform heavy acid wash decontamination after final operations to remove more embedded contaminants. The overall design of the plant allows for repair and maintenance including change-out of all major equipment with a few limited exceptions. This allows for all the plant equipment to be readily removed from the buildings after shutdown for disassembly, decontamination, and disposal. Special attention has been given in the design to provide access and equipment handling capabilities for the maintenance of major components. These design features, such as overhead monorails, lifting devices, and in-place ladders enhance access and removal of equipment and access to all parts of the plant except those most heavily contaminated. Additionally, two operational activities have a significant effect on decommissioning: (1) maintenance of plant water chemistry within existing limitations to minimize contamination, and (2) maintaining records of plant modifications to minimize post-operational uncertainty due to changes in equipment, piping, and electrical routing or inventive modifications.

5.9.4 STP Units 3 and 4 Decommissioning Cost Estimate

STPNOC has established a decommissioning cost estimate for each of the GE ABWR units proposed to be constructed on the STP site in order to assess the financial obligations pertaining to the eventual decommissioning of the two units. Part 1.4 of the COLA describes the plans for providing financial assurance for the decommissioning of the two units and includes a certification regarding the cost estimate for each unit, which is provided in Table 1.4 appended to Part 1 of the COLA. The cost estimate or "formula amount" for the minimum certification is calculated in accordance with the provisions of 10 CFR 50.75(c) and the guidance provided in NUREG-1307, Rev. 12 dated February 2007 (Reference 5.9-4), which assumes the DECON decommissioning alternative. The estimate assumes the removal of all contaminated and activated plant components and structural materials such that the owner may then have unrestricted use of the site with no further requirements for an operating license. Similar to the DOE study, the primary cost contributors identified are labor-related or associated with the management and disposition of the radioactive waste.

The STPNOC projected cost to decommission each of the GE ABWRs is estimated to be approximately $517 million, reported in end of year 2006 dollars. This minimum certification amount for each plant was calculated using the formula delineated in 10 CFR 50.75(c)(1) and appropriate escalation indices, including the waste burial factor provided in NUREG-1307, Rev. 12, for the vendor waste processing option.

5.9.5 Conclusions

STPNOC compared the activities analyzed in the GEIS of the environmental impacts associated with decommissioning the existing fleet of domestic nuclear power reactors with the activities that form the basis for decommissioning cost estimates prepared by DOE for advanced reactor designs and determined that the scope of activities is the same. Projected physical plant inventories associated with advanced reactor designs will generally be less than those for currently operating power reactors due to advances in technology that simplify maintenance and benefit decommissioning. Based on this comparison, STPNOC has concluded that the environmental impacts identified in the GEIS are representative of impacts that can be reasonably expected from decommissioning the GE ABWR.

STPNOC has projected a total decommissioning cost estimate using the NRC's formula amount in accordance with 10 CFR 50.75(c)(1). The cost projected to decommission two GE ABWRs using the DECON alternative is estimated to be $1.034 billion, reported in end of year 2006 dollars.

5.9.6 References

5.9-1 "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," NUREG-0586, Supplement 1, Volume 1, November 2002.

5.9-2 "U.S. Department of Energy, Study of Construction Technologies and Schedules, O&M Staffing and Cost, and Decommissioning Costs and Funding Requirements for Advanced Reactor Designs," prepared by Dominion Energy Inc., Bechtel Power Corporation, TLG, Inc., and MPR Associates for United States Department of Energy Cooperative Agreement DE-FC07-03ID14492, Contract DE-AT01-020NE23476, May 27, 2004.

5.9-3 "Environmental Standard Review Plan," NUREG-1555, October 1999.

5.9-4 "Report on Waste Burial Charges – Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities," NUREG-1307, Revision 12, February 2007.

5.9-5 "Assuring the Availability of Funds for Decommissioning Nuclear Reactors," Regulatory Guide 1.159, Revision 1, October 2003.