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September 28, 2018

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Oyster Creek Nuclear Generating Station
Renewed Facility Operating License No. DPR-16
NRC Docket Nos. 50-219 and 72-15

Subject: Notification of Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for Oyster Creek Nuclear Generating Station

Reference:

[1] Letter from Michael P. Gallagher, (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission - Oyster Creek Nuclear Generating Station - Post-Shutdown Decommissioning Activities Report, dated May 21, 2018

[2] Letter from James Barstow, (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission - Submittal of Updated Decommissioning Cost Analysis for Oyster Creek Nuclear Generation Station, March 30, 2016

[3] Letter from J. Bradley Fewell, (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission - Application for Order Approving Direct Transfer of Renewed Facility Operating License and General License and Proposed Conforming License Amendment Oyster Creek Nuclear Generating Station, August 31, 2018

Pursuant to 10 CFR 50.82(a)(4)(i), Exelon Generation submitted the post-shutdown decommissioning activities report (PSDAR) (Reference 1) for the SAFSTOR method for the Oyster Creek Nuclear Generating Station (OCNGS). The PSDAR referenced Exelon

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Generation's March 30, 2016, site-specific decommissioning cost estimate (DCE) (Reference 2) for the radiological decommissioning, spent fuel management, and site restoration for OCNGS following the cessation of plant operations.

On August 31, 2018, Exelon Generation and Holtec submitted a License Transfer Application (LTA) requesting NRC consent to transfer the Oyster Creek Renewed Facility Operating License and the General License for the Oyster Creek Independent Spent Fuel Storage Installation (ISFSI) to Oyster Creek Environmental Protection, LLC (OCEP), as the licensed owner, and to Holtec Decommissioning International (HDI), LLC as the licensed operator (Reference 3).

The OCNGS permanently shutdown on September 17, 2018. By letter dated September 25, 2018, Exelon Generation certified to the NRC that it had permanently removed fuel from the reactor vessel at Oyster Creek in accordance with 10 CFR 50.82(a)(2).

Pursuant to 10 CFR 50.82(a)(7), HDI is submitting the enclosed Revised Post-Shutdown Decommissioning Activities Report (DECON PSDAR) to notify the NRC of changes to accelerate the schedule for the prompt decommissioning of OCNGS and unrestricted release of all portions of the site (excluding the ISFSI) within eight (8) years after license transfer, if the LTA is approved. A revised site-specific DCE for decommissioning OCNGS is also being submitted as an enclosure to the DECON PSDAR. The revised site-specific DCE demonstrates that adequate funding is available in the Nuclear Decommissioning Trust (NDT) fund to complete radiological decommissioning and license termination of OCNGS.

This DECON PSDAR is contingent upon NRC approval of the LTA, completion of transfer of the licenses and asset sale closure. If the licenses are not transferred, this DECON PSDAR will be ineffective, and the May 21, 2018 PSDAR (Reference 1) submitted by Exelon Generation will remain in effect.

Exelon Generation has reviewed the contents of this letter and is aligned.

Funding for irradiated fuel management will be addressed in a separate submittal from Holtec as an update to the Spent Fuel Management Plan pursuant to 10 CFR 50.54(bb).

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In accordance with 10 CFR 50.82(a)(4)(i), a copy of the DECON PSDAR is being provided to the State of New Jersey by transmitting a copy of this letter and its enclosure to the designated State Officials.

This letter contains no new regulatory commitments.

If you have any questions, please contact Andrea Sterdis at (803) 740-1022.

Sincerely,

Pamela B. Cowan
Sr. Vice President & Chief Operating Officer
Holtec Decommissioning International, LLC

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Enclosure: Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for Oyster Creek Nuclear Generating Station

cc: w/ Enclosure

Regional Administrator- NRC Region I
NRC Senior Resident Inspector - Oyster Creek Nuclear Generating Station
NRC Project Manager, NRR - Oyster Creek Nuclear Generating Station
Director, Bureau of Nuclear Engineering - New Jersey Department of Environmental Protection
Mayor of Lacey Township, Forked River, NJ

# Oyster Creek Nuclear Power Station
# Revised Post-Shutdown Decommissioning Activities Report

Prepared for
**Holtec Decommissioning International, LLC**

Prepared by
**Comprehensive Decommissioning International, LLC**

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**Acronyms**

| | |
|---|---|
| ACM | Asbestos Containing Material |
| ALARA | As Low As Reasonably Achievable |
| BMP | Best Management Practice |
| BWR | Boiling Water Reactor |
| CDI | Comprehensive Decommissioning International, LLC. |
| CFR | Code of Federal Regulations |
| CoC | Certificate of Compliance |
| DCE | Decommissioning Cost Estimate |
| DCGL | Derived Concentration Guideline Levels |
| DECON | A Method of Decommissioning defined by the NRC |
| DGC | Decommissioning General Contractor |
| DOE | Department of Energy |
| E | State Endangered |
| EC | European Commission |
| ENTOMB | A Method of Decommissioning defined by the NRC |
| EPA | Environmental Protection Agency |
| FSS | Final Status Survey |
| FWS | Fish and Wildlife Service |
| GEIS | Generic Environmental Impact Statement (NUREG-0586) |
| GTCC | Greater than Class C |
| HDI | Holtec Decommissioning International |
| Holtec | Holtec International |
| HSA | Historical Site Assessment |
| IAEA | International Atomic Energy Agency |
| ISDC | International Structure for Decommissioning Costing |
| ISFSI | Independent Spent Fuel Storage Installation |
| LE | Federally Endangered |
| LLMW | Low-Level Mixed Waste |
| LLRW | Low-Level Radioactive Waste |
| LSA | Low Specific Activity |
| LT | Federally Threatened |
| LTA | License Transfer Application |
| LTP | License Termination Plan |
| MARSSIM | Multi-Agency Radiation Survey and Site Investigation Manual |
| MWe | Megawatt-electric |
| NB | Nonbreeding Population |
| NDT | Nuclear Decommissioning Trust |
| NEA | Nuclear Energy Agency |
| NEPA | National Environmental Policy Act |
| NJDEP | New Jersey Department of Environmental Protection |
| NJHPO | New Jersey Historic Preservation Office |
| NJNHP | New Jersey National Heritage Program |

| | |
|---|---|
| NJPDES | New Jersey Pollutant Discharge Elimination System |
| NMFS | National Marine Fisheries Services |
| NRC | Nuclear Regulatory Commission |
| NUREG | Nuclear Regulatory Commission technical report designation |
| OCNGS | Oyster Creek Nuclear Generating Station |
| OECD | Organization for Economic Cooperation and Development |
| OSHA | Occupational Safety and Health Association |
| PSDAR | Post-Shutdown Decommissioning Activities Report |
| RPV | Reactor Pressure Vessel |
| RVI | Reactor Vessel Internals |
| SAFSTOR | A Method of Decommissioning defined by the NRC |
| SCO | Surface Contaminated Object |
| SEIS | Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437), Supplement 28, "Regarding Oyster Creek Nuclear Generating Station" |
| SFP | Spent Fuel Pool |
| SME | Subject Matter Expert |
| SNF | Spent Nuclear Fuel |
| SSC | Structures, Systems and Components |
| T | State Threatened |
| TSDF | Treatment, Storage, and Disposal Facility |
| US | United States |
| USACE | United States Army Corps of Engineers |
| WBS | Work Breakdown Structure |
| WCS | Waste Control Specialists |
| WMP | Waste Management Plan |
| WP | Work Package |

# 1 INTRODUCTION AND SUMMARY

## 1.1 Introduction

On May 21, 2018, Exelon Generation, LLC (Exelon or Exelon Generation) submitted to the U.S. Nuclear Regulatory Commission (NRC) the Oyster Creek Nuclear Generating Station (OCNGS) Post-Shutdown Decommissioning Activities Report (PSDAR) pursuant to Title 10 of the Code of Federal Regulations (10 CFR), Section 50.82(a)(4) (Reference 1). The Exelon PSDAR selected the SAFSTOR method for decommissioning Oyster Creek and assumed license termination in 2078 and site restoration in 2080. The SAFSTOR PSDAR referenced the March 30, 2016, site-specific decommissioning cost estimate (DCE) for the radiological decommissioning, spent fuel management, and completion of site restoration for OCNGS following the cessation of plant operations (Reference 2). On September 24, 2018, Exelon Generation submitted a response to NRC request for additional information related to the environmental impacts of decommissioning activities described in the OCNGS PSDAR (Reference 6).

Exelon Generation also submitted the "Update to Spent Fuel Management Plan for Oyster Creek Generating Station" to the NRC on May 21, 2018 (Reference 3). Subsequent updates for the funding for irradiated fuel management will be addressed in a separate submittal from Holtec as an update to the Spent Fuel Management Plan pursuant to 10 CFR 50.54(bb).

On August 31, 2018, Exelon Generation and Holtec submitted a License Transfer Application (LTA) requesting NRC consent to transfer the OCNGS Renewed Facility Operating License No. DPR-16 and the general license for the Oyster Creek Independent Spent Fuel Storage Installation (ISFSI) to Oyster Creek Environmental Protection, LLC (OCEP) as the licensed owner, and to Holtec Decommissioning International (HDI) as the licensed operator (Reference 4).

Following NRC approval of the license transfer, OCEP (a wholly-owned subsidiary of Holtec) will acquire Oyster Creek, including the ISFSI, from Exelon Generation as an asset purchase. In addition, following asset sale closure and license transfer, HDI, an indirect wholly-owned subsidiary of Holtec will be the decommissioning operator of Oyster Creek with licensed responsibility for maintaining and decommissioning the facility. OCEP and HDI have been formed by Holtec to own Oyster Creek and decommission nuclear power plants including Oyster Creek, respectively. OCEP has been formed to become the licensed owner of Oyster Creek. HDI's mission is to assume licensed operator responsibilities for decommissioning nuclear power plants that Holtec acquires, including Oyster Creek. OCEP will enter into a decommissioning operator services agreement with HDI, which will require OCEP to pay HDI's costs of post-shutdown operations, including all decommissioning costs and spent fuel management costs.

HDI will contract with Comprehensive Decommissioning International, LLC (CDI), a company jointly formed and owned by Holtec and SNC-Lavalin Group, as the

decommissioning general contractor. CDI will manage and perform the day-to-day Oyster Creek licensed activities, including decommissioning activities, to maintain compliance with the Licenses and NRC regulations, subject to HDI's direct oversight and control as the decommissioning licensed operator.

This Revised Post-Shutdown Decommissioning Activities Report (DECON PSDAR) for the OCNGS is being submitted to notify the NRC of changes to accelerate the schedule for the prompt decommissioning of OCNGS and unrestricted release of all portions of the site other than the ISFSI, if the license transfer is approved by NRC.

This DECON PSDAR is contingent upon NRC approval of the LTA, completion of transfer of the licenses and asset sale closure. If the licenses are not transferred, this DECON PSDAR will be ineffective, and the May 21, 2018 PSDAR (Reference 1) submitted by Exelon Generation will remain in effect.

Prior to plant shutdown, Exelon Generation, in coordination with Holtec, is preparing for the safe and orderly transition from permanent shutdown to dismantlement and decontamination. After the transfer of the licenses is complete, the facility will be dismantled and decontaminated to levels that permit the unrestricted release of all portions of the site except for the ISFSI. This DECON PSDAR contains the following:

1. A description of the planned decommissioning activities along with a schedule for accomplishment.
2. A discussion that provides the reasons for concluding that the environmental impacts associated with site-specific decommissioning activities will be bounded by appropriate previously issued environmental impact statements.
3. A site-specific Decommissioning Cost Estimate (DCE), including the projected license termination, spent fuel management, and site restoration costs.

The DECON PSDAR has been developed consistent with Regulatory Guide 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report" (Reference 5). The DECON PSDAR is based on currently available information, and the plans discussed herein may be modified as additional information becomes available or conditions change. As required by 10 CFR 50.82(a)(7), the NRC will be notified in writing, with copies sent to the State of New Jersey, before performing any decommissioning activity inconsistent with, or making any significant schedule change from, those actions and schedules described in the DECON PSDAR, including changes that significantly increase the decommissioning cost.

## 1.2 Background

The Oyster Creek Nuclear Generating Station (OCNGS) is a single unit Boiling Water Reactor (BWR-2) with a Mark I type containment. It is located in Lacey Township, Ocean County, New Jersey, approximately two miles south of the community of Forked River. OCNGS is licensed to generate 1930 megawatts-thermal (MWt). The renewed

facility operating license for OCNGS expires on April 9, 2029. The principal structures at OCNGS site include a reactor building that houses primary containment and the reactor, turbine building, office buildings, old and new radwaste buildings, offgas building, emergency diesel generators, intake and discharge structures, ventilation stack, storage tanks, warehouse, security structures, and dry fuel storage facility (ISFSI).

A brief history of the major milestones related to OCNGS construction and operational history is as follows:

- Construction Permit Issued: Dec 15, 1964
- Provision Operating License Issued: April 9, 1969
- Commercial Operation: December 23, 1969
- Major Plant Refurbishment: 1984
- Full Term Operating License Issued July 2, 1991
- Original License Expiration: April 9, 2009
- Renewed License Expiration: April 9, 2029

On February 14, 2018, Exelon Generation announced its plan to retire OCNGS no later than October 31, 2018 in accordance with 10 CFR 50.82(a)(l)(i) and 10 CFR 50.4(b)(8) (Reference 7). OCNGS permanently shutdown on September 17, 2018. By letter dated September 25, 2018, Exelon Generation certified to the NRC that it had permanently removed fuel from the reactor vessel at Oyster Creek in accordance with 10 CFR 50.82(a)(2) (Reference 22). Upon docketing of the certifications required by CFR 50.82(a)(1)(i) and 10 CFR 50.82(a)(1)(ii), pursuant to 10 CFR 50.82(a)(2), the 10 CFR Part 50 license for OCNGS no longer authorizes operation of the reactor or emplacement or retention of fuel in the reactor vessel. Therefore, Exelon Generation is no longer authorized to operate the Oyster Creek reactor or emplace or retain fuel in the reactor vessel at Oyster Creek.

Pursuant to 10 CFR 50.51(b), "Continuation of license," the license for a facility that has permanently ceased operations continues in effect beyond the expiration date to authorize ownership and possession of the facility until the NRC notifies the licensee in writing that the license has been terminated.

During the period that the license remains in effect, 10 CFR 50.5l(b) requires that the licensee:

1. Take actions necessary to decommission and decontaminate the facility and, continue to maintain the facility (including storage, control, and maintenance of the spent fuel) in a safe condition.
2. Conduct activities in accordance with all other restrictions applicable to the facility in accordance with NRC regulations and the 10 CFR 50 renewed facility

operating license.

10 CFR 50.82(a)(9) states that power reactor licensees must submit an application for termination of the license at least two (2) years prior to the license termination date, and that the application must be accompanied, or preceded, by a License Termination Plan (LTP) to be submitted for NRC approval.

## 1.3 Summary of Decommissioning Methods

The NRC has evaluated the environmental impacts of three (3) general methods for decommissioning power reactor facilities in NUREG-0586, "Final Generic Environmental Impact Statement (GEIS) on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors" (Reference 8). The three (3) general methods evaluated are summarized as follows:

- DECON: The equipment, structures, and portions of the facility and site that contain radioactive contaminants are promptly removed or decontaminated to a level that permits termination of the license shortly after cessation of operations.
- SAFSTOR: After the plant is shutdown and defueled, the facility is placed in a safe, stable condition and maintained in that state (safe storage). The facility is decontaminated and dismantled at the end of the storage period to levels that permit license termination. During SAFSTOR, a facility is left intact, or may be partially dismantled, 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, thereby reducing the quantity of contamination and radioactivity that must be disposed of during decontamination and dismantlement.
- ENTOMB: Radioactive structures, systems, and components (SSCs) are encased 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.

## 1.4 Decommissioning Method Selected

Following license transfer and asset sale closure OCNGS will be decommissioned and dismantled using the DECON method. This DECON PSDAR describes the selected methods HDI plans to use for the decontamination and dismantlement of the site. The decommissioning strategy for the project is to initiate the prompt decommissioning with a project goal of achieving unrestricted release of the OCNGS site, except for the ISFSI within eight years of license transfer. To meet this goal once the license is transferred, HDI has the following decommissioning objectives:

a. Decommissioning of OCNGS and site restoration of all areas, except for the ISFSI.
b. NRC approval of partial site release, including issuance of amended licenses to include only the operation of the ISFSI.

c. Department of Energy (DOE) acceptance of Spent Nuclear Fuel (SNF) from the OCNGS ISFSI.
d. Decommissioning of the ISFSI after DOE has removed the SNF.
e. Termination of the NRC licenses and site release of the ISFSI area.
f. Site restoration of the ISFSI area.

The decommissioning strategy is to complete radiological decommissioning and release for unrestricted use of all portions of the site within eight years of license transfer and asset sale closure, except for the ISFSI ("partial site release") per the decommissioning schedule depicted in Figure 3-1. In accordance with 10 CFR 50.82(a)(9), the LTP will be developed and submitted to NRC approval at least two (2) years prior to the expected date for partial site release. NRC license termination will occur following spent fuel and GTCC waste removal from the site and ISFSI decommissioning.

The decommissioning approach for OCNGS is described in the following sections.

- Section 2.0 describes the planned decommissioning activities and the general timing of their implementation.
- Section 3.0 presents the overall decommissioning schedule and milestones, including the spent fuel management activities, in a project timeline.
- Section 4.0 provides an analysis of expected decommissioning costs, including the costs associated with spent fuel management and site restoration.
- Section 5.0 describes the basis for concluding that the environmental impacts associated with decommissioning OCNGS are bounded by the NRC GEIS related to decommissioning.
- Section 6.0 provides the list of references.
- Enclosure 1: Oyster Creek Nuclear Generating Station Site-Specific Decommissioning Cost Estimate

## 2 DESCRIPTION OF PLANNED DECOMMISSIONING ACTIVITIES

HDI will contract with CDI to decommission OCNGS using the DECON method. Use of the DECON method will require HDI to manage the SNF because of the DOE's failure to perform its contractual obligation to remove SNF in a timely manner. To explain the basis for projecting the cost of managing SNF, a discussion of spent fuel management activities for the site is included herein.

To facilitate efficient transition of the plant to DECON, Exelon Generation, in coordination with HDI, will direct the activities that will facilitate transitioning to the HDI decommissioning plan. Prior to the OCNGS license transfer and asset sale closure, Exelon Generation will perform activities to permanently shutdown and defuel the reactor, and place the plant in a safe storage condition (e.g., draining fluids and de-energizing systems, and reconfiguring the electrical distribution, ventilation, heating, and fire protection systems. The initial decommissioning activities will be performed consistent with the May 21, 2018 PSDAR.

In conjunction with HDI, CDI developed the decommissioning scope, schedule, and associated cost estimate for OCNGS. CDI adopted the International Structure for Decommissioning Costing (ISDC) Work Breakdown Structure (WBS) (Reference 9) and corresponding WBS dictionary to develop the OCNGS site-specific DCE and decommissioning schedule. The ISDC, developed jointly by the Organization for Economic Cooperation and Development (OECD)/Nuclear Energy Agency (NEA), the International Atomic Energy Agency (IAEA) and the European Commission (EC); provides a method for developing standardized itemization of decommissioning costs. The ISDC WBS is a delivery-based, hierarchical structure and is identified as the international standard cost structure for nuclear facility decommissioning. The ISDC WBS is organized into eleven (11) groups. Of the eleven principal work groups, Activity 03-Additional Activities for Safe Enclosure and Entombment and Activity 09-Research and Development are not applicable to the prompt decommissioning approach planned for the OCNGS decommissioning.

The ISDC WBS is organized differently than those traditionally used for US domestic decommissioning estimates. The decommissioning activities have been organized similarly to the decommissioning costs in NRC guidance to facilitate a comparison between projected OCNGS decommissioning costs and the NRC Reference BWR decommissioning costs contained in NUREG/CR 6174, "Revised Analyses of Decommissioning for the Reference Boiling Water Reactor Power Station" (Reference 10).

For consistency with the DCE format in Regulatory Guide 1.202, "Standard Format and Content of Decommissioning Cost Estimates for Nuclear Reactors," (Reference 11) the ISDC WBS is mapped into project periods. Periods 1 through 4 are consistent with the periods described in Regulatory Guide 1.202. The four periods are Planning & Preparation, Plant Deactivation, Safe Storage Operations, and Dismantlement. Period 5 includes the costs associated with storing spent fuel and Greater Than Class C (GTCC) waste following completion of OCNGS dismantlement activities in addition to the costs of the eventual

decommissioning of the storage facility. Period 6 includes program management costs that are applicable to multiple periods but are not readily distributable into individual periods. The mapping of the ISDC WBS elements to the project periods is shown in Table 2-1.

**Table 2-1 Decommissioning Periods and WBS Elements**

| Period | Period Title | WBS Element |
|---|---|---|
| 1 | Pre-Decommissioning Planning and Preparation | 01.02.01 Pre-Decommissioning Actions |
| 2 | Plant Deactivation | 01.02.02 Facility Shutdown Activities |
| 3 | Safe Storage Operations | 01.02.10 Fuel and Nuclear Material (until fuel on pad) |
| 4 | Dismantlement | 01.02.04 Dismantling Activities Within the Radiological Controlled Area |
| | | 01.02.05 Waste Processing, Storage and Disposal |
| | | 01.02.07 Conventional Dismantling, Demolition, and Site Restoration (LTP portion only) |
| 5 | Ongoing ISFSI Operations | 01.02.10 Fuel and Nuclear Material (after fuel on pad) |
| 6 | Program Management | 01.02.06 Site Infrastructure and Operation |
| | | 01.02.08 Project Management, Engineering and Support |
| | | 01.02.11 Miscellaneous Expenditures |
| *Note:* | *WBS 01.02.03 and 01.02.09 are not used in the cost model* | |

The major decommissioning activities and the general sequence for performing the activities are discussed in more detail in the sections that follow. The project decommissioning schedule is shown in Figure 3-1.

## 2.1 Period 1 – Pre-Decommissioning Planning and Preparation

**Pre-Decommissioning Planning & Preparation (Pre-License Transfer)**
HDI and CDI are working with Exelon Generation to understand and support the OCNGS plan for permanent shutdown, reactor defueling, and preparations for safe storage of SNF. These efforts are focused on facilitating the safe, compliant, and efficient license transfer and transition to prompt radiological decommissioning (i.e., DECON) of OCNGS once the license transfer is complete.

The transition activities ensure that the decommissioning organization is fully prepared to assume the responsibilities of OCNGS decommissioning. Alignment with Exelon Generation will begin well in advance of license transfer and asset sale closure. A Transition Plan has been prepared for the transition to DECON. The plan describes the process for conducting an orderly and effective transition in alignment with the NRC license

transfers, site permits, licenses, etc. from Exelon Generation to HDI.

**Period 1 – Pre-Decommissioning Planning and Preparation Activities**
This section discusses the activities that will be performed by HDI and CDI prior to license transfer, and those that will be performed immediately following license transfer.

At the time of asset sale and license transfer, OCNGS will be in a safe storage condition. Decommissioning planning takes into account the Exelon Generation shutdown, defueling, and safe storage transition activities in determining the expected plant condition at license transfer. In the time leading up to, and immediately following the asset sale and license transfer, the following activities will be performed:

- Decommissioning planning, including finalizing the plan for transitioning to DECON.
- Procurement of services, materials, and supplies.
- Stakeholder interaction.
- Review of the Historical Site Assessment (HSA) to support the identification, categorization, and quantification of radiological, regulated, and hazardous wastes in support of waste management planning.
- Development of the decommissioning As Low as Reasonably Achievable (ALARA) budget.
- Development of a Waste Management Plan (WMP), including determination of transportation and disposal container requirements and pathways.
- Performance of safety, security, and environmental studies as required.
- Review of the OCNGS reclassification of plant SSCs.
- Reactor Vessel Internals (RVI) and Reactor Pressure Vessel (RPV) segmentation, tooling design, fabrication, and testing.
- Licensing and permitting actions necessary to reflect the defueled and permanently shut-down plant configuration.

During Period 1, planning and preparing for the prompt decontamination and dismantlement of OCNGS will begin by completing the following activities:

- Finalize the decommissioning organization, including integration of incumbent plant staff and CDI personnel. OCNGS personnel will be incorporated into the decommissioning organization according to their expertise and the position that they held within Exelon Generation. Staffing and configuration requirements are expected to change during the period of decommissioning, principally dependent upon changes in license requirements, due to changes in the status of the spent fuel being stored onsite.
- Review the established OCNGS policies, programs, and procedures for ongoing activities, and identify changes to reflect the evolving plant status during

decommissioning. The NRC requirements and functional needs for the anticipated plant conditions and DECON activities will be determined, and the procedures and programs will be evaluated for adoption, revision, replacement, or revocation using the appropriate NRC regulatory change processes. The plan is to adopt, revise, or eliminate existing OCNGS policies, programs, procedures, and work instructions, where applicable, since these documents have been used by OCNGS for operations in accordance with NRC regulations and the NRC license. As the plant status evolves due to decommissioning progress, these determinations and procedure/program evaluations and changes will periodically recur.

- Develop decommissioning Work Packages (WPs), including the radiation work permits and job hazard analyses to support the WPs. Focus will be on the earliest activities in the schedule. To get input from the labor force who will be performing the work, area walkdowns with Subject Matter Experts (SMEs) and other appropriate personnel will be performed while preparing the WPs.
- Conduct site characterization activities so that radiological, regulated, and hazardous wastes are identified, categorized, and quantified to support decommissioning and waste management planning. Surveys will be conducted to establish the contamination and radiation levels throughout the plant. This information will be used in developing procedures to ensure that hazardous, regulated, and radiologically contaminated areas are remediated, and to ensure that worker exposure is controlled.
- Establish transportation and disposal contracts.

## 2.2 Period 2 – Plant Deactivation

Many of the activities associated with termination of operations, plant stabilization, isolation, and initial inspection will be completed by Exelon Generation as described in Section 2.1.1 above. In the period between permanent reactor defueling and asset sale closure/license transfer, Exelon Generation will be executing activities to deactivate the plant. The plant deactivation activities include the following:

- Continuing operation and maintenance of the systems required to maintain the spent fuel management and safe storage within NRC regulations and facility license requirements.
- Isolating power equipment and installation of temporary power systems in preparation for decommissioning of the turbine generators.
- Removing combustibles and chemicals to permit fire protection system modifications.
- Continuing the deactivation (de-energizing and/or draining) of systems that are no longer required, and the removal of combustibles and wastes that have not been completed by Exelon Generation.

Following the asset sale closure/license transfer, deactivation activities and other activities

required to prepare the OCNGS for decommissioning will continue, as necessary.

## 2.3 Period 3 – Safe Storage Operation

Since the DECON method is chosen for OCNGS decommissioning, the activities in this period only include preparations for, and conduct of, fuel movement to an onsite dry fuel storage facility. This period concludes once the fuel has been removed from the spent fuel pool (SFP) and placed into long-term storage at the ISFSI. Safe storage operation activities include the following:

- Construction of additional dry fuel storage capacity.
- Transfer of SNF to dry storage canisters.
- Movement of fuel to long-term storage on the ISFSI.
- Operation and maintenance of the ISFSI until the all spent fuel is removed from the spent fuel pool and placed on the ISFSI.

## 2.4 Period 4 – Dismantlement

Period 4 includes the dismantling and decontamination of the plant systems and structures. The work scope described in this section concludes with the removed components packaged and placed in containers, and transported to storage, treatment, or disposal. The waste will be properly packaged, shipped and tracked until properly disposed. The prompt decommissioning strategy does not rely on decontamination or offsite processing to accomplish free release of material and focuses instead on bulk removal of material as the most expedient and cost-effective solution to decommissioning. However, decontamination activities, such as surface wipe downs will be performed, where required, to limit worker exposure.

**Asbestos Containing Material, Hazardous, and Universal Waste Removal**
Removal of all Asbestos Containing Material (ACM) is one of the first priorities. Asbestos removal is planned prior to dismantling SSCs. Work boundaries will be established and set up with containment structures, tents, glove bags, ventilation, etc., for ACM removal. Final verification survey of all facilities will be performed to ensure all ACM has been removed prior to dismantlement and decontamination.

Removal of hazardous and universal waste[1] will also be conducted prior to dismantling SSCs, as constrained by the accessibility of the waste material. The waste will be placed in

[1] Universal waste is a category of waste materials designated as "hazardous waste" but containing materials that are commonly generated by a wide variety of establishments. US Environmental Protection Agency's (EPA) universal waste regulations streamline the hazardous waste management standards for these wastes. It is identified in 40 CFR 273.9 by the US EPA and applies to four (4) specific categories of materials that can be managed as universal wastes: batteries, pesticides, mercury-containing equipment and lamps. States may have corollary regulations regarding these materials, as well as additional materials.

the proper containers for transportation to the appropriate disposal facility.

**Site Characterization**

To supplement plant historical knowledge and the OCNGS HSA, site characterization activities will be performed during the decommissioning process. The characterization will further the identification, categorization, and quantification of radiological, regulated, and hazardous wastes. Surveys will be conducted to establish the contamination and radiation levels throughout the plant. This information will be used in developing procedures to ensure that hazardous, regulated, and radiologically contaminated areas are remediated, and to ensure that worker exposure is controlled. As decontamination and dismantlement work proceeds, surveys will be conducted to maintain current site characterization, and to ensure that decommissioning activities are adjusted accordingly.

**Segmentation and Dismantling of the RVIs and RPV**

The transfer of SNF to the ISFSI is critical to keeping the project on schedule. Spent fuel will initially be stored in the SFP, inside of the reactor building. Using the existing, NRC-approved Certificate of Compliance (CoC) for the casks that will be used at OCNGS, the spent fuel can all be loaded into the dry cask system within 4.5 years of permanent shutdown. At that point, SNF will be packaged and moved to the ISFSI. Segmenting, removing and packaging the RVI and RPV is also critical to keeping the project on schedule. The RVI highly activated core grid segments are expected to generate most of the GTCC waste. The decommissioning approach is to segment the RVI and RPV in parallel with the spent fuel cooling period, to shorten the overall decommissioning schedule.

To accommodate fuel movement from the SFP to the ISFSI, the RVI and RPV segmentation will start shortly after the license transfer. Initially, the RVI highly activated core grid will be segmented and packaged into the dry storage casks used for GTCC waste. Following the completion of the RVI segmentation, the RPV will be segmented and packaged for disposal. The GTCC waste generated during segmentation activities will be placed in dry storage canisters, transported away from the reactor building and stored at the ISFSI.

**Fuel and Equipment Pool Dismantlement**

After the fuel has been removed from the SFP, and the segmentation work in the equipment pool is completed, the pool equipment and fuel pool will be removed. The pools will be inspected with underwater cameras and radiation monitors to identify any radioactive material or debris remaining after fuel movement. Remote handling tools or vacuuming will be used to remove contamination found during the inspection. If any fuel fragments are identified, a regulatory compliant process will be used to remove and store the fragments.

The fuel racks will be removed from the pool, segmented, and size-reduced for disposal as Low-Level Radioactive Waste (LLRW). The SFP liner will be segmented after the pools have been drained and decontaminated. Some generated waste may be managed as GTCC waste. If this is the case, the waste will be placed in a dry storage cask, transported from the area, and stored on the ISFSI.

**Large Component Dismantlement**

The WPs developed in Period 1 will be used to remove the large components and the plant systems by building or area, to avoid impacting other critical path work. Access limitations, crane availability, and radiological conditions will drive the technology used for cutting and segmenting components and piping. Systems and/or components will be breached, air gapped, and purged to eliminate liquid waste prior to segmenting. While many large components are expected to be radiologically contaminated, they are not expected to require pre-dismantling decontamination. Spray fixative on components, or openings of piping will be capped to control contamination. Depending on the contamination levels and configuration of the segmented large components, the segments will be loaded in an appropriate shipping container, or the component will be sent for disposal as its own package with suitable wrapping or capping.

The turbines, main condenser, moisture separator reheaters, feedwater pumps and heaters, and steam and feedwater piping will be removed from the Turbine Building and segmented in a radiologically controlled area or removed intact and shipped offsite for disposal. The generator is not part of the contaminated steam system and can be removed whole for recycling or reuse.

The primary loop large components, including the recirculation pumps and piping, drywell cooling units, steam and feedwater piping, and segmented sections of the torus will be removed from the Reactor Building.

The auxiliary plant boilers, caustic and acid storage tanks, and the diesel generators will be removed from the auxiliary buildings.

**Radioactive Waste Management**

A major component of the decommissioning work scope for OCNGS is the packaging, transportation, and disposing of contaminated/activated equipment, piping, concrete, and soil. The WMP developed in Period 1 will incorporate the most cost-effective disposal strategy, consistent with regulatory requirements and disposal/processing options for each waste type. Characterization will be performed with systems and components in place to determine the waste classification, maximizing the use of non-destructive assay techniques, and direct instrumentation readings correlated with hard analytical data gathered via direct smears and sampling. OCNGS decommissioning will include a number of discrete waste stream profiles and a range of shipping packages. A range of reusable and single use containers will be used, and some items will be transported as sealed components without containerization (they become their own packaging).

Most waste will meet Class A, Low Specific Activity (LSA), or Surface Contaminated Object (SCO) definitions. LLRW will be managed in accordance with the site approved WMP and commercial disposal facility requirements. This includes characterizing contaminated materials, packaging, transporting, and disposal at a licensed LLRW disposal facility.

The guidance in NUREG-2155, "Implementation Guidance for Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material" (Reference 13) will be used for radioactive material that meet the form, concentration and quantity-of-concern criteria in 10 CFR 37, "Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material."

To ensure flexibility of disposal options, LLRW will be processed, packaged, and certified to meet the respective Waste Acceptance Criteria (WAC) for multiple Treatment, Storage and Disposal Facilities (TSDFs). The OCNGS is within the Atlantic Compact that provides access to the disposal site in Barnwell. The Barnwell facility will be the primary disposal option unless overall cost (packaging, transport, and disposal) are higher than out of compact options. If costs are favorable, the Energy Solutions facility in Clive Utah and Waste Control Specialists (WCS) facility in Andrews, TX could be used for waste disposal.

In most cases, waste will be prepared to meet acceptance requirements for multiple TSDFs. If a new or more efficient TSDF path emerges over the course of the project, a new profile for that option will be developed and technical guidance will be provided to the generator for the use of the new disposal path. Disposal of LLRW will be performed in accordance with applicable local, state, and federal regulations. In some cases, special approvals may be required prior to the selection and use of a specific disposal facility.

OCEP and HDI will decide whether or not to novate disposal contracts that are currently in place with Exelon Generation, including the "life of plant" agreements for disposal of LLRW, but will also seek bids from the alternative disposal facilities to obtain optimum disposal terms. A cost benefit analyses will also be performed to determine if the use of an existing Resource Conservation and Recovery Act licensed disposal facility with a OCNGS sponsored 10 CFR 20.2002 waste authorization is a cost effective option for Very Low-Level Waste.

**Waste Transportation**

The schedule and cost estimate assume a transportation approach for Class A, LSA, or SCO classes of waste using a combination of truck and rail to support bulk quantity removal of waste. Since there is no active rail at OCNGS, a truck will be used to deliver the waste to a transload facility. The waste transportation process will be fully defined in the WMP to include the number of shipments, the disposal facilities and applicable requirements. As discussed earlier, HDI may elect to ship large plant components by barge.

**Removal of Mixed Wastes**

Low-Level Mixed Waste (LLMW) generation will be minimized through appropriate characterization, as well as the demolition techniques employed. If mixed wastes are generated, they will be managed in accordance with applicable federal and state regulations. Mixed wastes from OCNGS will be transported by authorized and licensed transporters and shipped to authorized and licensed facilities.

**License Termination including Final Status Surveys**

In accordance with the requirements of 10 CFR 50.82(a)(9), an LTP will be submitted to the NRC at least two (2) years prior to the anticipated date of partial site release (i.e., amendment of the facility license to eliminate the site, except for the ISFSI). That plan will include the following: a site characterization, a description of the remaining dismantling/removal activities, plans for remediation of remaining radioactive materials, developed site-specific Derived Concentration Guideline Levels (DCGLs), plans for the Final Status (radiation) Survey (FSS), site end use designation, an updated cost estimate to complete the decommissioning, and associated environmental concerns.

The NRC-approved LTP will be used to perform the FSS, which will demonstrate that the remediated portion of the site (excluding the ISFSI containing the spent fuel and GTCC waste) can be released for unrestricted use and removed from the license. The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) protocol will be used to demonstrate that the site release criteria have been met. The license will be amended to limit the NRC facility license to the onsite ISFSI.

**Site Restoration**

During demolition, above-ground structures will be removed to a nominal depth of three (3) feet below the surrounding grade level. Characterization surveys would then be performed in the remainder of the below ground structure and any hot spots above the established DCGL would be removed. Final Status Surveys including NRC verification surveys, will be conducted. Once NRC approves the Final Status Surveys, the affected areas would then be backfilled with suitable fill materials, graded, and appropriate erosion controls established. Site restoration activities will begin in non-radiological areas after demolition of buildings and structures outside the radiological controlled area. Final site restoration will be completed after ISFSI decommissioning and demolition is completed.

## 2.5 Period 5 – Ongoing ISFSI Operations

Expansion of existing dry fuel storage capacity is planned to allow for dry storage of all spent fuel and GTCC waste. Spent fuel and GTCC waste will remain on the ISFSI until it is transferred to the DOE. The ISFSI will be staffed by a security force. In addition, personnel will be assigned to maintain the ISFSI and comply with the ISFSI license commitments. Fuel and GTCC waste shipping will be performed when repositories for this type of waste are developed by the DOE or other disposal options are available. No more than five (5) GTCC canisters are estimated to be required for decommissioning activities. Following the removal of the spent fuel and GTCC waste, the ISFSI site will be decommissioned, remediated, and surveyed per the NRC-approved LTP. Following FSS and NRC approval, license termination will occur.

## 2.6 Program Management

Program management costs include infrastructure and operation, management, and fees that are applicable to decommissioning Periods 1 through 4. These costs include the following:

- Site infrastructure and operation costs, including security, maintenance, site upkeep, operation of support systems, and environmental monitoring.
- Project management, engineering, and support including the core management group, scheduling and cost control, quality assurance, health and safety, records management, general administration and accounting, warehousing, engineering, regulatory, and support services.
- Regulatory fees, taxes, and insurance.

## 2.7 Changes to Management and Staffing

Following license transfer and asset sale, the OCNGS management team will be comprised of HDI and CDI personnel. CDI will be staffed with Holtec, Atkins and SNC-Lavalin personnel. In addition, CDI staffing will include Exelon Generation Oyster Creek Decommissioning Organization incumbent staff who, at license transfer, will be integrated into the CDI decommissioning organization in a manner consistent with their expertise and previous positions as part of Exelon Generation's Oyster Creek Decommissioning Organization. CDI's team of experts along with incumbent personnel retained from the plant will form a seamless organization operating under a common set of processes and procedures. This includes OCNGS personnel who transfer to CDI upon closure of the sale. Additionally, corporate support from Holtec, SNC-Lavalin and/or Atkins will be provided in areas such as legal, financial reporting systems, IT, procurement, and human resources.

The number of site personnel will vary throughout the life of the project, with increased or decreased staffing levels required as decommissioning activities ramp up or down, or as requirements for security and emergency planning are reduced. The staffing projections after license transfer and asset sale closure are described in Section 3 of the Enclosure 1 (revised site-specific DCE) of this PSDAR.

# 3 SCHEDULE OF PLANNED DECOMMISSIONING ACTIVITIES

## 3.1 Oyster Creek License Transfer and Asset Sale Schedule

As discussed in Sections 1 and 2 of this DECON PSDAR, Exelon Generation, OCEP and HDI are preparing for the OCNGS license transfer and closure of the asset sale on or before July 1, 2019. The purpose of this transaction is to enable the prompt and cost-effective decommissioning of OCNGS. Once the license transfer and asset sale are complete, the decommissioning of OCNGS utilizing the DECON method will commence. The following milestones support the planned asset sale agreement closure and license transfer:

August 31, 2018: The jointly prepared LTA submitted

September 17, 2018: Permanent shutdown

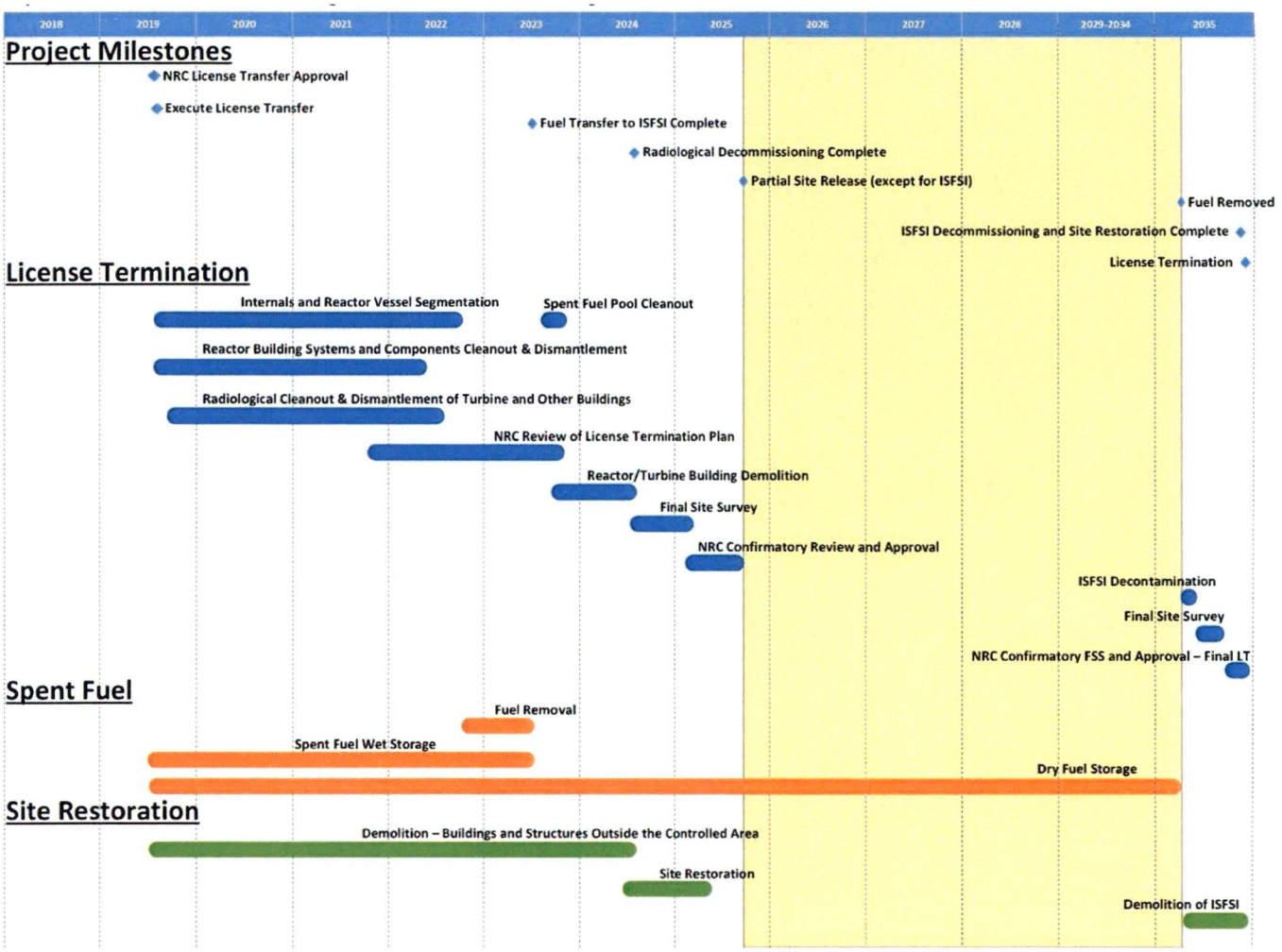
May 1, 2019: Target LTA approval date by the NRC

July 1, 2019: Asset sale closure/license transfer

## 3.2 Oyster Creek Decommissioning Schedule

Figure 3-1 OCNGS Decommissioning Schedule, provides a project timeline that presents the schedule and milestones for decommissioning, spent fuel management, including removal from the spent fuel pool to the ISFSI and spent fuel removal from the site. The timeline also depicts key licensing milestones. The schedule depicted begins on the date that the asset sale closure and license transfer are executed, and ends following ISFSI decommissioning and final license termination. The dates for the listed milestones assume execution of the license transfer and closing on the asset sale agreement by July 1, 2019.

## Figure 3-1 OCNGS Decommissioning Schedule



# 4 ESTIMATE OF EXPECTED DECOMMISSIONING AND SPENT FUEL MANAGEMENT COSTS

On December 30, 2014, Exelon Generation submitted a preliminary Decommissioning Cost Estimate (DCE) for OCNGS (Reference 12). The OCNGS DCE was based on data that was originally developed in 2011. An updated OCNGS DCE was submitted on March 30, 2016 (Reference 2), which included the site-specific projected costs of radiological decommissioning, managing spent fuel, and site restoration for the DECON, Delayed DECON and SAFSTOR scenarios.

Enclosure 1 includes a revised site-specific DECON DCE for the decommissioning of OCNGS. The site-specific DECON DCE is included as an enclosure to this PSDAR, as required by 10 CFR 50.82(a)(4)(i).

Costs in the revised site-specific DCE were determined based on the selection of the DECON method for decommissioning OCNGS. The attached cost estimate and schedule was prepared using several sources including the following:

- Information compiled by HDI and CDI during an extensive due diligence period.
- Submittal of Updated Decommissioning Cost Analysis for Oyster Creek Nuclear Generation Station," March 30, 2016 (Reference 2).
- Input and professional judgment of experienced specialty subcontractors and SMEs.

The revised site-specific DCE is based on regulatory requirements, site conditions, basis of estimate assumptions, LLRW disposal standards, high-level radioactive waste management options, and site restoration requirements. The methods utilized to estimate decommissioning costs were based on the professional judgment of the experienced SMEs, considering the nature of the work, degree of scope definition, availability of quantifiable cost and pricing data, among other factors. The decommissioning costs in the revised site-specific DCE are reported in 2018 dollars. Escalation of future decommissioning costs over the remaining decommissioning project life-cycle are excluded.

The detailed decommissioning project schedule is used as the foundation for developing the DCE model and the risk model. The schedule baseline is a detailed Critical Path Method schedule developed with input from the key decommissioning subcontractors and SMEs. The schedule and cost estimate are based on the ISDC WBS and corresponding WBS dictionary.

The revised site-specific DCE for decommissioning OCNGS demonstrates that adequate funding is available in the Nuclear Decommissioning Trust (NDT) fund to complete radiological decommissioning and license termination. In addition to the license termination costs, site restoration, and spent nuclear fuel management costs are included in this estimate; however, pursuant to regulatory requirements, the non-license termination cost estimates are segregated and listed separately.

The cost to decommission the site, safeguard the spent fuel until it can be transferred to the DOE, and restore the impacted area of the site is estimated to be $885 million in 2018 dollars. The summary of the costs estimated for License Termination, Spent Fuel Management, and Site Restoration activities are presented below.

**Table 4-1 OCNGS Decommissioning DECON Option Cost Summary**
(thousands of 2018 dollars)

| Cost Category | License Termination | Spent Fuel | Site Restoration | Total |
|---|---|---|---|---|
| Decontamination | N/A | N/A | N/A | N/A |
| Removal | 162,045 | | 17,157 | 179,202 |
| Packaging | 20,608 | | | 20,608 |
| Transportation | 30,498 | | 1,242 | 31,740 |
| Disposal | 143,646 | | 14,985 | 158,631 |
| Off-site Waste Processing | N/A | N/A | N/A | N/A |
| Program Management | 150,808 | 13,569 | 4,395 | 168,772 |
| Corporate A&G | N/A | N/A | N/A | N/A |
| Spent Fuel | | 201,474 | | 201,474 |
| Insurance and Regulatory Fees | 36,726 | 1,133 | 349 | 38,208 |
| Energy | 19,726 | 3,189 | 1,163 | 24,078 |
| Characterization and Licensing Surveys | 6,770 | | | 6,770 |
| Property Taxes | 27,503 | 6,441 | 2,074 | 36,018 |
| Miscellaneous Equipment/Site Services | 19,502 | | | 19,502 |
| Spent Fuel Pool Isolation | N/A | N/A | N/A | N/A |
| **Grand Total** | **617,832** | **225,807** | **41,365** | **885,004** |

# 5 ENVIRONMENTAL IMPACTS

## 5.1 Environmental Impact of OCNGS Decommissioning

HDI has concluded that the environmental impacts associated with planned OCNGS site-specific decommissioning activities are less than and bounded by the previously issued environmental impact statements. 10 CFR 50.82(a)(4)(i) requires that the PSDAR include, " ... a discussion that provides the reasons for concluding that the environmental impacts associated with site-specific decommissioning activities will be bounded by appropriate previously issued environmental impact statements." The following discussion provides the reasons for reaching this conclusion and is based on the previously issued environmental impact statements:

1. NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors" (herein referred to as the GEIS) (Reference 8).
2. NUREG-1496, "Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities" (Reference 14)
3. NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 28, Regarding Oyster Creek Nuclear Generating Station, January 2007 (herein referred to as the SEIS) (Reference 15).
4. NUREG-1437, Revision 1, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, June 2013 (herein referred to as the SEIS, Revision 1) (Reference 16).
5. Final Environmental Statement Related to the Operation of Oyster Creek Nuclear Generating Station Unit 1, Atomic Energy Commission, December 1974 (herein referred to as the OL-FES) (Reference 17).

In evaluating whether the impacts in these previously issued environmental impact statements are bounding, information from evaluations presented in the reports listed below was also considered.

- Applicant's Environmental Report – Operating License Renewal Stage – Oyster Creek Generating Station AmerGen 2005 (herein referred to as the Applicant's Environmental Report) (Reference 18).
- Environmental Report, Post-Shutdown Decommissioning Activities Report, Oyster Creek Nuclear Generating Station, dated April 18, 2018 (herein referred to as the Updated Environmental Report) (Reference 19).
- Post Shutdown Decommissioning Activities Report, Oyster Creek Generating Station, dated May 21, 2018 (herein referred to as the Exelon SAFSTOR

PSDAR) (Reference 1).

- Response to Request for Additional Information for Post Shutdown Decommissioning Activities Report, dated September 24, 2018 (herein referred to as the Exelon Generation PSDAR RAI response) (Reference 6).

### 5.1.1 Onsite/Offsite Land Use

The NRC concluded in the GEIS (Reference 8) that the experience of plants being decommissioned has not included any need for additional land offsite. Consistent with this determination, OCNGS does not anticipate any changes in land use beyond the site boundary during decommissioning.

#### 5.1.1.1 Onsite Land Use

OCNGS has sufficient previously disturbed area onsite (due to construction or operations activities) for use during decommissioning. This operational area consists of the plant area west of U.S. Highway 9 including the intake and discharge canals and the intake and discharge structures identified in the Updated Environmental Report (Reference 19).

HDI may elect to ship large plant components by barge using a landing on the north bank of Oyster Creek immediately east of U.S. Highway 9. This shoreline was used during plant construction for delivery of the reactor pressure vessel and has continued to be used during operations for large component delivery. The barge landing is located on Exelon Generation owned property. The barge landing would be reached by traversing the short distance from the OCNGS plant area across Barnegat Branch Trail and U.S. Highway 9. There is no permanently installed equipment / infrastructure at the barge landing site, or along the pathway proposed for the movement of large components to and from the plant, and none is anticipated to be needed to support decommissioning. This land use would be for a short duration.

As addressed in the Exelon Generation PSDAR RAI Response (Reference 6) and in Figure 3.4 of the OL-FES (Reference 17), the area within the OCNGS site boundary disturbed by original construction included the barge landing area. The area that would be used for moving large plant components during decommissioning from the OCNGS power block to the barge landing was used during original construction for similar activities. This area was used during the transport of the reactor pressure vessel to the site more than 50 years ago, and has been used, as needed, during the removal and delivery of other large components since then.

If HDI elects to utilize barge transportation, the associated decommissioning activities at OCNGS would utilize an existing barge landing previously used during plant construction and operation therefore there would be no changes to land use patterns. Furthermore, the transfer of large plant components to the barge landing would cause only temporary and short duration disturbance to land that has been previously disturbed for similar purposes.

Stormwater discharges from the site are currently regulated by existing New Jersey Pollutant Discharge Elimination System (NJPDES) Permit No. NJ00005550 (Reference 20), and any construction activities that would disturb one acre or greater of soil not covered by the existing permit would require a stormwater permit from the New Jersey Department of Environmental Protection (NJDEP) prior to proceeding with the activity. The NJPDES permit, and any NJDEP stormwater permit contain best management practices (BMPs) to control sediment and erosion effect on water courses and wetlands.

HDI concludes that the impacts of OCNGS decommissioning on onsite land use are bounded by the GEIS.

#### 5.1.1.2 Offsite Land Use

Section 4.3.1 of the GEIS (Reference 8) concluded that the impacts on land are not detectable or destabilizing, and are small for facilities having only onsite land use changes resulting from large component removal, structure dismantlement, and LLRW packaging and storage. These decommissioning activities will be conducted on previously disturbed land within the site boundary.

The NRC concluded in the GEIS that the experience of plants being decommissioned has not included any needs for additional land offsite. Consistent with this determination, HDI does not anticipate any changes in land use beyond the site boundary during decommissioning.

If HDI elects to use barge transportation it is anticipated that dredging between the barge landing and Barnegat Bay could be required to provide enough depth for barge navigation. If dredging is necessary, it will be conducted under U.S. Army Corps of Engineers (USACE) and appropriate NJDEP Division of Land Use Regulation permits.

HDI concludes that the impacts of OCNGS decommissioning on offsite land use are bounded by the GEIS.

### 5.1.2 Water Use

After plant shutdown, the operational demand for once-through cooling water and makeup water will be dramatically decreased. The amount of water used by the service water system after shutdown will also be reduced. The need for cooling water will continue to decrease as the heat load of spent fuel in the SFP declines due to radioactive decay, and as spent fuel is relocated from the SFP to the ISFSI.

After plant shutdown, the use of potable water will decrease commensurate with the expected decrease in plant staffing levels. For these reasons, Section 4.3.2 of the GEIS (Reference 8) concluded that water use at decommissioning nuclear reactor facilities is significantly smaller than water use during operation.

The GEIS also concluded that water use during the decontamination and dismantlement phase will be greater than that during the storage phase. There are no anticipated unique

water uses associated with the decommissioning of OCNGS that are not addressed by the evaluation of the reference facility in the GEIS.

Therefore, HDI concludes that the impacts of OCNGS decommissioning on water use are bounded by the GEIS.

### 5.1.3 Water Quality (Non-Radiological)

During the DECON planning and defueling periods, stormwater runoff and drainage paths will be maintained in their current configuration. Regulatory mandated programs and processes designed to minimize, detect, and contain spills will be maintained throughout the decommissioning process. Federal, state, and local regulations and permits pertaining to water quality will also remain in effect.

OCNGS will continue to receive potable water from the on-site ground water well(s).

Industrial and a minor fraction of site stormwater discharges to surface water from the facility are subject to the terms and conditions of the existing NJPDES permit (Reference 20). The remaining stormwater discharges are covered by an NJDEP general stormwater permit. Areas of one acre or more disturbed during decommissioning that are not covered by the existing permits will require new stormwater permits from the NJDEP. In addition to the specific permit requirements, selection and implementation of BMPs for stormwater that may be generated from areas disturbed by decommissioning activities is also required.

Sanitary waste water generated at the site is currently discharged to Lacey Township Municipal Utilities Authority and will continue to be discharged to this facility. As decommissioning proceeds, management of sanitary wastewater may be transitioned to temporary, contained onsite facilities with transport of the sanitary waste to offsite facilities permitted to receive, treat and dispose of the wastes.

During decommissioning, OCNGS will comply with applicable regulations requiring reporting of hazardous materials spills, and reasonable precautions will be taken to prevent or mitigate spills of hazardous materials.

New Jersey's Site Remediation Program oversees the ongoing remediation and monitoring systems at OCNGS. Remedial activities needed to meet Industrial Sites Recovery Act (ISRA) requirements will be completed in a timely manner in consultation with NJDEP. Reductions in groundwater use during decommissioning are not expected to alter groundwater flow paths or otherwise affect ongoing remedial activities.

The OCNGS circulating water intake structure and dilution water intake structure may be removed. Demolition of OCNGS structures and buildings, and related earth-moving work (digging, grading, filling), has at least a limited potential to result in erosion and sedimentation that could affect water quality, but these kinds of construction activities routinely take place around operating nuclear power plants and are subject to the provisions of state-issued, and as applicable federal, permits and appropriate BMPs.

Barging large plant components from OCNGS to Barnegat Bay and beyond may require dredging in portions of Oyster Creek between the barge landing and Barnegat Bay. It may also be necessary to dredge in Barnegat Bay to allow passage of loaded barges between the mouth of Oyster Creek and Barnegat Inlet. Dredging, if conducted, will be implemented in accordance with applicable federal, state and local permits, and required certifications, including a water quality certification and use of applicable BMPs. The NRC concluded in the final SEIS, Revision 1 (Reference 16) that the impact of dredging to remove accumulated sediments in the vicinity of intake and discharge structures and to maintain barge shipping has not being found to be a problem for surface water quality.

The GEIS (Reference 8) concludes that the impacts of decommissioning on non-radioactive aspects of water quality are small and will be neither detectable nor destabilizing. The SEIS (Reference 15) found that that there would be no impacts on water quality associated with OCNGS decommissioning beyond those discussed in the GEIS.

Therefore, HDI concludes that the impacts of OCNGS decommissioning on water quality are bounded by the GEIS.

### 5.1.4 Air Quality

There are many types of decommissioning activities listed in Section 4.3.4 of the GEIS (Reference 8) that have the potential to affect non-radiological air quality. For those activities applicable to the DECON method, OCNGS does not anticipate any activities beyond those listed in the GEIS that could potentially affect air quality. HDI will maintain existing air permits for equipment that will be used during OCNGS decommissioning. Federal, state, and local regulations pertaining to air quality will remain in effect to regulate emissions associated with fugitive dust, criteria air pollutants, hazardous air pollutants, and ozone depleting gases.

The GEIS concluded that air quality impacts associated with decommissioning are small. The SEIS (Reference 15) found that there would be no impacts on air quality associated with OCNGS decommissioning beyond those discussed in the GEIS.

Therefore, HDI concludes that the impacts of OCNGS decommissioning on air quality are bounded by the GEIS.

### 5.1.5 Aquatic Ecology

Aquatic ecology encompasses the plants and animals in the intake and discharge canals, the South Branch of the Forked River and Barnegat Bay. Aquatic ecology also includes the interaction of those organisms with each other and the environment. Section 4.3.5 of the GEIS (Reference 8) evaluates both the direct and indirect impacts from decommissioning on aquatic ecology.

Direct impacts can result from activities such as the removal of shoreline structures or the active dredging of canals. OCNGS's shoreline structures are similar to those present at the

plants listed in Table E-2 of the GEIS, and there are no apparent discriminators based on the salient characteristics (size and location) listed in Table E-5 of the GEIS.

Removal or abandonment in place of the intake and discharge structures and other shoreline structures will be conducted in accordance with BMPs defined in permits issued by the NJDEP and, as needed, the USACE. The NRC concluded in Section 4.3.5 of the GEIS that aquatic impacts from decommissioning activities within the operational areas of nuclear power plants would be small.

Moving large plant components from the OCNGS power block area to the barge landing, if conducted, will likely involve heavy equipment, but any ground disturbance would be minor and of relatively brief duration. Any impact on aquatic organisms from soil disturbance would be correspondingly minor. BMPs would be employed, as necessary, to limit erosion and sedimentation.

As addressed in the Exelon Generation PSDAR RAI Response (Reference 6) the area within the OCNGS site boundary disturbed by original construction includes the barge landing. The area proposed for moving large plant components during decommissioning from the OCNGS power block to the barge landing was used during original construction for similar activities. This area was used during the transport of the reactor pressure vessel to the site more than 50 years ago, and has been used, as needed, during the removal and delivery of other large components since then. Impacts of the original construction activities on aquatic resources are described in Section 4.3.2 of the OL-FES (Reference 17). The impacts included the effects of erosion and siltation on the aquatic environment within the original OCNGS site boundary.

Abandonment of the intake and discharge facilities and other shoreline structures (as needed), and use of the barge landing, including dredging if needed, will be conducted in accordance with BMPs defined in permits issued by the NJDEP and USACE. The NRC concluded in the SEIS Revision 1 (Reference 16) that the impact of dredging on aquatic resources would be small because dredging occurs infrequently over a relatively short duration and affects relatively small areas.

As described in Section 5.1.2, the amount of cooling water withdrawn from the intake canal will dramatically decrease after the plant is shutdown and defueled, thus reducing the potential impacts from impingement and entrainment of aquatic species during the period when spent fuel continues to be stored in the SFP and reducing the potential for thermal impacts. After transfer of the spent fuel to the ISFSI, the amount of water withdrawn will continue at a further reduced flow rate as needed to support remaining decommissioning activities.

Any significant potential for sediment runoff or erosion on disturbed areas will be controlled in accordance with BMPs outlined in the current NJPDES permit (Reference 20), the existing NJDEP stormwater permit or new stormwater permits obtained from the NJDEP.

The GEIS (Reference 8) concludes that for decommissioning activities that do not disturb lands beyond operational areas the effects on aquatic ecology are not detectable or destabilizing, and that effects on aquatic ecology related to use of a barge loading area and dredging for barge navigation are small.

The SEIS (Reference 15) found that there would be no impacts on ecological resources associated with decommissioning beyond those discussed in the GEIS.

Therefore, HDI concludes that the impacts of OCNGS decommissioning on aquatic ecology are bounded by the GEIS.

### 5.1.6 Terrestrial Ecology

Terrestrial ecology considers the plants and animals near OCNGS, as well as the interaction of those organisms with each other and the environment. Evaluations of impacts to terrestrial ecology are usually directed at important habitats and species, including plant and animals that are important to industry, recreational activities, the area ecosystems, and those protected by endangered species regulations and legislation. Section 4.3.6 of the GEIS (Reference 8) evaluates the potential impacts from both direct and indirect disturbance of terrestrial ecology.

Direct impacts can result from activities such as clearing native vegetation or filling a wetland. HDI does not anticipate disturbing habitat beyond the operational areas of the plant. All dismantlement, demolition, and waste staging activities are envisioned to be conducted within the operational area of the site. Also, the NJDEP controls significant impacts to the environment through regulation of construction activities.

Indirect impacts may result from effects such as erosional runoff, dust or noise. Any construction activities that would disturb one acre or greater of soil would be subject to an existing or new stormwater permit from the NJDEP prior to proceeding with the activity. The stormwater permit would contain BMPs to control sediment and the effects of erosion associated with the construction activity. Fugitive dust emissions will be controlled through the judicial use of water spraying. The basis for concluding that the environmental impacts of noise are bounded by the GEIS is discussed in Section 5.1.16 below.

Prior to station construction, the operational area consisted primarily of pitch pine-scrub oak woodlands and freshwater wetlands. Most of the native vegetation was removed during construction, and most of the site's wetlands were drained and filled. Only scattered patches of low-quality wildlife habitat remained onsite after the station was built. Over time, the areas north and south of the power block area recovered (some as a result of active restoration / revegetation efforts, some as a result of natural successional changes), and they now support habitats including open grassland / meadow, cedar / conifer forest, pitch pine-scrub oak forest, and freshwater wetland. Although these habitats support a variety of disturbance-tolerant wildlife species, their value as wildlife habitat is reduced by the fact that they are ringed by industrial canals, bordered to the east by a busy highway, and exposed to human activity and noise from the station.

Section 4.3.6 of the GEIS concludes that if BMPs are used to control indirect disturbances and habitat disturbance is limited to operational areas, the potential impacts to terrestrial ecology are small. As discussed above, there are no unique disturbances to the terrestrial ecology anticipated during the decommissioning of OCNGS. Accordingly, HDI concludes that impacts of decommissioning activities within the OCNGS operational area would be small.

The barge landing on the north bank of Oyster Creek may be used to transfer large plant components to barges during decommissioning. As explained in the Exelon Generation PSDAR RAI Response (Reference 6) the area within the OCNGS site boundary disturbed by original construction included the barge landing area, which was used during original construction for similar activities. It was used during transport of the reactor pressure vessel to the site more than 50 years ago, and it has been used as needed during removal and delivery of other large plant components since then. Impacts of original construction activities on terrestrial resources are described in Section 4.3.1 of the OL-FES (Reference 17). Any transfer of a large plant components during decommissioning would be of short duration and would have minimal impact on terrestrial resources because the components will be transported across a heavy-industrial area, a highway, and a previously-disturbed area that contains no unusual, rare, or sensitive plants or animals, and no important or sensitive habitats. Because no high-value terrestrial habitats will be disturbed, impacts are expected to be small and should not require mitigation beyond routine construction BMPs.

The SEIS (Reference 15) found that there would be no impacts on ecological resources associated with decommissioning beyond those discussed in the GEIS. Therefore, HDI concludes that the impacts of OCNGS decommissioning on terrestrial ecology, including those outside of the operational area, are small and bounded by the GEIS and OL-FES.

### 5.1.7 Threatened and Endangered Species

Section 4.3.7 of the GEIS (Reference 8) does not make a generic determination on the impact of decommissioning on threatened and endangered species, and it concludes that the adverse impacts and associated significance of the impacts must be determined on a site-specific basis. The NRC noted in the GEIS that impacts to threatened and endangered species are expected to be minor and nondetectable if decommissioning activities are confined to site operational areas.

Table 5.1 identifies state and federally listed species potentially occurring in the vicinity of OCNGS based on site-specific assessments conducted in support of license renewal (2005-2007), information Exelon submitted to the Wildlife Habitat Council in 2015, the Ocean County rare plant list (dated March 2014) that is posted on the New Jersey Natural Heritage Program (NJNHP) website, and the profiles of federally listed species on the website of the New Jersey Field Office of the U.S. Fish and Wildlife Service (FWS). Table 5.1 was updated in the Updated Environmental Report (Reference 19), and confirmed to be current by comparing the information in Table 5.1 with information

available on the NJNHP and FWS websites for the OCNGS area (Ocean County) in June 2018.

## Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of OCNGS

| Scientific Name | Common Name | Federal Status[1a] | State Status[1b] |
|---|---|---|---|
| **Vascular plant** | | | |
| *Amaranthus pumilus* | Seabeach Amaranth | LT | E |
| *Arnoglossum atriplicifolium* | Pale Indian Plantain | | E |
| *Aster radula* | Low Rough Aster | | E |
| *Cardamine longii* | Long's Bittercress | | E |
| *Cirsium virginianum* | Virginia Thistle | | E |
| *Clitoria mariana* | Butterfly-pea | | E |
| *Corema conradii* | Broom Crowberry | | E |
| *Cyperus pseudovegetus* | Marsh Flat Sedge | | E |
| *Desmodium pauciflorum* | Few-flower Tick-trefoil | | E |
| *Diodia virginiana var. virginiana* | Larger Buttonweed | | E |
| *Eleocharis tortilis* | Twisted Spike-rush | | E |
| *Eriophorum tenellum* | Rough Cotton-grass | | E |
| *Eupatorium resinosum* | Pine Barren Boneset | | E |
| *Fraxinus profunda* | Pumpkin Ash | | E |
| *Galactia volubilis* | Downy Milk-pea | | E |
| *Gnaphalium helleri var. macradenium* | Small Everlasting | | E |
| *Helonias bullata* | Swamp-pink | LT | E |
| *Honckenya peploides var. robusta* | Seabeach Sandwort | | E |
| *Hottonia inflata* | Featherfoil | | E |

**Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of OCNGS**

| Scientific Name | Common Name | Federal Status[1a] | State Status[1b] |
|---|---|---|---|
| *Jeffersonia diphylla* | Twinleaf | | E |
| *Juncus caesariensis* | New Jersey Rush | | E |
| *Juncus torreyi* | Torrey's Rush | | E |
| *Kyllinga pumila* | Low Spike Sedge | | E |
| *Limosella australis* | Awl-leaf Mudwort | | E |
| *Linum intercursum* | Sandplain Flax | | E |
| *Luzula acuminata var. acuminata* | Hairy Wood-rush | | E |
| *Malaxis unifolia* | Green Adder's-mouth | | E |
| *Melanthium virginicum* | Virginia Bunchflower | | E |
| *Myriophyllum tenellum* | Slender Water-milfoil | | E |
| *Myriophyllum verticillatum* | Whorled Water-milfoil | | E |
| *Narthecium americanum* | Bog Asphodel | | E |
| *Nuphar lutea ssp. pumila* | Small Yellow Pond-lily | | E |
| *Onosmodium virginianum* | Virginia False-gromwell | | E |
| *Plantago pusilla* | Dwarf Plantain | | E |
| *Polygonum glaucum* | Sea-beach Knotweed | | E |
| *Ranunculus cymbalaria* | Seaside Buttercup | | E |
| *Rhynchospora knieskernii* | Kneiskem's Beaked-rush | | E |
| *Rhynchospora microcephalia* | Small-head Beaked-rush | | E |
| *Rhynchospora recognita* | Coarse Grass-like Beaked-rush | | E |

## Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of OCNGS

| Scientific Name | Common Name | Federal Status[1a] | State Status[1b] |
|---|---|---|---|
| *Rumex hastatulus* | Engelmann's Sorrel | | E |
| *Sagittaria teres* | Slender Arrowhead | | E |
| *Schoenoplectus maritimus* | Saltmarsh Bulrush | | E |
| *Schwalbea americana* | Chaffseed | LE | E |
| *Scirpus longii* | Long's Woolgrass | | E |
| *Spiranthes laciniata* | Lace-lip Ladies'-tresses | | E |
| *Stylisma pickeringii var. pickeringii* | Pickering's Morning-glory | | E |
| *Tridens flavus var. chapmanii* | Chapman's Redtop | | E |
| *Triglochin maritima* | Seaside Arrow-grass | | E |
| *Utricularia biflora* | Two-flower Bladderwort | | E |
| *Utricularia minor* | Lesser Bladderwort | | E |
| *Utricularia resupinata* | Reversed Bladderwort | | E |
| *Uvularia puberula var. nitida* | Pine Barren Bellwort | | E |
| *Valerianella radiata* | Beaked Cornsalad | | E |
| *Verbena simplex* | Narrow-leaf Vervain | | E |
| *Xyris Fimbriata* | Fringed Yellow-eyed-grass | | E |
| *Zigadenus leimanthoides* | Death-camus | | E |
| **Invertebrates** | | | |
| *Cincindela d. dorsalis* | Beetle, Northeastern beach tiger | LT | E |
| *Nicrophorus americanus* | Beetle, American burying | LE[1] | E |

**Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of OCNGS**

| Scientific Name | Common Name | Federal Status[1a] | State Status[1b] |
|---|---|---|---|
| **Fish** | | | |
| *Acipenser oxyrinchus oxyrinchus* | Sturgeon, Atlantic | LE[2] | E |
| *Acipenser brevirostrum* | Sturgeon, shortnose | LE | E |
| **Amphibians** | | | |
| *Ambystoma tigrinum* | Salamander, Eastern tiger | | E |
| *Hyla andersonii* | Treefrog, Pine Barrens | | T |
| *Hyla chrysocelis* | Treefrog, Southern gray | | E |
| **Reptiles** | | | |
| *Caretta caretta* | Loggerhead, Atlantic | | E |
| *Chelonia mydas* | Turtle, green | LT | T |
| *Clemmys muhlenbergii* | Turtle, bog | LE | E |
| *Crotalus h. horridus* | Rattlesnake, timber | | E |
| *Dermochelys coriacea* | Leatherback, Atlantic | LE | E |
| *Elaphe g. guttata* | Snake, corn | | E |
| *Eretmochelys imbricata* | Hawksbill, Atlantic | LE | E |
| *Glyptemys insculpta* | Turtle, wood | | T |
| *Lepidochelys kempii* | Ridley, Kemp's | LE | E |
| *Pituophis m. melanoleucus* | Snake, Northern pine | | T |
| **Birds** | | | |
| *Ammodramus henslowii* | Sparrow, Henslow's | | E |
| *Ammodramus savannarum BR* | Sparrow, grasshopper BR | | T |
| *Asio flammeus BR* | Owl, short-eared BR | | E |

## Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of OCNGS

| Scientific Name | Common Name | Federal Status[1a] | State Status[1b] |
|---|---|---|---|
| *Batramia longicauda* | Sandpiper, upland | | E |
| *Botaurus lentiginosos BR* | Bittern, American BR | | E |
| *Buteo lineatus BR* | Hawk, red-shouldered BR | | E |
| *Calidris canutus* | Knot, red | LT | E |
| *Charadrius melodus* | Plover, piping | LT | E |
| *Circus cyaneus BR* | Harrier, Northern BR | | E |
| *Cistothorus platensis* | Wren, sedge | | E |
| *Falco peregrinus BR* | Falcon, peregrine BR | | E |
| *Falco sparverius* | Kestrel, American | | T |
| *Haliaeetus leucocephalus BR* | Eagle, bald BR | | E |
| *Haliaeetus leucocephalus NB* | Eagle, bald NB | | T |
| *Laterallus jamaicensis BR* | Rail, black BR | | E |
| *Laterallus jamaicensis NB* | Rail, black NB | | T |
| *Melanerpes erythrocephalus* | Woodpecker, red-headed | | T |
| *Nyctanassa violacea* | Night-heron, yellow-crowned | | T |
| *Nycticorax nycticorax BR* | Night-heron, black-crowned BR | | T |
| *Pandion haliaetus BR* | Osprey BR | | T |
| *Passerculus sandwichensis* | Sparrow, savannah | | T |
| *Podilymbus podiceps BR* | Grebe, pied-billed BR | | E |
| *Pooecetes gramineus BR* | Sparrow, vesper BR | | E |
| *Rynchops niger* | Skimmer, black | | E |
| *Sterna dougallii* | Tern, roseate | LE | E |

**Table 5.1 State and Federally Listed Species Potentially Occurring in the Vicinity of OCNGS**

| Scientific Name | Common Name | Federal Status[a] | State Status[b] |
|---|---|---|---|
| *Sternula antillarum* | Tern, least | | E |
| *Strix varia* | Owl, barred | | T |
| **Mammals** | | | |
| *Lynx rufus* | Bobcat | | E |
| *Myotis septentrionalis* | Bat, Northern long-eared | LT | |

[a] LT = federally threatened; LE=federally endangered
[b] T = state threatened: E = state endangered
[1] NB = nonbreeding population
[2] Believed to have extirpated in New Jersey

### 5.1.7.1 Protected Terrestrial Species

A comprehensive review of threatened and endangered terrestrial species in the OCNGS area was conducted in 2004 in support of proposed national security upgrades. and summarized in the 2005 Applicant's Environmental Report (Reference 18). The assessment included a review of the NJDEP Natural Heritage Program records, maps of threatened and endangered species habitat and occurrences and other records. The barred owl (Strix varia), Cooper's hawk (Accipter cooperii), northern pine snake (Pituophos m. melanoleucus) and wood turtle (Clemmy's insculpta) were identified as occurring in the site area. None were detected during a field survey conducted to determine if the species were present in the site area.

There appears to be sufficient space within the operational area for all decommissioning activities (save movement of large plant components to the barge landing) and temporary storage of materials and equipment. Moving large plant components from the powerblock area to the barge landing will likely involve heavy equipment and could produce some minor soil disturbance. These activities will be of short duration and take place in previously disturbed areas on OCNGS-owned land that has very little value as wildlife habitat. No protected terrestrial species will be affected by this activity.

### 5.1.7.2 Protected Aquatic Species

No protected fish species were found in pre-operational surveys of freshwater reaches of Oyster Creek and the South Branch of the Forked River or in Barnegat Bay. Atlantic sturgeon and shortnose sturgeon are found in the Delaware River in New Jersey, but none of the resource agencies contacted by the NRC in 2006 when OCNGS was seeking to renew its operating license evidenced concern about these species. Furthermore, neither has been collected by biologists conducting ecological studies at OCNGS.

In the SEIS (Reference 15), five species of sea turtles, including the loggerhead turtle (Caretta caretta), Kemp's ridley turtle (Lepidochelys kempii), leatherback turtle (Dermochelys coriacea), hawksbill turtle (Eretmochelys imbricate) and green turtle (Chelonia mydas) were identified as occurring in the vicinity of the OCNGS. There were no federally listed fish or marine mammal species, nor any federally designated critical habitats in the project area.

Sea turtles were first observed in the vicinity of OCNGS in 1992 and have periodically been impinged on the station's circulating water intake trash rack (Updated Environmental Report Reference 19). OCNGS is required to notify the NRC and NMFS of sea turtle captures, those data and restrictions issued by the NMFS were considered in the SEIS (Reference 15), and the NRC concluded that the environmental impact of continued operation on sea turtles would be small.

In the GEIS (Reference 8), the NRC anticipated that the potential impacts of decommissioning on aquatic threatened or endangered species will normally be no greater than and likely far less than the potential impacts of plant operations because the cooling system is not used at a plant undergoing decommissioning.

After reactor shutdown and defueling, the potential for environmental impacts due to impingement and entrainment will be reduced by the dramatically lower flow rates and thermal differentials associated with decommissioning activities. Discharges from the facility will be reduced to those associated with continued operation of the SFP for several years, discharges associated with decommissioning activities, and stormwater. Flow rates will be further reduced after transfer of the spent fuel from the SFP to the ISFSI, and shutdown of the SFP. Discharges during decommissioning will continue to be regulated by the NJPDES permit (Reference 20), the existing NJPDES stormwater permit, or new NJDEP stormwater permits, as applicable.

Barging large plant components from Oyster Creek to Barnegat Bay and beyond may require dredging portions of Oyster Creek between the barge landing and Barnegat Bay. If dredging is needed, it will be conducted in accordance with applicable federal, state and local permits, and certifications, that include consideration of environmental impacts to threatened and endangered species. In the SEIS Revision 1 (Reference 16), the NRC noted that if dredging could affect threatened or endangered species or critical habitat, as established under the Endangered Species Act, the USACE must consult with the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS) before it

makes a permit decision. Dredging would be conducted in accordance with BMPs defined in the applicable permits issued by the NJDEP and USACE.

When the details of decommissioning activities, such as demolition or disturbance of land areas that could affect a protected species have been finally determined and scheduled, if potential impacts associated with those activities are considered unbounded by existing environmental impact statements and evaluations, the site-specific assessment of environmental impacts to protected species in the PSDAR will be updated, or provided through a separate and appropriate permit or certification process (e.g., USACE permitting).

#### 5.1.7.3 Conclusion

HDI anticipates that decommissioning activities at OCNGS will not encroach on the habitat of any state or federally-listed terrestrial species. Any indirect (disturbance-related) impacts from construction noise and human activity are expected to be localized, of short duration, and ecologically insignificant.

Based on the site-specific information presented in this section, and conclusions reached by the NRC in the GEIS, SEIS (Reference 15) and SEIS Revision 1, (Reference 16) HDI concludes that OCNGS decommissioning activities are unlikely to significantly affect any threatened or endangered species, and will have no effect on any designated critical habitat.

Therefore, HDI concludes that the impacts of OCNGS decommissioning on threatened and endangered species are bounded by the GEIS, as supplemented by the SEIS and the SEIS Revision 1, and the site-specific evaluations presented in the Updated Environmental Report (Reference 19).

### 5.1.8 Radiological

The GEIS (Reference 8) considered radiological doses to workers and members of the public when evaluating the potential consequences of decommissioning activities.

#### 5.1.8.1 Occupational Dose

The occupational radiation exposure to OCNGS plant personnel will be maintained ALARA and below the occupational dose limits in 10 CFR Part 20 during decommissioning. The need for plant personnel to routinely enter radiological areas to conduct maintenance, calibration, inspection, and other activities associated with an operating plant will be reduced, thus it is expected that the occupational dose to plant personnel will significantly decrease after the plant is shutdown and defueled.

HDI has elected to decommission OCNGS using the DECON method. It is expected that the occupational dose required to complete the decommissioning activities at OCNGS will be within the range of the cumulative occupational dose estimates for decommissioning BWR plants of 700-1874 person-rem provided in Table 4-1 of the GEIS. This is based on the fact that OCNGS is bounded by the BWRs evaluated in the GEIS, and because the

ALARA program will be maintained to ensure that occupational dose is maintained ALARA and well within 10 CFR Part 20 limits.

#### 5.1.8.2 Public Dose

Section 4.3.8 of the GEIS considered doses from liquid and gaseous effluents when evaluating the potential impacts of decommissioning activities on the public. Table G-15 of the GEIS compared effluent releases between operating facilities and decommissioning facilities and concluded that decommissioning releases are lower. The GEIS also concluded that the collective dose, and the dose to the maximally exposed individual from decommissioning activities, are expected to be well within the regulatory standards in 10 CFR Part 20 and Part 50. In Section 7.1 of the SEIS (Reference 15), no new or significant information was identified during the NRC's independent review of OCNGS to indicate that public radiation dose impacts would occur during decommissioning beyond those discussed in the GEIS.

The expected radiation dose to the public from OCNGS decommissioning activities will be maintained within regulatory limits and below comparable levels when the plant was operating through the continued application of radiation protection and contamination controls, combined with the reduced source term available in the facility. Also, Section 7.1 of the SEIS concluded that there would be no radiation dose impacts associated with decommissioning of OCNGS.

#### 5.1.8.3 Conclusion

HDI concludes that the impacts of OCNGS decommissioning on public dose are small and are bounded by the GEIS.

### 5.1.9 Radiological Accidents

The likelihood of a large offsite radiological release that impacts public health and safety after OCNGS is permanently shutdown and defueled is considerably lower than the likelihood of a release from the plant during power operation. This is because most of the potential releases associated with power operation are not relevant after the fuel has been removed from the reactor. Furthermore, handling of spent fuel assemblies will continue to be controlled under work procedures designed to minimize the likelihood and consequences of a fuel handling accident. In addition, emergency plans and procedures will remain in place to protect the health and safety of the public while the possibility of significant radiological releases exists.

Section 4.3.9 of the GEIS (Reference 8) assessed the range of possible radiological accidents during decommissioning and separated them into two (2) general categories; fuel related accidents and non-fuel related accidents. Fuel related accidents have the potential to be more severe, and zirconium fire accidents could produce offsite doses that exceed the EPA's protective action guides. As part of its effort to develop generic, risk-informed requirements for decommissioning, the NRC staff performed analysis of the offsite radiological consequences of beyond-design-basis SFP accidents using fission product

inventories at 30 and 90 days, and two (2), five (5), and 10 years. The results of the study indicate that the risk at SFPs is low, and well within the NRC's Quantitative Health Objectives. The generic risk is low primarily due to the very low likelihood of a zirconium fire.

The potential for decommissioning activities to result in radiological releases not involving spent fuel (i.e., releases related to decontamination, dismantlement, and waste handling activities) will be minimized by use of procedures designed to minimize the likelihood and consequences of such releases.

Therefore, HDI concludes that the impacts of OCNGS decommissioning on radiological accidents are small, and are bounded by the previously issued GEIS.

### 5.1.10 Occupational Issues

Occupational issues are related to human health and safety. Section 4.3.10 of the GEIS (Reference 8) evaluates physical, chemical, ergonomic, and biological hazards. HDI has reviewed these occupational hazards in the GEIS and concluded that the decommissioning approach chosen for OCNGS poses no unique hazards from those evaluated in the GEIS. HDI will continue to maintain appropriate administrative controls and requirements to ensure occupational hazards are minimized and that applicable federal, state, and local occupational safety standards and requirements continue to be met.

Section 4.3.10 in the GEIS concluded that impacts due to occupational issues would be small for all plants based on strict adherence to NRC and Occupational Safety and Health Administration (OSHA) standards, practices, and procedures. Therefore, HDI concludes that the impacts of OCNGS decommissioning on occupational issues are bounded by the GEIS.

### 5.1.11 Cost

Decommissioning costs for OCNGS are discussed in Section 4.0 and in Enclosure 1 to this report. Section 4.3.11 of the GEIS recognizes that an evaluation of decommissioning cost is not a National Environmental Policy Act (NEPA) requirement. Therefore, a bounding analysis is not applicable.

### 5.1.12 Socioeconomics

Decommissioning of OCNGS is expected to result in negative socioeconomic impacts.

As OCNGS ceases operation and transitions through the phases of decommissioning, an overall decrease in plant workforce and tax payments will occur. The lost wages of these plant staff will result in decreases in revenues available to support the local economy and local tax authorities. Some laid-off workers may relocate, thus potentially impacting the local cost of housing and availability of public services.

The changes during decommissioning would primarily impact Ocean County where the majority (>83 percent) of the plant workforce resides and Lacey Township which receives the preponderance of OCNGS property tax payments. The largest station workforce reduction (during decommissioning) would decrease the Ocean County population by 0.2 percent. OCNGS is not a significant source of tax revenue for state and local government. Plant property tax payments during operation have been approximately 4 percent of Lacey Township revenue. Compared with the existing property tax base, the anticipated decrease in OCNGS property taxes as a result of decommissioning is likely to be small

Section 4.3.12 of the GEIS (Reference 8) evaluated changes in workforce and population changes, changes in local tax revenue, and changes in public services. The decommissioning method selected for OCNGS is DECON, with decommissioning planned to begin shortly after shutdown. The GEIS noted that when decommissioning begins shortly after shutdown, the impact of facility closure is mitigated, with less immediate negative impacts than would occur with the SAFSTOR and ENTOMB decommissioning methods.

The GEIS concluded that socioeconomic impacts of decommissioning are neither detectable nor destabilizing, and that mitigation measures are not warranted. Therefore, HDI concludes that the impacts of OCNGS decommissioning on socioeconomic impacts are bounded by the GEIS.

### 5.1.13 Environmental Justice

Executive Order 12898 dated February 16, 1994, (Reference 23) directs federal executive agencies to consider environmental justice under the NEPA. It is designed to ensure that low income and minority populations do not experience disproportionately high and adverse human health or environmental effects because of federal actions.

Section 4.3.13 in the GEIS (Reference 8) determined environmental justice to be an environmental impact area for which no generic conclusion could be determined due to its site-specific nature. Therefore, the GEIS indicates that site-specific assessments for each decommissioning nuclear power plant must be prepared.

The geographic distribution of minority and low-income populations within a 50-mile radius of the OCNGS site was determined using the 2012-2016 American Community Survey 5-year estimates. Census block groups containing minority populations were identified and were concentrated in the larger metropolitan areas, such as Philadelphia, Trenton, and Atlantic City. The nearest minority population is located about 8 miles north of OCNGS, near Toms River. Census block groups containing low-income populations were concentrated in the cities of Philadelphia and Trenton. The nearest low-income population is located near Toms River approximately 9 miles north of OCNGS.

Section 4.3.13.3 of the GEIS reviewed environmental justice decommissioning impacts related to land use, environmental and human health, and socioeconomics.

As previously discussed in Section 5.1.12, it was determined that socioeconomic impacts from decommissioning are bounded by the GEIS. Potential impacts to minority and low-income populations would mostly consist of radiological effects. Based on the radiological environmental monitoring program data from OCNGS, the SEIS (Reference 15) determined that the radiation and radioactivity in the environmental media monitored around the plant have been well within applicable regulatory limits. As a result, the SEIS found that no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations (i.e., minority and or low-income populations) in the region as a result of subsistence consumption of water, local food, fish, and wildlife.

The change in transportation at shift change during decommissioning is expected to be reduced over time, and during peak periods of decommissioning activity, would be less than, or similar to, outage traffic the area has encountered during plant operations. Any major activities, when they occur, would be temporary in nature and would occur over extended periods of time such that significant changes to local traffic patterns are not expected.

Therefore, HDI concludes that the impacts of OCNGS decommissioning on environmental justice are small and are bounded by the GEIS.

### 5.1.14 Cultural, Historic and Archeological Resources

Section 4.3.14 in the GEIS (Reference 8) determined that potential effects of decommissioning on cultural, historical and archaeological resources would be small for all plants when the decommissioning activities are confined to the operational area. However, impacts outside the operational area "must be determined through site-specific analysis."

HDI anticipates that decommissioning activities will take place within the OCNGS operational area, except for the use of the existing barge landing on the north bank of Oyster Creek and the possible use of offsite fill to backfill the foundations of buildings and structures after demolition.

A review of available information including data on locations of inventoried resources from the New Jersey Historic Preservation Office (NJHPO) regarding cultural, historical, and archaeological resources for the OCNGS site and within an approximately 6-mile radius of the site. Currently, no historic properties, including prehistoric and historic archaeological sites, above-ground historic structures or traditional cultural properties eligible for listing or listed on the National Register of Historic Places are present within the OCNGS operational area. As part of the OCNGS license renewal process, the NJHPO concurred that continued operation of OCNGS would not adversely affect cultural or historic resources at the plant or its immediate environs because no expansion or structural modifications were planned and maintenance activities would be limited to previously disturbed areas. Decommissioning activities within the previously disturbed operational area, or resulting from use of the barge landing, would not impact

cultural resources. (Exelon SAFSTOR PSDAR (Reference 1).

The Exelon Generation PSDAR RAI Response (Reference 6) recognized that the plant may be of some historical interest to local history and former employees. A collection of memorabilia, artifacts, videos and photos that chronicle OCNGS was established. The collection is intended for eventual donation to local historical societies (e.g., Lacey Township, Waretown and Ocean County Historical societies). OCNGS representatives have already been in contact with local historical experts to partner with and assist the station in these efforts. In addition, engineering drawings from the station have been archived by Exelon records management.

No Historic American Buildings Survey/Historic American Engineering Record documentation of the OCNGS has been prepared to date, and although it is well known that the plant is destined for decommissioning, there has been no request from the New Jersey Historic Preservation Office or other agencies to do so.

Therefore, HDI concludes that potential for impacts to cultural, historical and archaeological resources is bounded by the GEIS.

### 5.1.15 Aesthetic Issues

During decommissioning, the impact of activities on aesthetic resources will be temporary and remain consistent with the aesthetics of an industrial plant. In most cases, Section 4.3.15 of the GEIS (Reference 8) concludes that impacts such as dust, construction disarray, and noise would not easily be detectable offsite.

The GEIS concluded that the demolition and dismantlement of structures during decommissioning using the DECON method could result in aesthetic impacts improving fairly rapidly as a result of the removal of structures and restoration of the site. The GEIS concludes that the removal of structures is generally considered beneficial to the aesthetic impacts of the site, and that the potential aesthetic impacts of decommissioning are small. Therefore, HDI concludes that the impacts of OCNGS decommissioning on aesthetic issues are bounded by the GEIS.

### 5.1.16 Noise

General noise levels during the decommissioning process are not expected to be any more severe than during refueling outages and are not expected to present an audible intrusion on the surrounding community. Some decommissioning activities may result in higher than normal onsite noise levels (i.e., some types of demolition activities). However, these noise levels would be temporary and are not expected to experience an audible intrusion on the surrounding community.

Section 4.3.16 of the GEIS (Reference 8) indicates that noise impacts are not detectable or destabilizing and makes a generic conclusion that potential noise impacts are small. Based on the standard decommissioning approach proposed for OCNGS, HDI concludes that the

impacts of OCNGS decommissioning on noise are bounded by the GEIS.

### 5.1.17 Transportation

The transportation impacts of decommissioning are dependent on the number of shipments to and from the plant, the types of shipments, the distance the material is shipped, and the radiological waste quantities and disposal plans. The shipments from the plant would be primarily radioactive waste and non-radioactive waste associated with dismantlement and disposal of SSCs.

The estimated cubic feet of radioactive waste associated with OCNGS decommissioning destined for land disposal at an LLRW (Class A, B or C) disposal facility, or GTCC geologic repository is summarized below:

- Class A: 952,918 cubic feet
- Class B: 954 cubic feet
- Class C: 729 cubic feet
- GTCC: 1428 cubic feet

The estimated LLRW volume (Class A, B, and C) for OCNGS that is destined for land disposal will be approximately 954,601 cubic feet using the DECON method. The anticipated waste volume for OCNGS decommissioning is bounded by the high-end estimate of 1.5 million cubic feet listed in Table 4-7 of the GEIS (Reference 8) associated with decommissioning of a facility to unrestricted conditions.

HDI must comply with applicable regulations when shipping radioactive waste from decommissioning. The NRC has concluded in Section 4.3.17 of the GEIS that these regulations are adequate to protect the public against unreasonable risk from the transportation of radioactive materials.

The number of GTCC waste shipments expected to occur during decommissioning is expected to be within the range of shipments for decommissioning facilities listed in Table K-1 of the GEIS.

These shipments will occur over an extended period of time and will not result in significant changes to local traffic density, or patterns, or significant dose to workers or the public.

A portion of the waste may be removed from the site by barge and transported to an appropriate offsite location where it will be transferred to railcars or trucks for shipment to an appropriate disposal facility. If implemented, barge transportation will reduce the number of shipments from the site over local roadways. Construction and operation of a barge slip for this purpose will increase marine vessel traffic in the area. It is expected that these activities will not cause a navigational safety hazard or a substantial delay in the normal movements of commercial or recreational vessels.

Shipments of non-radioactive wastes from the site are not expected to result in measurable deterioration of affected roads or a destabilizing increase in traffic density.

The GEIS concludes that both non-radiological and radiological impacts of decommissioning transportation are small. No unique features or site-specific conditions are present at OCNGS that would alter these findings. Therefore, HDI concludes that the impacts of OCNGS decommissioning on transportation are bounded by the GEIS.

### 5.1.18 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments are commitments of resources that cannot be recovered, and irretrievable commitments of resources are those that are lost for only a period of time.

Uranium is a natural resource that is irretrievably consumed during power operation. After the plant is shutdown, uranium is no longer consumed. The use of the environment (air, water, land) is not considered to represent a significant irreversible or irretrievable resource commitment, but rather a relatively short-term investment. Since the OCNGS site will be decommissioned to meet the unrestricted release criteria found in 10 CFR 20.1402, the land is not considered an irreversible resource. The only irretrievable resources that would occur during decommissioning would be materials used to decontaminate the facility (i.e., rags, solvents, gases, and tools), and the fuel used for decommissioning activities and transportation of materials to and from the site. However, the use of these resources is minor.

The NRC concluded in Section 4.3.18 of the GEIS (Reference 8) that the impacts of decommissioning on irreversible and irretrievable commitments of resources are small. Therefore, HDI concludes that the impacts of OCNGS decommissioning on irreversible and irretrievable commitment of resources are bounded by the GEIS.

## 5.2 Environmental Impacts of License Termination

According to the schedule provided in Section 3 of this report, an LTP for OCNGS will not be developed until approximately two (2) years prior to the final site decontamination (approximately the year 2026). At that time, a supplemental environmental report will be submitted as required by 10 CFR 50.82(a) (9). While detailed planning for license termination activities will not be performed until after completion of most of the DECON decommissioning activities, the absence of any unique site-specific factors, significant groundwater contamination, unusual demographics, or impediments to achieving unrestricted release suggest that impacts resulting from license termination will be similar to those evaluated in NUREG-1496 (Reference 14).

## 5.3 Discussion of Decommissioning in the SEIS

Postulated impacts associated with decommissioning are discussed in Section 7.0 of the SEIS (Reference 15), which identified six (6) issues related to decommissioning as follows:

- Radiation Doses

- Waste Management
- Air Quality
- Water Quality
- Ecological Resources
- Socioeconomic Impacts

The NRC staff did not identify any new and significant information during their independent review of the OCNGS license renewal environmental report at that time, the site audit, or the scoping process for license renewal. Therefore, the NRC concluded that there are no impacts related to these issues beyond those discussed in the SEIS or the GEIS (Reference 8) for decommissioning. For the issues above, the license renewal and decommissioning GEIS' both concluded the anticipated impacts are small. The NRC found no site-specific issues related to decommissioning and there are no decommissioning activities contemplated for OCNGS that would alter that conclusion.

## 5.4 Additional Considerations

While not quantitative, the following considerations are relevant to concluding that decommissioning activities will not result in significant environmental impacts not previously reviewed:

- The release of effluents will continue to be controlled by plant license requirements and plant procedures.
- OCNGS will continue to comply with the Offsite Dose Calculation Manual, Radiological Environmental Monitoring Program, and the Groundwater Protection Initiative Program during decommissioning.
- Releases of non-radiological effluents will continue to be controlled per the requirements of the NJPDES permit (Reference 20) and applicable NJDEP permits.
- Systems used to treat or control effluents during power operation will either be maintained or replaced by temporary or mobile systems for the decommissioning activities.
- Radiation protection principles used during plant operations will remain in effect during decommissioning.
- Sufficient decontamination and source term reduction prior to dismantlement will be performed to ensure that occupational dose and public exposure will be maintained below applicable limits.
- Transport of hazardous and or radioactive waste will be in accordance with plant procedures, applicable federal regulations, and the requirements of the receiving facility.

Site access control during decommissioning will minimize or eliminate radiation release

pathways to the public.

Additionally, NUREG-2157 (Reference 21) found that the generic environmental impacts of ongoing spent fuel storage are small.

## 5.5 Conclusions

Based on the above discussions, HDI concludes that the environmental impacts associated with planned OCNGS site-specific decommissioning activities will be bounded by appropriate, previously issued environmental impact statements. Specifically, the environmental impacts are bounded by the GEIS (Reference 8), SEIS (Reference 15), SEIS Revision 1 (Reference 16) and the Updated Environmental Report (Reference 19).

1. The postulated impacts associated with the decommissioning method chosen, DECON, have already been considered in the SEIS and GEIS.
2. There are no unique aspects of OCNGS or of the decommissioning techniques to be utilized that would invalidate the conclusions reached in the SEIS and GEIS.
3. The methods assumed to be employed to dismantle and decontaminate OCNGS are standard construction-based techniques fully considered in the SEIS and GEIS.

Therefore, it can be concluded that the environmental impacts associated with the site-specific decommissioning activities for OCNGS will be bounded by appropriate previously issued environmental impact statements.

10 CFR 50.82(a) (6) (ii) states that licensees shall not perform any decommissioning activities, as defined in 10 CFR 50.2 that result in significant environmental impacts not previously reviewed. No such impacts have been identified.

# 6 REFERENCES

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2. Letter from James Barstow, (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission - Submittal of Updated Decommissioning Cost Analysis for Oyster Creek Nuclear Generation Station, March 30, 2016, (ADAMS Accession No. ML16090A067).
3. Letter from Michael P. Gallagher, (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission - Update to Spent Fuel Management Plan for Oyster Creek Nuclear Generating Station, May 21, 2018 (ADAMS Accession No. ML18141A486).
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12. Letter from James Barstow (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission – Submittal of Preliminary Decommissioning Cost Estimate and Spent Fuel Management Plan, December 30, 2014 (ADAMS Accession No. ML14365A067).

13. NUREG-2155, Revision 1, Implementation Guidance for Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material, NRC, January 2015 (ADAMS Accession No. ML15016A172).

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15. NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 28, Regarding Oyster Creek Nuclear Generating Station, NRC, July 2007 (ADAMS Accession Nos. ML070100234 (Vol 1) and ML070100258 (Vol 2)).

16. NUREG-1437, Revision 1, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NRC, June 2013 (ADAMS Accession Nos. ML13106A241 (Vol 1) and ML13106A244 (Vol 3))

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18. AmerGen, Applicant's Environmental Report, Operating License Renewal Stage, Oyster Creek Generating Station, 2005 (ADAMS Accession No. ML052080189).

19. Environmental Report, Post-Shutdown Decommissioning Activities Report, Oyster Creek Nuclear Generating Station, dated April 18, 2018

20. NJDEP Bureau of Surface Water Permitting, Final Surface Water Renewal Permit Action, Category B, Industrial Wastewater, NJPDES Permit No. NJ00005550, Oyster Creek Generating Station, December 2011.

21. NUREG-2157, Vol. 1, Final Report. Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel, NRC, September 2014 (ADAMS Accession No. ML14196A105).

22. Letter from Michael P. Gallagher, (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission - Certification of Permanent Removal of Fuel from the Reactor Vessel for Oyster Creek Generating Station (ADAMS Accession No. ML18268A258).

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**Enclosure 1: Oyster Creek Nuclear Power Station Revised Site-Specific Decommissioning Cost Estimate**

# Oyster Creek Nuclear Power Station
# Revised Site-Specific Decommissioning Cost Estimate

Prepared for
**Holtec Decommissioning International, LLC**

Prepared by
**Comprehensive Decommissioning International, LLC**

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## ACRONYM LIST

| | |
|---|---|
| ACM | Asbestos Containing Material |
| ALARA | As Low As Reasonably Achievable |
| BOE | Basis of Estimate |
| BWR | Boiling Water Reactor |
| CDI | Comprehensive Decommissioning International, LLC |
| CFR | Code of Federal Regulations |
| CoC | Certificate of Conformance |
| CPM | Critical Path Method |
| D&D | Decontamination and Dismantlement |
| DCE | Decommissioning Cost Estimate |
| DCGL | Derived Concentration Guideline Level |
| DECON | A Method of Decommissioning defined by the NRC |
| DGC | Decommissioning General Contractor |
| DOE | Department of Energy |
| EC | European Commission |
| ENTOMB | A Method of Decommissioning defined by the NRC |
| GEIS | Generic Environmental Impact Statement |
| GTCC | Greater Than Class C |
| HDI | Holtec Decommissioning, International, LLC |
| HI | Holtec International |
| HSA | Historical Site Assessment |
| IAEA | International Atomic Energy Agency |
| IFMP | Irradiated Fuel Management Plan |
| ISDC | International Structure for Decommissioning Costing |
| ISFSI | Independent Spent Fuel Storage Installation |
| JHA | Job Hazards Analysis |
| LC | Large Components |
| LCR | Large Component Removal |
| LLRW | Low Level Radioactive Waste |
| LTA | License Transfer Application |
| LTP | License Termination Plan |
| MARSSIM | Multi-Agency Radiation Survey and Site Investigation Manual |
| MLLW | Mixed Low-Level Waste |
| MPC | Multi-Purpose Canister |
| MSS | Master Summary Schedule |
| MTU | Metric Tons of Uranium |
| MWt | Megawatts Thermal |
| NDT | Nuclear Decommissioning Trust |
| NEA | OECD Nuclear Energy Agency |
| NRC | Nuclear Regulatory Commission |
| NUREG | Nuclear Regulatory Commission technical report designation |
| OPRA | Oracle Primavera Risk Analysis |

| | |
|---|---|
| O&M | Operations and Maintenance |
| OCNGS | Oyster Creek Nuclear Generating Station |
| OECP | Oyster Creek Environmental Protection, LLC |
| PSA | Asset Purchase and Sales Agreement |
| PSDAR | Post Shutdown Decommissioning Activities Report |
| RCRA | Resource Conservation and Recovery Act |
| RRR | Real Rate of Return |
| RV | Reactor Vessel |
| RVI | Reactor Vessel Internals |
| RWP | Radiation Work Permit |
| SFP | Spent Fuel Pool |
| SNF | Spent Nuclear Fuel |
| TSDF | Treatment Storage and Disposal Facility |
| TSCA | Toxic Substances Control Act |
| US | United States |
| WBS | Work Breakdown Structure |
| WCS | Waste Control Specialists |
| WMP | Waste Management Plan |

## SUMMARY

This report presents a revised site-specific Decommissioning Cost Estimate (DCE), as required by 10 CFR 50.82(a)(8)(iii), for the decommissioning of the Oyster Creek Nuclear Generating Station (Oyster Creek or OCNGS) following the scheduled cessation of plant operations. This revision provides the Holtec Decommissioning International (HDI) site-specific DCE using the DECON method for decommissioning that is planned to be implemented following Exelon Generation's sale of OCNGS to Holtec. This revised site-specific DCE is included as an enclosure to the revised Oyster Creek Post-Shutdown Decommissioning Activities Report (PSDAR) that describes HDI's decommissioning plan using the DECON method.

On December 9, 2010, Exelon Generation Company, LLC (Exelon Generation) and the New Jersey Department of Environmental Protection executed an Administrative Consent Order, under which Exelon Generation agreed to permanently cease operations at Oyster Creek no later than December 31, 2019. By letter dated January 7, 2011, Exelon Generation notified the Nuclear Regulatory Commission (NRC) of its intent to permanently cease operations at Oyster Creek no later than December 31, 2019 (Reference 1). Subsequently, by letter dated February 14, 2018, Exelon Generation notified the NRC that it would permanently cease operations at Oyster Creek no later than October 31, 2018 (Reference 2).

OCNGS permanently shutdown on September 17, 2018. By letter dated September 25, 2018, Exelon Generation certified to the NRC that it had permanently removed fuel from the reactor vessel at Oyster Creek in accordance with 10 CFR 50.82(a)(2) (Reference 4). Upon docketing of the certifications required by CFR 50.82(a)(1)(i) and 10 CFR 50.82(a)(1)(ii), pursuant to 10 CFR 50.82(a)(2), the 10 CFR Part 50 license for OCNGS no longer authorizes operation of the reactor or emplacement or retention of fuel in the reactor vessel. Therefore, Exelon Generation is no longer authorized to operate the Oyster Creek reactor or emplace or retain fuel in the reactor vessel at Oyster Creek.

On August 31, 2018, Exelon Generation and Holtec submitted a License Transfer Application (LTA) requesting NRC consent to transfer the OCNGS Renewed Facility Operating License No. DPR-16 and the general license for the Oyster Creek Independent Spent Fuel Storage Installation (ISFSI) to Oyster Creek Environmental Protection, LLC (OCEP) as the licensed owner, and to Holtec Decommissioning International (HDI) as the licensed operator (Reference 3). The LTA (Reference 3) requests that the license transfer be approved to support an asset sale and license transfer of OCNGS to HDI in July 2019.

Following license transfer, OCEP, a special purpose entity formed by Holtec to own Oyster Creek, will acquire Oyster Creek, including the ISFSI, from Exelon Generation as an asset purchase. Following asset sale closure and license transfer, HDI, a special purpose entity formed by Holtec to operate, maintain and decommission nuclear power plants including Oyster Creek, will be the decommissioning operator of Oyster Creek with licensed responsibility for maintaining and decommissioning the facility

HDI will contract with Comprehensive Decommissioning International, LLC (CDI), a company jointly formed and owned by Holtec and SNC-Lavalin Group, as the decommissioning general contractor. CDI will manage and perform the day-to-day Oyster

Creek licensed activities, including decommissioning activities, to maintain compliance with the Licenses and NRC regulations, subject to HDI's direct oversight and control as the decommissioning licensed operator.

Following the asset sale and transfer of the facility licenses, CDI intends to initiate decommissioning activities using the DECON method under HDI's governance and oversight. Decommissioning is planned to be completed well before 60 years following permanent cessation of operations as required by 10 CFR 50.82(a)(3).

Costs in this revised DCE were determined based on the selection of the DECON method for decommissioning OCNGS. CDI prepared this cost estimate and schedule on behalf of HDI using several sources, including Oyster Creek plant data and historical information obtained from Exelon Generation, the updated site-specific DCE referenced in the Post-Shutdown Decommissioning Activities Report (Reference 12) and the Update to the Spent Fuel Management Plan (Reference 13), both submitted to the NRC by Exelon Generation on May 21, 2018, and the input and professional judgment of experienced decommissioning, demolition and waste management specialty subcontractors and subject matter experts (SMEs). This estimate is based on regulatory requirements, site conditions, basis of estimate assumptions, low-level radioactive waste disposal standards, high-level radioactive waste management options, and site restoration requirements. The methods utilized to estimate decommissioning costs were based on the professional judgment of experienced SMEs considering the nature of the work, degree of scope definition, availability of quantifiable cost and pricing data. The decommissioning costs presented in this report are reported in 2018 dollars. Escalation of future decommissioning costs over the remaining decommissioning project life-cycle are excluded.

HDI's detailed decommissioning project schedule, implementing the DECON method, is used as the foundation for developing the decommissioning cost estimate model and the risk model. The schedule baseline is a detailed Critical Path Method (CPM) schedule developed with input from key decommissioning subcontractors and SMEs. The schedule and cost estimate are based on the International Structure for Decommissioning Costing (ISDC) for Nuclear Installations (Reference 5), Work Breakdown Structure (WBS) and corresponding WBS dictionary.

The schedule and financial information in this revised site-specific decommissioning cost estimate are based on the HDI decommissioning plan for Oyster Creek. The schedule, decommissioning costs, and cash flow analysis presented in this revised DCE assume a fuel cooling period based on the existing Certificate of Compliance ("CoC") for the spent fuel canisters planned to be used at Oyster Creek. Holtec has submitted a request to amend the CoC for these canisters that would allow a shorter fuel cooling period and anticipates NRC approval of the amendment in mid-2020. However, consistent with the LTA (Reference 3) the schedule, costs, and cash flow analysis presented herein do not rely on the earlier loading time that would be allowed by the CoC amendment upon NRC approval.

This DECON site-specific DCE for decommissioning OCNGS demonstrates that adequate funding is available in the Nuclear Decommissioning Trust (NDT) fund to complete license termination. In addition to the license termination costs, site restoration and spent nuclear fuel management costs are included in this estimate; however, per regulatory requirements, the non-

radiological estimates are segregated and listed separately. HDI is aware that an exemption from the requirements of 10 CFR 50.82(a)(8)(i)(A) is required prior to the use of NDT funds for spent fuel management expenditures. HDI plans to submit the required exemption in October 2018.

HDI costs to decommission the site, safeguard the spent fuel until it can be transferred to the Department of Energy (DOE) and restore the impacted area of the site are estimated to be $885 million in 2018 dollars, exclusive of costs incurred by Exelon prior to closure of the asset sale. The summary of the costs estimated for License Termination, Spent Fuel Management and Site Restoration activities are presented below.

**OCNGS Decommissioning DECON Cost Summary (thousands of 2018 dollars)**

| Cost Category | License Termination | Spent Fuel | Site Restoration | Total |
|---|---|---|---|---|
| Decontamination | N/A | N/A | N/A | N/A |
| Removal | 162,045 | | 17,157 | 179,202 |
| Packaging | 20,608 | | | 20,608 |
| Transportation | 30,498 | | 1,242 | 31,740 |
| Disposal | 143,646 | | 14,985 | 158,631 |
| Off-site Waste Processing | N/A | N/A | N/A | N/A |
| Program Management | 150,808 | 13,569 | 4,395 | 168,772 |
| Corporate A&G | N/A | N/A | N/A | N/A |
| Spent Fuel | | 201,474 | | 201,474 |
| Insurance and Regulatory Fees | 36,726 | 1,133 | 349 | 38,208 |
| Energy | 19,726 | 3,189 | 1,163 | 24,078 |
| Characterization and Licensing Surveys | 6,770 | | | 6,770 |
| Property Taxes | 27,503 | 6,441 | 2,074 | 36,018 |
| Miscellaneous Equipment / Site Services | 19,502 | | | 19,502 |
| Spent Fuel Pool Isolation | N/A | N/A | N/A | N/A |
| **Grand Total** | **617,832** | **225,807** | **41,365** | **885,004** |

## 1.0 INTRODUCTION

This report presents a revised site-specific Decommissioning Cost Estimate (DCE), as required by 10 CFR 50.82(a)(8)(iii), for the decommissioning of the Oyster Creek Nuclear Generating Station (Oyster Creek or OCNGS) following the scheduled cessation of plant operations. This revision provides the Holtec Decommissioning International (HDI) site-specific DCE using the DECON method for decommissioning that is planned to be implemented following Exelon Generation's planned sale of OCNGS to Holtec. This revised sSite-specific DCE is included as an enclosure to the revised Oyster Creek Post-Shutdown Decommissioning Activities Report (PSDAR) that describes HDI's decommissioning plan using the DECON method.

On December 9, 2010, Exelon Generation and the New Jersey Department of Environmental Protection executed an Administrative Consent Order, under which Exelon Generation agreed to permanently cease operations at Oyster Creek no later than December 31, 2019. By letter dated January 7, 2011, Exelon Generation notified the NRC of its intent to permanently cease operations at Oyster Creek no later than December 31, 2019 (Reference 1). Subsequently, by letter dated February 14, 2018, Exelon Generation notified the NRC that it would permanently cease operations at Oyster Creek no later than October 31, 2018 (Reference 2).

OCNGS permanently shutdown on September 17, 2018. By letter dated September 25, 2018, Exelon Generation certified to the NRC that it had permanently removed fuel from the reactor vessel at Oyster Creek in accordance with 10 CFR 50.82(a)(2) (Reference 4). Upon docketing of the certifications required by CFR 50.82(a)(1)(i) and 10 CFR 50.82(a)(1)(ii), pursuant to 10 CFR 50.82(a)(2), the 10 CFR Part 50 license for OCNGS no longer authorizes operation of the reactor or emplacement or retention of fuel in the reactor vessel. Therefore, Exelon Generation is no longer authorized to operate the Oyster Creek reactor or emplace or retain fuel in the reactor vessel at Oyster Creek.

On August 31, 2018, Exelon Generation and Holtec submitted a License Transfer Application (LTA) requesting NRC consent to transfer the OCNGS Renewed Facility Operating License No. DPR-16 and the general license for the Oyster Creek Independent Spent Fuel Storage Installation (ISFSI) to Oyster Creek Environmental Protection, LLC (OCEP) as the licensed owner, and to Holtec Decommissioning International (HDI) as the licensed operator (Reference 3). The LTA (Reference 3) requests that the license transfer be approved to support an asset sale and license transfer of OCNGS to HDI in July 2019.

Following license transfer, OCEP, a special purpose entity formed by Holtec to own Oyster Creek, will acquire Oyster Creek, including the ISFSI, from Exelon Generation as an asset purchase. Following asset sale closure and license transfer, HDI, a special purpose entity formed by Holtec to operate, maintain and decommission nuclear power plants including Oyster Creek, will be the decommissioning operator of Oyster Creek with licensed responsibility for maintaining and decommissioning the facility

HDI will contract with Comprehensive Decommissioning International, LLC (CDI), a company jointly formed and owned by Holtec and SNC-Lavalin Group, as the decommissioning general contractor. CDI will manage and perform the day-to-day Oyster Creek licensed activities, including decommissioning activities, to maintain compliance with

the Licenses and NRC regulations, subject to HDI's direct oversight and control as the decommissioning licensed operator.

The initiation of decommissioning activities will occur immediately following the asset sale closure and license transfer of Oyster Creek from Exelon Generation to Holtec. Exelon Generation has permanently ceased power operation of Oyster Creek on September 17, 2018 and permanently defueled the reactor as of September 25, 2018 (reference 4). Following asset sale closure and license transfer, HDI will initiate decommissioning activities utilizing funding from the Oyster Creek Nuclear Decommissioning Trust (NDT). In addition, HDI plans to submit a request for NRC approval of an exemption request for use of comingled decommissioning funds for spent fuel management and site restoration activities.

Following asset sale closure and transfer of the facility licenses, HDI will initiate decommissioning activities using the DECON method. Decommissioning will be completed well before 60 years following permanent cessation of operations as required by 10 CFR 50.82(a)(3). HDI has a project goal to complete all non-ISFSI decommissioning activities and obtain NRC approval of partials site release and issuance of a license amendment reducing the Oyster Creek licensed area to the ISFSI within approximately eight years of license transfer.

### 1.1 Objectives

The goal for the project is the prompt decommissioning of OCNGS following permanent shutdown and reactor defueling leading ultimately to the termination of the NRC licenses. Decommissioning objectives are:

a. Decommissioning of OCNGS and site restoration of all areas, except for the ISFSI.
b. NRC approval of partial site release, including issuance of amended licenses to include only the operation of the ISFSI.
c. Department of Energy (DOE) acceptance of Spent Nuclear Fuel (SNF) from the OCNGS ISFSI.
d. Decommissioning of the ISFSI after DOE has removed the SNF.
e. Termination of the NRC licenses and site release of the ISFSI area.
f. Site restoration of the ISFSI area.

The objective of this revised DCE is to provide a description of the planned decommissioning activities and an estimate of the cost, along with the detailed schedule of associated activities required to complete the decommissioning of the plant and obtain NRC approval of license termination. The estimate and schedule are based on the assumptions delineated in this document.

### 1.2 Site Description

Oyster Creek is a single unit boiling water nuclear reactor with a licensed thermal power of 1,930 MWt. Oyster Creek is located in Ocean County, New Jersey, and consists of the boiling water nuclear reactor, other associated plant equipment, and related site facilities. Oyster Creek is also the site of the generally-licensed Oyster Creek ISFSI. Oyster Creek is currently owned and operated by Exelon Generation.

## 1.3 Regulatory Guidance

Current regulations governing decommissioning, waste management, spent fuel management and the funding of those elements include the following:

- Decommissioning is defined in 10 CFR 50.2 as the safe removal of a facility or site from service and the reduction of residual radioactivity to levels that permit release of the site and termination of the license.
- Pursuant to 10 CFR 50.51(b), each license for a facility that has permanently ceased operations continues in effect beyond the expiration date to authorize ownership and possession of the production or utilization facility, until the Commission notifies the licensee inwriting that the license is terminated.
- Prior to, or within two years following permanent cessation of operations, the licensee is required by 10 CFR 50.82(a)(4)(i) to submit a PSDAR to the NRC. The PSDAR must contain a site-specific DCE, including the projected cost of managing irradiated fuel.
- Pursuant to 10 CFR 50.82(a)(8)(iii), within 2 years following permanent cessation of operations, if not already submitted, the licensee shall submit a site-specific decommissioning cost estimate.
- In accordance with 10 CFR 72.30, licensees must have a proposed decommissioning plan for the ISFSI site and facilities that includes a cost estimate for the plan. The plan should contain sufficient information on the proposed practices and procedures for the decontamination of the ISFSI and for the disposal of residual radioactive materials after all spent fuel, high-level radioactive waste, and reactor related GTCC waste have been removed.
- Use of the decommissioning funds is limited by 10 CFR 50.82(a)(8)(i) to legitimate decommissioning expenses that neither reduces the value of the trust fund below that necessary to place and maintain the reactor in a safe storage condition if unforeseen conditions or expenses arise, nor inhibits the ability of the licensee to complete funding of any shortfalls in the trust needed to ensure the availability of funds to ultimately release the site and terminate the license. .
- As provided in 10 CFR 50.82(a)(8)(ii), a licensee may withdraw funds from the decommissioning trust up to a cumulative total of 3 percent of the generic amount calculated under 10 CFR 50.75 for decommissioning planning purposes at any time. After submittal of the certifications of permanent shutdown and fuel removal required under 10 CFR 50.82(a)(1) and commencing 90 days after the NRC has received the PSDAR, the licensee may use an additional 20 percent of the decommissioning funds prescribed in 10 CFR 50.75(c) for decommissioning purposes. The licensee is prohibited from using the remaining 77 percent of the generic decommissioning funds until a site-specific decommissioning cost estimate is submitted to the NRC.

- Regulatory Guide 1.202, Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Plants, (Reference 8) provides the standard format and content to facilitate preparation and NRC review of required cost estimates.

# 2.0 DECOMMISSIONING OPTIONS, THE METHOD SELECTED AND APPROACH

## 2.1 Decommissioning Methods

The NRC has evaluated the environmental impacts of three general methods for decommissioning power reactor facilities in NUREG-0586, "Final Generic Environmental Impact Statement (GEIS) on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors," (Reference 7). The three general methods evaluated are summarized as follows:

- DECON: The equipment, structures and portions of the facility and site that contain radioactive contaminants are promptly removed or decontaminated to a level that permits termination of the license shortly after cessation of operations.
- SAFSTOR: After the plant is shutdown and defueled, the facility is placed in a safe, stable condition and maintained in that state (safe storage). The facility is decontaminated and dismantled at the end of the storage period to levels that permit license termination. During SAFSTOR, a facility is left intact or may be partially dismantled, 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, thereby reducing the quantity of contamination and radioactivity that must be disposed of during decontamination and dismantlement.
- ENTOMB: Radioactive structures, systems and components (SSCs) are encased 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.

## 2.2 Decommissioning Method Selected

Oyster Creek decommissioning activities will be planned and executed using the DECON method. Decommissioning activities will proceed following asset sale and license transfer to HDI. Decommissioning is expected to be completed well before 60 years following permanent cessation of operations as required by 10 CFR 50.82(a)(3).

The DECON PSDAR and this revised DCE provide an estimate of the costs to decommission the OCNGS facility utilizing the DECON method. Immediately following the asset sale and license transfer, CDI will finalize decommissioning preparations and transition the plant into DECON.

## 2.3 Decommissioning Approach

The decommissioning approach reflected in this cost estimate is organized into activities based on the International Structure for Decommissioning Costing (ISDC) Work Breakdown Structure (WBS) and corresponding WBS dictionary. The ISDC WBS is a

delivery-based, hierarchical structure organized at the highest level of a decommissioning project into eleven groups of similar activities or principal work groups:

01 – Pre-Decommissioning Actions
02 – Facility Shutdown Activities
03 – Additional Activities for Safe Enclosure and Entombment
04 – Dismantling Activities Within the Radiologically Controlled Area
05 – Waste Processing, Storage and Disposal
06 – Site Infrastructure and Operation
07 – Conventional Dismantling, Demolition and Site Restoration
08 – Project Management, Engineering and Support
09 – Research and Development
10 – Fuel and Nuclear Material
11 – Miscellaneous Expenditures

Of the eleven principal work groups identified in the ISDC Level 1 WBS, activities 03 and 09 are not used for the OCNGS project. Activity 03-Additional Activities for Safe Enclosure and Entombment is not applicable to the prompt decommissioning approach used by CDI for the OCNGS decommissioning. There are no experimental activities associated with the project, therefore Activity 09-Research and Development is not used.

NRC guidance in Regulatory Guide 1.202, Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Plants, (Reference 8) provides the recommended method of summarizing total decommissioning costs by period. The four periods are: Planning & Preparation, Plant Deactivation, Safe Storage Operations, and Dismantlement. NUREG-1713, Standard Review Plan for Decommissioning Cost Estimates for Nuclear Reactors (Reference 9), and NUREG/CR-6174, Revised Analyses of Decommissioning for the Reference Boiling Water Reactor Power Station, (Reference 10) divides decommissioning activities associated with the DECON method into similar periods.

To facilitate a comparison of projected OCNGS decommissioning costs to the reference BWR, decommissioning activities are organized into periods like those described in NRC guidance, with differences outlined below.

Periods 1 through 4 are generally consistent with the decommissioning periods described in Regulatory Guide 1.202; however, a Program Management cost category is added to capture generic labor and project support costs that are applicable to periods 1 through 4 but not readily distributable into individual periods. Since acceptance of spent nuclear fuel by DOE is not assumed to be completed until 2035, a fifth period is included in the OCNGS cost estimate and is identified as Ongoing Independent Spent Fuel Installation (ISFSI) Operations. This fifth period captures the costs associated with storing spent fuel and Greater Than Class C (GTCC) waste following completion of OCNGS dismantlement activities in addition to the costs of the eventual decommissioning of the storage facility.

Period 1 – Pre-decommissioning Planning & Preparation

In the time leading up to and immediately following the asset sale and license transfer, preparations for performance of decommissioning will include the following activities:

1. Final decommissioning planning
2. Procurement of services, materials and supplies
3. Reactor Vessel Internals (RVI) and Reactor Pressure Vessel (RPV) segmentation, tooling design, fabrication, and testing.
4. Licensing and permitting actions necessary to reflect the defueled and permanently shut-down plant configuration
5. Stakeholder interaction
6. Facility characterization so that radiological, regulated, and hazardous wastes are identified, categorized and quantified to support decommissioning and waste management planning
7. Waste management planning, including determination of transportation and disposal container requirements and disposal pathways
8. Performance of safety, security and environmental studies

Period 2 - Plant Deactivation

During the time between plant shutdown and asset sale and license transfer, OCNGS personnel will defuel the reactor in preparation for decommissioning. Following license transfer, CDI will operate and maintain the Spent Fuel Pool (SFP) and supporting systems required for cooling of the Spent Nuclear Fuel (SNF) and perform the following activities:

1. Isolation of power equipment
2. Drainage and drying of systems
3. Removal of system fluids, operational waste and redundant material
4. Radiological inventory characterization to support detailed planning

Due to the prompt decommissioning strategy utilized by CDI, reactor vessel and internals segmentation and removal activities are included in Period 4.

Period 3 - Safe Storage Operations

Since the DECON method will be used for OCNGS decommissioning, the activities in this period only include preparations for and conduct of fuel movement to an on-site dry fuel storage facility. This period concludes once all the spent nuclear fuel has been removed from the SFP and placed into long term storage at the ISFSI. Activities include the following:

1. Construction of additional dry fuel storage capacity
2. Transfer of spent nuclear fuel to dry storage canisters
3. Movement and placement of fuel into long term storage at the ISFSI
4. Operation of the ISFSI until all fuel is placed in the ISFSI

Period 4 - Dismantlement

The following dismantlement activities will be performed during this period according to the project decommissioning schedule. These activities include detailed work planning, procurement, mobilization and execution of the dismantlement and disposal work and support activities, including measures to maintain occupational dose As Low As Reasonably Achievable (ALARA).

1. Asbestos Containing Material, Hazardous, and Universal Waste removal
2. Dismantling of main process systems, structures and components
3. Dismantling of reactor internals, core components and reactor vessel
4. Dismantling of other primary loop components
5. Dismantling of other systems and components
6. Procurement of equipment, tools and services
7. Procurement of waste containers
8. Demolition of buildings and structures within the radiologically controlled area
9. Maintenance, surveillance and operational support for waste management
10. Low level waste management
11. Management of exempt waste and materials
12. Management of waste and materials generated outside the radiologically controlled area
13. Final status survey
14. Earthworks and land works
15. Landscaping and site finishing

Period 5 – Ongoing ISFSI Operations

Ongoing ISFSI Operations activities are associated with storing spent fuel and Greater Than Class C (GTCC) waste following completion of OCNGS dismantlement activities in addition to the costs of the eventual decommissioning of the storage facility. Activities for Period 5 include:

1. Operational activities from the time that all spent fuel is in storage at the ISFSI until all SNF and GTCC waste is removed from the ISFSI
2. Decommissioning of the ISFSI

Program Management

Program Management costs include infrastructure and operation, management and fees that are generic in nature and applicable across decommissioning Periods 1 through 4. These costs include the following:

1. Site infrastructure and operation costs, including security, maintenance, site upkeep, operation of support systems and environmental monitoring
2. Project management, engineering and support including the core management group, scheduling and cost control, quality assurance, health

and safety, records management, general administration and accounting, warehousing, engineering, regulatory and support services
3. Regulatory fees, taxes and insurance

Due to the generic nature of Program Management costs and the fact that many of the work activities associated with Periods 1 through 4 are performed concurrently, it is not feasible to allocate these costs to discrete Periods. Once decommissioning activities are complete, and the project enters Period 5, Ongoing ISFSI Operations, all costs, including Program Management, are captured within the Period.

WBS Principal Activities Mapping

The nine Level 1 WBS principal activities used for the Oyster Creek project are mapped in Table 2-1 to the decommissioning periods described above in accordance with the following conventions:

- Period 1, Pre-Decommissioning Planning and Preparation maps directly to principal work group 01-Pre-decommissioning actions.
- Period 2, Plant Deactivation, maps directly to principal work group 02-Facility Shutdown.
- Period 3, Safe Storage Operations maps to principal work group 10-Fuel and Nuclear Material for those activities required to complete the movement of all spent nuclear fuel into dry storage, as indicated by the 2023 end date.
- Period 4, Dismantlement, maps to principal work groups 04-Dismantling Activities Within the Controlled Area, 05-Waste Processing, Storage and Disposal and 07-Convential Dismantling Demolition and Site Restoration.
- Period 5, Ongoing ISFSI Operations, maps to principal work group 10-Fuel and Nuclear Materials like Period 2, but activities in this period begin once all spent nuclear fuel is placed in dry storage and end when the ISFSI is decommissioned in 2035.
- Program Management is applicable to activities performed across Periods 1 through 4 and is mapped to principal work groups 06-Site Infrastructure and Operation; 08- Project Management, Engineering and Support and 11-Miscellaneous Expenditures.

## Table 2-1 Decommissioning Periods and WBS Elements

| Period | WBS Element | Start and End Dates[1] |
|---|---|---|
| 1.Pre-Decommissioning Planning and Preparation | 01.02.01 Pre-decommissioning actions | 4/1/2018 – 11/5/2023 |
| 2. Plant Deactivation | 01.02.02 Facility Shutdown Activities | 9/17/2018 – 6/23/2023 |
| 3. Safe Storage Operations | 01.02.10 Fuel and Nuclear Material | 9/12/2018 – 6/23/2023 |
| 4. Dismantlement | 01.02.04 Dismantling Activities Within the Radiological Controlled Area | 4/2/2018 – 10/24/2025 |
| | 01.02.05 Waste Processing, Storage and Disposal | 4/1/2018 – 10/23/2025 |
| | 01.02.07 Conventional Dismantling, Demolition, and Site Restoration | 3/29/2019 – 10/23/2025 |
| 5. Ongoing ISFSI Operations | 01.02.10 Fuel and Nuclear Material | 6/23/2023 – 12/1/2035 |
| Program Management | 01.02.06 Site Infrastructure and Operation | 9/17/2018 – 10/23/2025 |
| | 01.02.08 Project Management, Engineering and Support | 6/28/2018 – 10/23/2025 |
| | 01.02.11 Miscellaneous Expenditures | 9/17/2018 – 10/23/2025 |

[1] Planning and preparation may begin for work activities prior to the closing of the asset sale and the transfer of the Oyster Creek licenses

# 3.0 DECOMMISSIONING COST ESTIMATE

The revised site-specific DCE for decommissioning OCNGS presented in this section demonstrates that adequate funding is available in the Nuclear Decommissioning Trust (NDT) fund to complete license termination. In addition to the License Termination costs, Site Restoration and Spent Fuel Management costs are included in this estimate; however, per regulatory requirements, the Spent Fuel Management and Site Restoration estimates are segregated and listed separately. To demonstrate the reasonableness of this estimate, this section also presents a comparison of this DCE with the updated site-specific decommissioning cost estimate submitted by Exelon on March 30, 2016 (Reference 11) and referenced in the Post-Shutdown Decommissioning Activities Report submitted by Exelon on May 21, 2018. In addition, this section provides a cash flow analysis demonstrating the adequacy of decommissioning funding.

The decommissioning costs are reported in 2018 dollars. Escalation of future decommissioning costs over the remaining decommissioning project life-cycle are excluded.

The cost estimate summary and a comparison with the Exelon estimate are presented, followed by a discussion of the site-specific matters that were taken into consideration when developing this DCE. Site-specific matters include items that are applicable to the DECON method for Boiling Water Reactors. Section 4.0 discusses the estimating methodology, basis of estimate, inflation, and assumptions that were used in preparing this cost estimate; as well as the methods of handling the risk and uncertainty that are inherent in the project, which carry over to the estimate.

## 3.1 Cost Estimate Summary

This site-specific DCE conforms with the guidance provided in NRC Regulatory Guide 1.202. The estimate was developed using the International Structure for Decommissioning Costing (ISDC) Work Breakdown Structure (WBS) and corresponding WBS dictionary. The ISDC WBS is a delivery-based, hierarchical structure and is identified as the international standard cost structure for nuclear facility decommissioning projects, addressing the entirety of work within the planned scope of a typical nuclear facility decommissioning project (i.e., license termination, site restoration, and spent nuclear fuel management). The ISDC WBS is organized at the highest level of a decommissioning project into eleven principal work groups of which nine are applicable to the OCNGS project. As described in subsection 2.3 of this DCE, Activity 03-Additional Activities for Safe Enclosure and Entombment and Activity 09-Research and Development are not used.

To organize the WBS information in a format consistent with regulatory guidance, Table 3-1 presents decommissioning costs by the five Periods and Program Management category described in Section 2.3.

Table 3-2 provides a detailed view of the Program Management costs on an annualized basis. Program Management costs include expenses that are common to decommissioning Periods 1 through 4, and include site infrastructure and operation,

project management, engineering, regulatory, support services, scheduling and cost control, quality assurance, general administration, materials management, insurance, taxes and fees. Due to the generic nature of Program Management costs and the fact that many of the work activities associated with Periods 1 through 4 are performed concurrently, it is not feasible to allocate these costs to discrete Periods. Once decommissioning activities are complete, and the project enters Period 5, Ongoing ISFSI Operations, all costs, including Program Management, are captured within the Period.

The decommissioning project cost estimate summary by cost category is shown in Table 3-3.

The estimate captures costs associated with License Termination, in addition to costs associated with Spent Fuel Management and Site Restoration. License Termination are those costs associated with the collective work required to plan, mobilize and execute the removal of the radioactive contamination from the site, consistent with the definition of decommissioning per 10 CFR 50.2. Site Restoration costs are those costs associated with conventional dismantling, demolition, and removal from the site of structures and systems after confirmation that radioactive contaminants have been removed. Spent Fuel Management are the costs to safely manage spent fuel from asset sale and license transfer until successful transfer to the DOE. The costs of Spent Fuel Management and Site Restoration are not considered part of the 10 CFR 50.2 definition of decommissioning and are listed separately per regulatory requirements.

The costs estimates presented in this section exclude decommissioning costs incurred by Exelon prior to the asset sale and license transfer.

## 3.2 Comparison with the Exelon Decommissioning Cost Analysis

In the Post Shutdown Decommissioning Activities Report submitted by Exelon Generation on May 21, 2018 (Reference 12), Exelon identified the SAFSTOR scenario presented in the DCE submitted to the NRC on March 30, 2016 (Reference 11) as the OCNGS site-specific DCE that fulfills the requirements of 10 CFR 50.82(a)(4)(i) and 10 CFR50.82(a)(8)(iii). The Exelon cost estimate used the unit cost factor method for estimating decommissioning activity costs presented in the cost estimating guidelines developed by the Atomic Industrial Forum (now Nuclear Energy Institute). The detailed cost estimate used unit cost factors incorporating OCNGS specific costs and applied these unit cost factors to plant inventory, decommissioning waste streams and estimated waste quantities. The Exelon basis of estimate and the resulting cost estimate details are a reference condition for the CDI cost estimate development e□ort.

The Exelon estimate evaluated DECON, Delayed DECON and SAFSTOR scenarios that were representative of available decommissioning methods evaluated by the NRC. Since the CDI decommissioning approach for OCNGS is prompt decommissioning using the DECON method, the Exelon estimate for the DECON method is used for comparison to the CDI projected costs. The results of the comparison are shown in Table 3-4. The Exelon estimate is escalated to 2018 dollars to facilitate direct comparison.

The CDI estimate reflects HDI costs only and does not include approximately $94 million in expenses, including decommissioning planning and other decommissioning activities, accrued by Exelon prior to the asset transfer to OECP and HDI.

Differences between the CDI and Exelon estimates are attributable to the prompt DECON decommissioning approach that will be employed by CDI as well as the use of specific rates for decommissioning and waste packaging, transportation and disposal costs instead of the unit cost factor approach used in the Exelon estimate. The CDI cost estimate reflects a methodology that emphasizes bulk removal and disposal of plant equipment and structures with minimal decontamination and no offsite processing operations to accomplish free release of material, resulting in a significant difference in the characterization and survey costs and the amount of low level waste requiring packaging, transportation and disposal.

The Exelon estimate for Program Management costs is significantly higher and the estimate of costs for Spent Fuel Management is significantly lower than the costs in the CDI estimate. These variances are due to the different approaches used by Exelon and CDI for capturing expenditures associated with spent fuel storage. The Exelon cost estimate captures a portion of the costs of fuel storage operations under the Program Management category, while CDI captures the costs of storage until the fuel is accepted by DOE in the Spent Fuel Management category. Note that the Program Management cost category presented in Table 3-4 is consistent with the Program Management category described in Section 2.3 after taxes, insurance, fees, energy and other costs have been removed and listed separately. The CDI estimate does not include a Security cost category, but rather includes Security costs in the Program Management and Spent Fuel cost categories.

## 3.3 Site-Specific Matters Considered in DCE

Based on the guidance in Regulatory Guide 1.202, the following site-specific matters are discussed. These items not only influence the methods used or the approach to decommission the plant, but many have significant cost impacts as well, which are discussed in this section and/or provided in the cost estimate details.

- Management After License Transfer, DECON Labor Requirements and Costs

  Following approval of license transfer and closing on the asset sale, the management team will be comprised of HDI and CDI personnel as well as site incumbent personnel who accept offers of employment that will be transferred to CDI upon closure of the sale. These personnel will be incorporated into the decommissioning organization according to their expertise and previous positions held while the plant was operating. HDI will ensure that positions filled by incumbent employees that are vacated due to attrition are backfilled with qualified personnel, subject to a determination of need to fill the position. The attrition strategy includes filling vacant positions with other qualified employees, hiring from the community of retired Oyster Creek employees, assigning qualified

personnel from the HDI and CDI parent companies, and seeking qualified personnel from industry staff augmentation firms.

Table 3-5 presents the labor costs and the annualized labor requirements and Table 3-6 presents labor costs and the labor requirements by decommissioning period. The cost basis for labor resources was developed using a salary survey for comparable rates across the US, to confirm that rates are within reasonable ranges based on national survey data. Neither Table 3-5 or Table 3-6 includes resources that will be mobilized by subcontractors that will be responsible for providing appropriate levels of project management, supervisory, engineering and labor resources necessary to accomplish decommissioning activities. Subcontractor labor resources and associated labor costs will be included in the subcontracts. For the decommissioning cost estimate documented herein, CDI has included subcontract cost estimates including labor costs using previous decommissioning experience, discussions with potential subcontractors, and SME opinion.

At license transfer, daily onsite staffing excluding subcontractor resources, is estimated to be between 300 and 350 personnel and is expected to decrease as the spent fuel cools, as the fuel is moved from the pool to the ISFSI and as requirements for security and emergency planning are reduced. The subcontractor onsite staffing will be defined during detailed work planning, contract development, bidding and selection. The maximum site population, inclusive of subcontractor resources, will vary throughout the life of the project, with increased and decreased staffing required as decommissioning activities ramp up or down. The maximum site population including subcontractors is not expected to exceed 450 personnel. Onsite CDI staffing changes (excluding subcontractor resources) are expected to occur at the following milestones:

1. The spent fuel emergency planning zone is reduced following the spent fuel cooling period of approximately 12 months
2. All spent fuel has been moved from the SFP to the ISFSI
3. Start of major demolition

- Characterization

Characterization will be performed with systems and components in place, maximizing the use of non-destructive assay techniques and direct reading instrumentation readings correlated with analytical data gathered via direct smears and sampling. The CDI prompt decommissioning approach minimizes decontamination activities, resulting in maintaining occupational doses ALARA and reducing decommissioning costs.

- Segmentation of the RPV and Internals

CDI will subcontract reactor and fuel system dismantling services. The subcontract will include project management, supervision, engineering, labor, tooling (including the design, fabrication, and testing of segmentation tooling) for

the Reactor Pressure Vessel (RPV), Reactor Pressure Vessel Internals (RPVI), irradiated hardware, spent fuel pool, equipment pool and cavity pool liner removals in addition to removal and disassembly of the refueling machine and bridge. GTCC waste generated during segmentation activities will be placed into dry storage canisters, transported away from the area and stored at the ISFSI until acceptance by the Department of Energy.

The RPV internals will be size-reduced using specially designed tooling and mechanical techniques. The tooling will be developed during the decommissioning planning period and will be mobilized to the site and tested prior to use. Segmentation of the reactor internals will be completed systematically from the top to the bottom of the reactor. Highly activated portions of the internals will be segmented into pieces that are sized to fit within the dry storage casks used for GTCC waste.

The RPV will be separated from the surrounding structure and segmented in stages. The reactor support structures will be removed when they are no longer required to maintain needed structural support. RPV segments will be loaded into waste shipment casks using the reactor building crane and the loaded casks will be moved across the reactor hall, lowered through the access hatch and readied for transport to the disposal site.

- Fuel Pool, Equipment Pool and, Spent Fuel Racks

The fuel pool and equipment pool will be inspected with underwater cameras and surveyed with radiation monitors to identify any radioactive material or debris remaining after removal of the spent fuel. Remote handling or vacuum lines will remove fuel contamination found during the inspection.

The fuel racks will be removed from the pool, segmented and sized reduced for disposal as Low Level Radioactive Waste (LLRW). Pool liners will be segmented after pools have been drained and decontaminated to protect workers. Any GTCC waste generated during these activities will be placed in a dry storage cask, transported away from the area and stored at the ISFSI. CDI intends to subcontract the Fuel Pool, Equipment Pool and Spent Fuel Rack removal scope.

- Turbine and Condenser Segmentation

CDI will subcontract segmentation of the turbine and condenser components in a radiologically controlled area. While the turbine and condenser are expected to be radiologically contaminated, they are not expected to require pre-dismantlement decontamination. The subcontractor will remove large parts of the turbine (such as the low-pressure portion) intact, if contamination levels allow, and send the components offsite for disposal as intact packages suitably wrapped. The generator is not part of the contaminated steam system and can be removed whole for possible recycling or re-use.

- Large Contaminated Components

CDI will subcontract the removal of large contaminated components such as moisture separator reheaters, feedwater heaters, feedwater pumps, and coolant piping from the Reactor Building and the Turbine Building. The prompt decommissioning strategy involves minimal decontamination and no offsite processing to accomplish free release of material and focuses instead on bulk removal of material as the most expedient and cost-effective solution to decommissioning. The subcontractor will provide management, labor, tools and equipment to complete the removal of large components at the OCNGS site. Support services include radiation protection, security, engineering support, heavy lift services and segmentation of components, if required. Containers or packaging will be provided by CDI.

- Building and Structure Removal

Building demolition will be subcontracted with scope including equipment, personnel, permits, and surveys to perform the following activities:

1. Hazardous waste (asbestos and lead paint) removal from buildings and components
2. Demolition of site buildings to 3 feet below grade and backfill with clean fill material
3. Demolition of above ground tanks
4. Removal of parking lot surfaces
5. Final grading, and
6. Site restoration

- Review of Decommissioning Records

Based on a review of OCNGS decommissioning records required by 10 CFR 50.75(g), CDI has concluded that events occurring during operation involving the spread of contamination in and around the facility, equipment, or site are well documented and that cleanup efforts were effective such that no significant contamination remained following cleanup operations. The decommissioning cost estimate includes a conservative estimate of contaminated soil that will be removed, packaged, shipped and disposed as low level or exempt waste. In addition, CDI plans to review the Historical Site Assessment (HSA) prepared by Exelon Generation and confirm contamination estimates and assumptions.

- Final Radiological Surveys

After completing radiological decommissioning activities, the final status surveys will be performed to demonstrate that the remediated portion of the site (excluding the ISFSI containing the spent fuel and GTCC waste) can be released for unrestricted use and removed from the license. The site release criteria are defined by the Multi-Agency Radiation Survey and Site Investigation Manual

(MARSSIM) protocol and will satisfy NRC requirements for unrestricted release. Surveys will be conducted in adherence to the NRC-approved License Termination Plan (LTP) and MARSSIM guidance to ensure that applicable regulatory criteria are satisfied.

- Spent Fuel Management

The DOE's repository program assumes that spent fuel will be accepted for disposal from the nation's commercial nuclear plants in the order (the "queue") in which it was removed from service ("oldest fuel first"). Repository operations were based upon annual industry-wide receipt of 400 Metric Tons Heavy Metal (MTHM) in the first year of operation, a total of 3,800 MTHM in years 2 through 4 and 3,000 MTHM for year 5 and beyond.

In January 2013, the DOE issued the "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste" (Reference 15), indicating plans to implement a program over the next 10 years that begins operations of a pilot interim storage facility by 2021 with an initial focus on accepting used nuclear fuel from shut-down reactor site with a larger interim storage facility to be available by 2025.

OCNGS possesses some of the oldest fuel in the queue and is therefore eligible per the DOE Acceptance Priority Ranking & Annual Capacity Report, DOE/RW-0567 (Reference 16) for capacity allocations beginning in the first year of the operation of any DOE fuel storage or disposal facility. It is reasonable to assume that, based on cost and logistics, DOE will choose to remove fuel from shut-down reactors like OCNGS in one mobilization campaign rather than multiple mobilization efforts extending over several decades.

Assuming a 2025 start date for DOE initiating transfer of commercial spent fuel to a federal facility (based upon the proposed timeline for the availability of the larger interim storage facility), the assemblies generated from Oyster Creek operations are projected to be shipped from the Oyster Creek site in the years 2034 through 2035.

Spent fuel storage operations continue at the site, independent of decommissioning operations, until the transfer of the fuel to the DOE is complete. At that time, the ISFSI is decommissioned and the site released for unrestricted use.

To accommodate a prompt decommissioning approach, the nuclear fuel stored in the SFP will be placed in dry fuel storage casks following the required cooling period and stored at the ISFSI. The completion of the SFP-to-ISFSI pad campaign at the earliest possible time is made possible through application of the Holtec proprietary material and licensed multi-purpose canisters (MPCs). Following decommissioning, the ISFSI will remain under the amended NRC license and will be managed by HDI.

The OCNGS spent fuel project will be funded from the NDT following receipt of an exemption from current NRC restrictions on use of the fund.

- Stand-alone ISFSI

Expansion of existing dry fuel storage capacity will be completed prior to the start of structure demolition. The stand-alone ISFSI design includes features to address security and electrical supply to support ISFSI operation independent from other plant systems. Once all spent fuel is removed from the SFP and stored at the ISFSI, the OCNGS security, Technical Specifications and emergency planning requirements will be revised to reflect plant conditions.

Following site decommissioning, the NRC license will be amended to limit applicability to that portion of the site where the ISFSI containing the spent fuel and GTCC waste is located, with the remainder of the site being released for unrestricted use. Once the fuel and the GTCC waste are removed from the site, the ISFSI will be decommissioned and the license terminated.

- ISFSI Decommissioning

In accordance with 10 CFR §72.30, licensees must have a proposed decommissioning plan for the ISFSI site and facilities that includes a cost estimate for the plan. The plan should contain sufficient information on the proposed practices and procedures for the decontamination of the ISFSI and for the disposal of residual radioactive materials after all spent fuel, high-level radioactive waste, and reactor related GTCC waste have been removed.

Decommissioning of the ISFSI will be managed by the Decommissioning General Contractor, CDI, and performed by decommissioning, demolition and waste management specialty subcontractors. CDI prepared the ISFSI decommissioning cost estimate based on Oyster Creek plant data obtained from Exelon, the Updated Decommissioning Cost Analysis for OCNGS submitted by Exelon on dated March 30, 2016 (Reference 11) and the input and professional judgment of decommissioning, demolition and waste management specialty subcontractors. This estimate is based on the assumed configuration and condition of the ISFSI following removal of spent fuel and GTCC waste, prevailing low-level radioactive waste disposal rates and estimates of material and labor requirements from specialty subcontractors.

The estimate includes costs for work planning, survey and characterization work in preparation for decommissioning in addition to costs for demolition, packaging, transportation and disposal of radioactive and non-radioactive waste. Costs are included for HDI's management staff, industrial security, and other site operating costs as well as the costs for the supporting equipment, materials and supplies. Finally, costs are included for the final site survey, verification surveys and activities necessary to release the ISFSI site for unrestricted use and terminate the licenses.

A small number of the spent fuel storage canister overpack assemblies are assumed to have some level of neutron-induced activation as a result of the exposure to the fuel. Due to the leak-proof design of the spent fuel and GTCC canisters, it is assumed that there will be no contamination of ISFSI structures or components. The cost of the disposition of any material exceeding free release criteria, as well as the demolition of the ISFSI facility, is included in the cost estimate.

In accordance with the specific requirements of 10 CFR §72.30 for the ISFSI work scope, the cost estimate for decommissioning the ISFSI reflects: 1) the cost of CDI performing the decommissioning activities; 2) a Contingency Allowance of 25%; and 3) the cost of meeting the criteria for unrestricted use. The cost summary for decommissioning the ISFSI is presented in Appendix A

- Equipment

Equipment needs required to support characterization, removal and dismantlement efforts are based on the technical approach for performing the activities, and include laboratory equipment, lifts, cranes, excavators, spreaders and trucks. Existing site equipment will be used to the extent possible, supplemented by equipment rental or purchase where required. Rental of equipment is preferred due to mitigation of maintenance costs and the limited time periods when specialty equipment is required. For subcontracted work scope, subcontractors are responsible for providing their own equipment.

- Waste Management

To estimate waste management costs, CDI reviewed the Exelon estimated volumes of waste by type. Using the Exelon information as a reference condition, CDI adjusted the specific waste streams to reflect the decommissioning approach, then performed a disposition analysis to determine the type, size, and quantity of waste containers required to hold the anticipated waste volume. Disposal facilities were identified, and pricing was confirmed, and various methods of transportation to the disposal facility were evaluated. Transportation logistics were evaluated to ensure that the overall shipping strategy would be efficient and balanced with respect to container utilization, transport cycles and support for shipping during peaks in demolition activities.

Greater-Than-Class C (GTCC) Waste

GTCC waste will be managed and stored onsite until the DOE accepts the waste for final disposition, or until an appropriately licensed facility becomes available. The GTCC waste will be generated during reactor internal segmentation and potentially present in the spent fuel pool. The segmentation plan will use characterization information and an activation analysis to minimize the quantity of GTCC waste, and the packaging plan will reflect the segmentation plan. It is anticipated that no more than five

GTCC canisters will be required for the storage of GTCC waste from OCNGS decommissioning activities.

Low-Level Radioactive Waste (LLRW)

A major component of the decommissioning work scope for OCNGS is the packaging, transportation and disposal of contaminated/activated equipment, piping, concrete, and soil. Most of the waste volume will meet Class A, Low Specific Activity, or Surface Contaminated Object definitions, and higher activity items will be segmented and loaded to avoid complex transportation modes (e.g., cask transport) as much as possible. Some components will be capped and shipped with minimal sectioning but will require special conveyance equipment for at least a portion of the haul route. This is most likely for the RPV, large components, and some bulk debris items. Most of the radioactive debris will be shipped in metal shield boxes or standard combination intermodal containers.

To ensure flexibility of disposal options, CDI will process, package, and certify all LLRW to meet the respective Waste Acceptance Criteria (WAC) for multiple Treatment, Storage and Disposal Facilities (TSDFs). Because OCNGS is within the Atlantic Compact that provides access to the disposal site in Barnwell, this facility will be utilized as the primary disposal option unless overall cost (packaging, transport, and disposal) are higher than out of compact options. If costs are favorable, the Energy Solutions facility in Clive Utah and Waste Control Specialists (WCS) facility in Andrews, Texas could be used for waste disposal.

In most cases, waste will be prepared to meet acceptance requirements for multiple TSDFs. If a new or more efficient TSDF path emerges over the course of the project, CDI will develop a new profile for that option and provide technical guidance to the generator so that the new disposal path can be utilized. Disposal of LLRW will be performed in accordance with applicable local, state, and federal regulations. In some cases, special approvals may be required prior to selection and use of a particular disposal facility.

Mixed Wastes

Mixed Low-Level Waste (MLLW) generation will be minimized through appropriate characterization and demolition techniques and will be managed in accordance with applicable Federal and State regulations. Onsite treatment will not be pursued; rather, CDI will procure treatment needs from vendors such as Perma-Fix, Waste Control Specialists, and Energy*Solutions*.

Waste Transportation

The transportation approach for Class A, Low Specific Activity, or Surface Contaminated Object classes of waste will use a combination of truck, rail and potentially barge to support bulk quantity removal of waste. Since there is no active rail line at the site, a truck will be used to deliver the waste to a transload facility. Transportation of waste by barge from OCNGS to a nearby facility with rail access is an opportunity warranting further investigation due to the potential for a reduction in waste transportation vehicle road traffic and costs. However, transportation by barge is not used as a basis for costs in this estimate.

The transportation of all other classes of waste (Class B and C, hazardous, and mixed), as well as the transportation of the spent fuel and GTCC to the DOE repository, when it becomes available, will be by truck, as this mode of transportation minimizes transit time and is consistent with cask use requirements.

Table 3-7 presents OCNGS waste volume and weight estimates by Class. The CDI estimate of waste volumes is significantly higher than the Exelon cost estimate due to a decommissioning strategy that utilizes bulk removal with minimal decontamination. Additionally, the CDI estimate does not include off-site processing since this option would only be utilized if items require decontamination to meet transportation criteria or if the item has significant residual value and can be salvaged or reused.

## Table 3-1 Decommissioning Activities and Costs (thousands of 2018 dollars) by Period

| | Period 1 | Period 2 | Period 3 | Period 4 | Period 5 | | |
|---|---|---|---|---|---|---|---|
| Activities | Pre-decom Planning & Preparation | Plant Deactivation | Safe Storage Operations | Dismantlement | Ongoing ISFSI Operations | Program Management Costs | Total |
| **License Termination (Decommissioning) Activities** | **20,553** | **1,092** | | **350,353** | **11,732** | **234,103** | **617,832** |
| **Radioactive Component Removal** | | | | 48,954 | | | 48,954 |
| Dismantling of main process systems, structures and components | | | | 17,487 | | | 17,487 |
| Dismantling of reactor internals | | | | 31,166 | | | 31,166 |
| Dismantling of main process systems in fuel cycle facilities | | | | 301 | | | 301 |
| **Decontamination and Dismantlement** | | | | 43,212 | | | 43,212 |
| **Procurement of equipment for decontamination and dismantling** | | | | 39,163 | | | 39,163 |
| Procurement of general site-dismantling equipment | | | | 2,815 | | | 2,815 |
| Procurement of special tools for dismantling the reactor systems | | | | 36,348 | | | 36,348 |
| **Removal of materials requiring specific procedures** | | | | 151 | | | 151 |
| Removal of asbestos | | | | 151 | | | 151 |
| **Dismantling of other systems and components** | | | | 3,897 | | | 3,897 |
| Dismantling of remaining components | | | | 589 | | | 589 |
| **Conventional dismantling, demolition and site restoration** | | | | 59,740 | | | 59,740 |
| **Demolition of buildings and structures** | | | | 58,147 | | | 58,147 |
| Demolition of buildings and structures from the formerly controlled area | | | | 58,147 | | | 58,147 |
| **Final radioactivity survey of site** | | | | 1,593 | | | 1,593 |
| Final survey | | | | 1,593 | | | 1,593 |
| **Fuel and nuclear material** | | | | | 11,732 | | 11,732 |
| **ISFSI Storage fuel and/or nuclear material** | | | | | 10,574 | | 10,574 |
| Transfer of fuel and/or nuclear material away from the ISFSI | | | | | 10,574 | | 10,574 |
| **ISFSI Decommissioning** | | | | | 1,159 | | 1,159 |
| ISFSI Decommissioning | | | | | 1,159 | | 1,159 |
| ISFSI Decommissioning - ISFSI Decommissioning - License Termination costs | | | | | 1,159 | | 1,159 |
| **Waste** | | | | 198,447 | | | 198,447 |
| **Waste management system** | | | | 3,695 | | | 3,695 |

## Oyster Creek Nuclear Generating Station
## Revised Site-Specific Decommissioning Cost Estimate

| | Period 1 | Period 2 | Period 3 | Period 4 | Period 5 | | |
|---|---|---|---|---|---|---|---|
| Activities | Pre-decom Planning & Preparation | Plant Deactivation | Safe Storage Operations | Dismantlement | Ongoing ISFSI Operations | Program Management Costs | Total |
| Maintenance, surveillance and operational support for waste management system | | | | 3,695 | | | 3,695 |
| **Management of decommissioning intermediate-level waste/GTCC** | | | | 6,210 | | | 6,210 |
| Containers | | | | 6,210 | | | 6,210 |
| **Management of decommissioning low-level waste** | | | | 145,848 | | | 145,848 |
| **Management of decommissioning exempt waste and materials** | | | | 42,695 | | | 42,695 |
| **Management and Support** | 20,553 | 1,092 | | | | 234,103 | 255,747 |
| **Pre-decommissioning actions** | 20,553 | | | | | | 20,553 |
| Decommissioning planning | 14,537 | | | | | | 14,537 |
| Facility characterization | 5,177 | | | | | | 5,177 |
| Safety, security and environmental studies | 838 | | | | | | 838 |
| **Facility shutdown activities** | | 1,092 | | | | | 1,092 |
| Plant shutdown and inspection | | 1,092 | | | | | 1,092 |
| **Site infrastructure and operation** | | | | | | 72,015 | 72,015 |
| Site security and surveillance | | | | | | 33,328 | 33,328 |
| Site operation and maintenance | | | | | | 13,837 | 13,837 |
| Operation of Support Systems | | | | | | 879 | 879 |
| Radiation and environmental safety monitoring | | | | | | 23,972 | 23,972 |
| **Project management, engineering and support** | | | | | | 86,405 | 86,405 |
| Project management | | | | | | 44,003 | 44,003 |
| Support services | | | | | | 35,085 | 35,085 |
| Health and safety | | | | | | 7,317 | 7,317 |
| **Miscellaneous expenditures** | | | | | | 75,683 | 75,683 |
| **Owner costs** | | | | | | 42,740 | 42,740 |
| Implementation of transition plans | | | | | | 11,454 | 11,454 |
| Payments (fees) to authorities | | | | | | 31,286 | 31,286 |
| **Taxes** | | | | | | 27,503 | 27,503 |
| Local, community, federal taxes | | | | | | 27,503 | 27,503 |
| **Insurances** | | | | | | 5,440 | 5,440 |
| Nuclear related insurances | | | | | | 5,440 | 5,440 |
| **Spent Fuel Management Activities** | | | **83,479** | | **117,995** | **24,333** | **225,807** |
| **Fuel and nuclear material** | | | 83,479 | | 117,995 | | 201,474 |
| **Removal of fuel or nuclear material from facility to be decommissioned** | | | 16,567 | | | | 16,567 |
| Transfer of fuel or nuclear material to ISFSI | | | 16,567 | | | | 16,567 |
| **ISFSI Storage fuel and/or nuclear material** | | | 66,911 | | 115,944 | | 182,855 |

## Oyster Creek Nuclear Generating Station
## Revised Site-Specific Decommissioning Cost Estimate

| Activities | Period 1<br>Pre-decom Planning & Preparation | Period 2<br>Plant Deactivation | Period 3<br>Safe Storage Operations | Period 4<br>Dismantlement | Period 5<br>Ongoing ISFSI Operations | Program Management Costs | Total |
|---|---|---|---|---|---|---|---|
| Construction of ISFSI Expansion | | | 49,702 | | | | 49,702 |
| Operation of the ISFS | | | 17,209 | | 72,782 | | 89,991 |
| Transfer of fuel and/or nuclear material away from the ISFSI | | | | | 43,162 | | 43,162 |
| **ISFSI Decommissioning** | | | | | 2,051 | | 2,051 |
| ISFSI Decommissioning | | | | | 1,676 | | 1,676 |
| ISFSI Decommissioning - ISFSI Decommissioning - Spent Fuel Management costs | | | | | 1,676 | | 1,676 |
| Management of waste | | | | | 375 | | 375 |
| ISFSI Decommissioning - Management of waste - Spent Fuel Management costs | | | | | 375 | | 375 |
| **Waste** | | | | | | | |
| **Management and Support** | | | | | | 24,333 | 24,333 |
| **Project management, engineering and support** | | | | | | 16,759 | 16,759 |
| Project management | | | | | | 9,249 | 9,249 |
| Support services | | | | | | 6,134 | 6,134 |
| Health and safety | | | | | | 1,376 | 1,376 |
| **Miscellaneous expenditures** | | | | | | 7,574 | 7,574 |
| **Taxes** | | | | | | 6,441 | 6,441 |
| Local, community, federal taxes | | | | | | 6,441 | 6,441 |
| **Insurances** | | | | | | 1,133 | 1,133 |
| Nuclear related insurances | | | | | | 1,133 | 1,133 |
| **Site Restoration Activities** | | | | **32,652** | **732** | **7,980** | **41,365** |
| **Conventional dismantling, demolition and site restoration** | | | | 16,425 | | | 16,425 |
| **Demolition of buildings and structures** | | | | 12,112 | | | 12,112 |
| Demolition of buildings and structures outside the controlled area | | | | 12,112 | | | 12,112 |
| **Final cleanup, landscaping and refurbishment** | | | | 4,313 | | | 4,313 |
| Earthworks, landworks | | | | 261 | | | 261 |
| Landscaping and other site finishing activities | | | | 4,052 | | | 4,052 |
| **Fuel and nuclear material** | | | | | 732 | | 732 |
| **ISFSI Decommissioning** | | | | | 732 | | 732 |
| ISFSI Decommissioning | | | | | 655 | | 655 |
| ISFSI Decommissioning - ISFSI Decommissioning - Site Restoration costs | | | | | 655 | | 655 |
| Management of waste | | | | | 77 | | 77 |

## Oyster Creek Nuclear Generating Station
## Revised Site-Specific Decommissioning Cost Estimate

| | Period 1 | Period 2 | Period 3 | Period 4 | Period 5 | | |
|---|---|---|---|---|---|---|---|
| Activities | Pre-decom Planning & Preparation | Plant Deactivation | Safe Storage Operations | Dismantlement | Ongoing ISFSI Operations | Program Management Costs | Total |
| ISFSI Decommissioning - Management of waste - Site Restoration costs | | | | | 77 | | 77 |
| **Waste** | | | | 16,227 | | | 16,227 |
| **Management of decommissioning waste and materials generated outside controlled areas** | | | | 16,227 | | | 16,227 |
| **Management and Support** | | | | | | 7,980 | 7,980 |
| **Project management, engineering and support** | | | | | | 5,557 | 5,557 |
| Project management | | | | | | 2,957 | 2,957 |
| Support services | | | | | | 2,128 | 2,128 |
| Health and safety | | | | | | 472 | 472 |
| **Miscellaneous expenditures** | | | | | | 2,423 | 2,423 |
| **Taxes** | | | | | | 2,074 | 2,074 |
| Local, community, federal taxes | | | | | | 2,074 | 2,074 |
| **Insurances** | | | | | | 349 | 349 |
| Nuclear related insurances | | | | | | 349 | 349 |
| | | | | | | | |
| **Grand Total** | **20,553** | **1,092** | **83,479** | **383,005** | **130,459** | **266,416** | **885,004** |

## Table 3-2 Annual Program Management Cost (thousands of 2018 dollars)

| Cost By Year By WBS Split - Program Management Cost | | 2019 - Q3 | 2019 - Q4 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| WBS Code | Cost Category | | | | | | | | | |
| | License Termination | 27,495 | 13,464 | 44,118 | 51,190 | 35,697 | 30,077 | 22,128 | 9,934 | **234,103** |
| 01.02.06 | Site infrastructure and operation | 7,053 | 4,065 | 18,258 | 15,092 | 12,715 | 8,813 | 3,993 | 2,026 | **72,015** |
| 01.02.06.01 | Site security and surveillance | 3,140 | 1,756 | 8,786 | 7,144 | 7,174 | 3,889 | 792 | 648 | 33,328 |
| 01.02.06.01.03 | Security fencing and protection of remaining entrances against trespassing | | | 1,581 | | | | | | 1,581 |
| 01.02.06.01.04 | Deployment of guards/security forces | 3,140 | 1,756 | 7,204 | 7,144 | 7,174 | 3,889 | 792 | 648 | 31,747 |
| 01.02.06.02 | Site operation and maintenance | 1,635 | 685 | 2,813 | 2,789 | 2,801 | 2,195 | 918 | | 13,837 |
| 01.02.06.02.01 | Inspection and maintenance of buildings and systems | 698 | 685 | 2,813 | 2,789 | 2,801 | 2,195 | 918 | | 12,900 |
| 01.02.06.02.02 | Site Upkeep Activities | 937 | | | | | | | | 937 |
| 01.02.06.03 | Operation of Support Systems | 290 | 77 | 315 | 196 | | | | | 879 |
| 01.02.06.03.01 | Electricity Supply Systems | 38 | | | | | | | | 38 |
| 01.02.06.03.02 | Ventilation Systems | 179 | 77 | 315 | 196 | | | | | 767 |
| 01.02.06.03.07 | Other Systems | 73 | | | | | | | | 73 |
| 01.02.06.04 | Radiation and environmental safety monitoring | 1,987 | 1,547 | 6,344 | 4,963 | 2,740 | 2,729 | 2,283 | 1,378 | 23,972 |
| 01.02.06.04.01 | Procurement and maintenance of equipment for radiation protection and environmental monitoring | 35 | 25 | 99 | 99 | 99 | 99 | 61 | 7 | 526 |
| 01.02.06.04.02 | Radiation protection and monitoring | 1,913 | 1,483 | 6,087 | 4,707 | 2,484 | 2,473 | 2,063 | 1,242 | 22,453 |
| 01.02.06.04.03 | Environmental protection and radiation environmental monitoring | 39 | 38 | 158 | 156 | 157 | 156 | 158 | 129 | 992 |
| 01.02.08 | PI - OC - Project management, engineering and support | 9,308 | 4,662 | 10,886 | 16,993 | 15,000 | 14,267 | 11,412 | 3,877 | **86,405** |
| 01.02.08.02 | Project management | 3,599 | 2,475 | 5,821 | 8,857 | 7,533 | 6,988 | 6,104 | 2,625 | 44,003 |
| 01.02.08.02.01 | Core management group | 2,153 | 1,652 | 3,885 | 6,088 | 5,506 | 4,947 | 4,023 | 1,640 | 29,894 |
| 01.02.08.02.02 | Project implementation planning, detailed ongoing planning | 185 | 75 | 176 | 238 | 148 | 149 | 151 | 72 | 1,193 |
| 01.02.08.02.03 | Scheduling and cost control | 743 | 456 | 1,072 | 1,386 | 726 | 731 | 746 | 353 | 6,212 |
| 01.02.08.02.04 | Safety and environmental analysis, ongoing studies | 38 | 35 | 82 | 136 | 137 | 138 | 141 | 67 | 775 |
| 01.02.08.02.05 | Quality assurance and quality surveillance | 248 | 128 | 300 | 499 | 503 | 507 | 517 | 244 | 2,946 |
| 01.02.08.02.06 | General administration and accounting | 198 | 98 | 231 | 384 | 387 | 389 | 397 | 188 | 2,272 |
| 01.02.08.02.07 | Public relations and stakeholders involvement | 35 | 32 | 75 | 125 | 126 | 127 | 129 | 61 | 710 |
| 01.02.08.03 | Support services | 5,276 | 1,786 | 4,121 | 6,632 | 6,062 | 5,864 | 4,305 | 1,040 | 35,085 |
| 01.02.08.03.01 | Engineering support | 966 | 52 | 122 | 202 | 204 | 205 | 209 | 99 | 2,058 |
| 01.02.08.03.02 | Information system and computer support | 101 | 93 | 219 | 365 | 368 | 370 | 315 | 112 | 1,943 |
| 01.02.08.03.03 | Waste management support | 133 | 123 | 289 | 480 | 484 | 488 | 278 | | 2,275 |
| 01.02.08.03.04 | Decommissioning support including chemistry, decontamination | 48 | 45 | 106 | 176 | 177 | 178 | 102 | | 831 |
| 01.02.08.03.05 | Personnel management and training | 316 | 169 | 398 | 626 | 571 | 575 | 586 | 277 | 3,518 |
| 01.02.08.03.06 | Documentation and records control | 85 | 79 | 185 | 272 | 212 | 214 | 218 | 103 | 1,368 |
| 01.02.08.03.07 | Procurement, warehousing, and materials handling | 318 | 232 | 546 | 798 | 618 | 444 | 279 | 132 | 3,367 |
| 01.02.08.03.08 | Housing, office equipment, support services | 3,309 | 993 | 2,256 | 3,713 | 3,429 | 3,391 | 2,318 | 317 | 19,726 |
| 01.02.08.04 | Health and safety | 433 | 401 | 944 | 1,504 | 1,405 | 1,414 | 1,003 | 211 | 7,317 |

## Oyster Creek Nuclear Generating Station
## Revised Site-Specific Decommissioning Cost Estimate

| Cost By Year By WBS Split - Program Management Cost | | 2019 - Q3 | 2019 - Q4 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| 01.02.08.04.01 | Health physics | 168 | 155 | 365 | 542 | 435 | 438 | 447 | 211 | 2,761 |
| 01.02.08.04.02 | Industrial safety | 266 | 246 | 579 | 962 | 970 | 976 | 557 | | 4,555 |
| 01.02.11 | Miscellaneous expenditures | 11,134 | 4,737 | 14,974 | 19,105 | 7,981 | 6,998 | 6,723 | 4,031 | **75,683** |
| 01.02.11.01 | Owner costs | 8,259 | 2,024 | 9,581 | 12,893 | 3,199 | 2,440 | 2,397 | 1,947 | 42,740 |
| 01.02.11.01.01 | Implementation of transition plans | 6,072 | | | 5,382 | | | | | 11,454 |
| 01.02.11.01.03 | Payments (fees) to authorities | 2,187 | 2,024 | 9,581 | 7,511 | 3,199 | 2,440 | 2,397 | 1,947 | 31,286 |
| 01.02.11.02 | Taxes | 2,557 | 2,412 | 4,703 | 5,056 | 3,623 | 3,664 | 3,704 | 1,785 | 27,503 |
| 01.02.11.02.02 | Local, community, federal taxes | 2,557 | 2,412 | 4,703 | 5,056 | 3,623 | 3,664 | 3,704 | 1,785 | 27,503 |
| 01.02.11.03 | Insurances | 319 | 301 | 689 | 1,156 | 1,159 | 894 | 622 | 300 | 5,440 |
| 01.02.11.03.01 | Nuclear related insurances | 319 | 301 | 689 | 1,156 | 1,159 | 894 | 622 | 300 | 5,440 |
| | Spent Fuel | 258 | 242 | 11,818 | 1,187 | 2,817 | 2,446 | 363 | 5,202 | **24,333** |
| 01.02.08 | PI - OC - Project management, engineering and support | 197 | 153 | 7,903 | 870 | 2,136 | 1,854 | 263 | 3,383 | **16,759** |
| 01.02.08.02 | Project management | 76 | 81 | 4,226 | 453 | 1,073 | 908 | 141 | 2,291 | 9,249 |
| 01.02.08.02.01 | Core management group | 46 | 54 | 2,820 | 312 | 784 | 643 | 93 | 1,431 | 6,183 |
| 01.02.08.02.02 | Project implementation planning, detailed ongoing planning | 4 | 2 | 128 | 12 | 21 | 19 | 3 | 63 | 253 |
| 01.02.08.02.03 | Scheduling and cost control | 16 | 15 | 778 | 71 | 103 | 95 | 17 | 308 | 1,403 |
| 01.02.08.02.04 | Safety and environmental analysis, ongoing studies | 1 | 1 | 60 | 7 | 20 | 18 | 3 | 58 | 168 |
| 01.02.08.02.05 | Quality assurance and quality surveillance | 5 | 4 | 218 | 26 | 72 | 66 | 12 | 213 | 616 |
| 01.02.08.02.06 | General administration and accounting | 4 | 3 | 168 | 20 | 55 | 51 | 9 | 164 | 473 |
| 01.02.08.02.07 | Public relations and stakeholders involvement | 1 | 1 | 55 | 6 | 18 | 16 | 3 | 53 | 154 |
| 01.02.08.03 | Support services | 112 | 59 | 2,992 | 339 | 863 | 762 | 99 | 908 | 6,134 |
| 01.02.08.03.01 | Engineering support | 20 | 2 | 88 | 10 | 29 | 27 | 5 | 86 | 267 |
| 01.02.08.03.02 | Information system and computer support | 2 | 3 | 159 | 19 | 52 | 48 | 7 | 98 | 388 |
| 01.02.08.03.03 | Waste management support | 3 | 4 | 210 | 25 | 69 | 63 | 6 | | 380 |
| 01.02.08.03.04 | Decommissioning support including chemistry, decontamination | 1 | 1 | 77 | 9 | 25 | 23 | 2 | | 139 |
| 01.02.08.03.05 | Personnel management and training | 7 | 6 | 289 | 32 | 81 | 75 | 14 | 242 | 745 |
| 01.02.08.03.06 | Documentation and records control | 2 | 3 | 134 | 14 | 30 | 28 | 5 | 90 | 306 |
| 01.02.08.03.07 | Procurement, warehousing, and materials handling | 7 | 8 | 397 | 41 | 88 | 58 | 6 | 115 | 719 |
| 01.02.08.03.08 | Housing, office equipment, support services | 70 | 33 | 1,638 | 190 | 488 | 441 | 54 | 277 | 3,189 |
| 01.02.08.04 | Health and safety | 9 | 13 | 685 | 77 | 200 | 184 | 23 | 184 | 1,376 |
| 01.02.08.04.01 | Health physics | 4 | 5 | 265 | 28 | 62 | 57 | 10 | 184 | 615 |
| 01.02.08.04.02 | Industrial safety | 6 | 8 | 420 | 49 | 138 | 127 | 13 | | 761 |
| 01.02.11 | Miscellaneous expenditures | 61 | 89 | 3,915 | 318 | 681 | 592 | 100 | 1,819 | **7,574** |
| 01.02.11.02 | Taxes | 54 | 79 | 3,414 | 259 | 516 | 476 | 85 | 1,557 | 6,441 |
| 01.02.11.02.02 | Local, community, federal taxes | 54 | 79 | 3,414 | 259 | 516 | 476 | 85 | 1,557 | 6,441 |
| 01.02.11.03 | Insurances | 7 | 10 | 500 | 59 | 165 | 116 | 14 | 262 | 1,133 |
| 01.02.11.03.01 | Nuclear related insurances | 7 | 10 | 500 | 59 | 165 | 116 | 14 | 262 | 1,133 |
| | Site Restoration | 218 | 507 | 3,191 | 2,210 | 6 | | 1,488 | 361 | **7,980** |
| 01.02.08 | PI - OC - Project management, engineering and support | 167 | 320 | 2,134 | 1,618 | 5 | | 1,079 | 235 | **5,557** |
| 01.02.08.02 | Project management | 64 | 170 | 1,141 | 843 | 2 | | 577 | 159 | 2,957 |

## Oyster Creek Nuclear Generating Station
## Revised Site-Specific Decommissioning Cost Estimate

| Cost By Year By WBS Split - Program Management Cost | | 2019 - Q3 | 2019 - Q4 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| 01.02.08.02.01 | Core management group | 39 | 113 | 761 | 580 | 2 | | 380 | 99 | 1,975 |
| 01.02.08.02.02 | Project implementation planning, detailed ongoing planning | 3 | 5 | 35 | 23 | | | 14 | 4 | 84 |
| 01.02.08.02.03 | Scheduling and cost control | 13 | 31 | 210 | 132 | | | 70 | 21 | 479 |
| 01.02.08.02.04 | Safety and environmental analysis, ongoing studies | 1 | 2 | 16 | 13 | | | 13 | 4 | 50 |
| 01.02.08.02.05 | Quality assurance and quality surveillance | 4 | 9 | 59 | 48 | | | 49 | 15 | 183 |
| 01.02.08.02.06 | General administration and accounting | 4 | 7 | 45 | 37 | | | 38 | 11 | 141 |
| 01.02.08.02.07 | Public relations and stakeholders involvement | 1 | 2 | 15 | 12 | | | 12 | 4 | 45 |
| 01.02.08.03 | Support services | 94 | 123 | 808 | 632 | 2 | | 407 | 63 | 2,128 |
| 01.02.08.03.01 | Engineering support | 17 | 4 | 24 | 19 | | | 20 | 6 | 90 |
| 01.02.08.03.02 | Information system and computer support | 2 | 6 | 43 | 35 | | | 30 | 7 | 123 |
| 01.02.08.03.03 | Waste management support | 2 | 8 | 57 | 46 | | | 26 | | 140 |
| 01.02.08.03.04 | Decommissioning support including chemistry, decontamination | 1 | 3 | 21 | 17 | | | 10 | | 51 |
| 01.02.08.03.05 | Personnel management and training | 6 | 12 | 78 | 60 | | | 55 | 17 | 227 |
| 01.02.08.03.06 | Documentation and records control | 2 | 5 | 36 | 26 | | | 21 | 6 | 96 |
| 01.02.08.03.07 | Procurement, warehousing, and materials handling | 6 | 16 | 107 | 76 | | | 26 | 8 | 239 |
| 01.02.08.03.08 | Housing, office equipment, support services | 59 | 68 | 442 | 354 | 1 | | 219 | 19 | 1,163 |
| 01.02.08.04 | Health and safety | 8 | 28 | 185 | 143 | | | 95 | 13 | 472 |
| 01.02.08.04.01 | Health physics | 3 | 11 | 72 | 52 | | | 42 | 13 | 192 |
| 01.02.08.04.02 | Industrial safety | 5 | 17 | 113 | 92 | | | 53 | | 280 |
| 01.02.11 | Miscellaneous expenditures | 51 | 186 | 1,057 | 592 | 1 | | 409 | 126 | **2,423** |
| 01.02.11.02 | Taxes | 46 | 166 | 922 | 481 | 1 | | 350 | 108 | 2,074 |
| 01.02.11.02.02 | Local, community, federal taxes | 46 | 166 | 922 | 481 | 1 | | 350 | 108 | 2,074 |
| 01.02.11.03 | Insurances | 6 | 21 | 135 | 110 | | | 59 | 18 | 349 |
| 01.02.11.03.01 | Nuclear related insurances | 6 | 21 | 135 | 110 | | | 59 | 18 | 349 |

## Table 3-3 CDI Decommissioning Cost Estimate Summary (thousands of 2018 dollars)

| Cost Category | License Termination | Spent Fuel | Site Restoration | Total |
|---|---|---|---|---|
| Decontamination | N/A | N/A | N/A | N/A |
| Removal | 162,045 | | 17,157 | 179,202 |
| Packaging | 20,608 | | | 20,608 |
| Transportation | 30,498 | | 1,242 | 31,740 |
| Disposal | 143,646 | | 14,985 | 158,631 |
| Off-site Waste Processing | N/A | N/A | N/A | N/A |
| Program Management | 150,808 | 13,569 | 4,395 | 168,772 |
| Corporate A&G | N/A | N/A | N/A | N/A |
| Spent Fuel | | 201,474 | | 201,474 |
| Insurance and Regulatory Fees | 36,726 | 1,133 | 349 | 38,208 |
| Energy | 19,726 | 3,189 | 1,163 | 24,078 |
| Characterization and Licensing Surveys | 6,770 | | | 6,770 |
| Property Taxes | 27,503 | 6,441 | 2,074 | 36,018 |
| Miscellaneous Equipment / Site Services | 19,502 | | | 19,502 |
| Spent Fuel Pool Isolation | N/A | N/A | N/A | N/A |
| **Grand Total** | **617,832** | **225,807** | **41,365** | **885,004** |

## Table 3-4 HDI vs Exelon DCE Comparison (thousands of 2018 dollars)

| Cost Category | Total[1] | Values from Exelon (Escalated to $2018) | Difference |
|---|---|---|---|
| Decontamination | | 27,992 | (27,992) |
| Removal | 179,202 | 197,293 | (18,091) |
| Packaging | 20,608 | 29,463 | (8,855) |
| Transportation | 31,740 | 29,064 | 2,676 |
| Disposal | 158,631 | 94,490 | 64,141 |
| Off-site Waste Processing | | 14,696 | (14,696) |
| Program Management | 168,772 | 383,163 | (214,391) |
| Security | | 167,594 | (167,594) |
| Spent Fuel Pool Isolation | | 13,590 | (13,590) |
| Spent Fuel | 201,474 | 155,372 | 46,101 |
| Insurance and Regulatory Fees | 38,208 | 24,274 | 13,934 |
| Energy | 24,078 | 13,024 | 11,054 |
| Characterization and Licensing Surveys | 6,770 | 32,958 | (26,187) |
| Property Taxes | 36,018 | 19,273 | 16,745 |
| Miscellaneous Equipment / Site Services | 19,502 | 7,690 | 11,813 |
| **Grand Total** | **885,004** | **1,209,934** | **(324,930)** |

[1] The estimate reflects HDI costs only and does not include approximately $94 million in expenses, including decommissioning planning and other decommissioning activities, accrued by Exelon prior to the asset transfer to OECP and HDI

## Table 3-5 Labor Costs (thousands of 2018 dollars) and Labor Requirements by Year

| | Labor Costs ($Thousands) and Labor Requirements (FTEs) by Year | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | Total Cost |
| Management Labor Cost | 52 | 4,116 | 8,150 | 7,657 | 6,973 | 6,285 | 4,906 | 3,403 | 1,139 | 1,139 | 1,142 | 1,139 | 1,139 | 1,139 | 1,142 | 1,139 | 1,139 | 565 | **52,359** |
| Management Labor FTEs | 0.6 | 54.6 | 26.9 | 25.8 | 23.9 | 21.6 | 16.8 | 11.4 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 1.2 | |
| | | | | | | | | | | | | | | | | | | | |
| Professional Labor Cost | 222 | 16,397 | 24,070 | 22,555 | 19,907 | 15,439 | 10,578 | 7,655 | 3,869 | 3,869 | 3,880 | 3,869 | 3,869 | 3,869 | 3,880 | 3,944 | 3,944 | 1,368 | **153,185** |
| Professional Labor FTEs | 3.9 | 431.2 | 162.2 | 155.7 | 141.0 | 105.1 | 66.8 | 50.1 | 24.0 | 24.0 | 24.0 | 24.0 | 24.0 | 24.0 | 24.0 | 24.3 | 24.3 | 8.6 | |
| | | | | | | | | | | | | | | | | | | | |
| Craft Labor Cost | | 5,912 | 10,352 | 9,435 | 3,532 | 1,720 | 2,181 | 838 | | | | | | | | | | | **33,970** |
| Craft Labor FTEs | 0.0 | 144.9 | 60.1 | 59.5 | 22.2 | 11.0 | 13.8 | 5.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | | | | | | | | | | | | | | | | |
| **Total Labor Cost** | 274 | 26,425 | 42,571 | 39,647 | 30,412 | 23,444 | 17,665 | 11,896 | 5,008 | 5,008 | 5,022 | 5,008 | 5,008 | 5,008 | 5,022 | 5,083 | 5,083 | 1,932 | **239,514** |
| **Total Labor FTEs** | 4.5 | 630.7 | 249.1 | 241.0 | 187.1 | 137.7 | 97.3 | 66.8 | 26.0 | 26.0 | 26.0 | 26.0 | 26.0 | 26.0 | 26.0 | 26.3 | 26.3 | 9.7 | |

## Table 3-6 Labor Costs (thousands of 2018 dollars) and Labor Requirements by Period

| | Labor Costs ($Thousands) and Labor Requirements (FTEs) by Period | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Period 1 | | Period 2 | | Period 3 | | Period 4 | | Period 5 | | Program Management | | Total | |
| | Labor Req | Labor Cost | Labor Req | Labor Cost | Labor Req | Labor Cost | Labor Req | Labor Cost | Labor Req | Labor Cost | Labor Req | Labor Cost | Labor Req | Labor Cost |
| **BWR DECON** | | | | | | | | | | | | | | |
| Decommissioning Crews | 0.0 | 0 | 2.5 | 109 | 0.0 | 0 | 149.5 | 16,898 | 0.0 | 0 | 164.9 | 16,963 | 316.9 | 33,970 |
| Management/Support Staff | 4.5 | 274 | 21.1 | 983 | 249.1 | 48,127 | 59.1 | 6,285 | 156.1 | 13,224 | 1051.6 | 136,651 | 1541.6 | 205,544 |
| **Total** | **4.5** | **274** | **23.6** | **1,092** | **249.1** | **48,127** | **208.6** | **23,184** | **156.1** | **13,224** | **1216.5** | **153,614** | **1858.5** | **239,514** |

## Table 3-7 OCNGS Waste Quantities

| Waste | Class | Volume (cubic feet) | Weight (pounds) |
|---|---|---|---|
| Low-Level Radioactive Waste | A | 952,918 | 61,939,638 |
| | B | 954 | 88,771 |
| | C | 729 | 67,834 |
| Greater Than Class C Waste | GTCC | 1428 | 285,600 |
| **Total** | | **956,029** | **62,381,843** |

# 4.0 COST ESTIMATING APPROACH

## 4.1 Estimating Methodology

The CDI estimating methodology is an iterative process which is compatible with the development of integrated scope, schedule, cost, risk, and contingency baselines. Summary highlights of the key steps in the estimating process include:

- Initiating the cost estimate process with a discovery period, and cataloging project specific details, due diligence, applicable industry standards, and available benchmarking data
- Capturing and organizing the work scope into the hierarchical structure of standard decommissioning activities outlined in the major decommissioning elements and sub-elements contained within the ISDC WBS along with a corresponding WBS dictionary
- Identifying the major decommissioning project milestones and developing a Decommissioning Project Milestone Summary Schedule capturing the relationship and sequencing of the milestones
- Assigning each WBS sub-element to subject matter experts to develop a detailed basis of estimate for each WBS sub-element capturing the project specific scope of work, technical approach, deliverables, assumptions, existing and verifiable data, judgmental factors, exclusions, and resources
- Identifying and qualitatively ranking the discrete risk events having a potential impact on the project scope, schedule and budget; and populating the risk register
- Developing detailed schedule fragnets for each WBS sub-element, fully defining the activities, durations and logic ties and compiling these detailed schedule fragnets into a detailed activity schedule model in Primavera, P6
- Identifying quantities, resources, and cost elements to accomplish the detailed scope of work in alignment with the P6 schedule activities
- Compiling the estimate details into the cost model and validating results
- Assigning estimate uncertainty categories to WBS sub-elements
- Developing an integrated estimate and schedule risk model to validate schedule integrity and to establish and define cost and schedule contingency reserves
- Verifying and validating the cost, schedule, and risk models, model input and model results
- Documenting the estimate development details, basis methodologies and assumptions

## 4.2 Basis of Estimate

The decommissioning scope of work for OCNGS was organized into 39 Level 4 WBS elements, and an individual basis of estimate (BOE) was developed for each of the elements. These BOEs capture the essential cost estimating and schedule development data; including the site-specific scope, technical approach, key deliverables, assumptions,

judgmental factors, existing and verifiable data, exclusions, and resources (quantities and pricing). Table 4-1 includes the 39 WBS elements for which the detailed BOEs were developed.

A variety of methods were used to prepare the decommissioning cost estimate. The method utilized to estimate each WBS work scope was based on the professional judgment of the responsible SME considering the nature of the work, degree of scope definition, availability of quantifiable cost and pricing data, and other factors. Common methods employed were:

- Subcontractor Quote: Cost and pricing information for a well-defined scope of work provided by a specialty subcontractor
- Bottoms Up: A detailed take-o□ of material quantities, direct labor, and equipment is prepared from a set of drawings and/or specifications
- Parametric: Relies on the relationship between variables to estimate the costs
- Analogous: Uses a top down approach where costs of work captured from historical similar projects as the basis to estimate or forecast costs for new work
- Professional Judgment/Expert Opinion: Used when no other technique of data is readily available

CDI reviewed the decommissioning cost estimate submitted to the NRC by Exelon Generation on March 30, 2016. The Exelon estimate evaluated DECON, Delayed DECON and SAFSTOR scenarios that were representative of available methods. The detailed cost estimate used unit cost factors incorporating OCNGS specific costs and applied these unit cost factors to plant inventory, decommissioning waste streams and estimated waste quantities. The Exelon basis of estimate and the resulting cost estimate details are a reference condition for the CDI cost estimate development e□ort.

CDI used plant data and historical information obtained from Exelon during an extensive due diligence effort in addition to the input and professional judgment of experienced specialty subcontractors and subject matter experts (SMEs). This estimate is based on regulatory requirements, site conditions, basis of estimate assumptions, low-level radioactive waste disposal standards, high-level radioactive waste management options, and site restoration requirements. The methods utilized to estimate decommissioning costs were based on the professional judgment of the experienced SMEs considering the nature of the work, degree of scope definition, availability of quantifiable cost and pricing data, and other factors.

CDI reviewed the estimates of costs associated with license termination in NUREG/CR-6174, Revised Analyses of Decommissioning for the Reference Boiling Water Reactor Power Station, in order to evaluate the reasonableness of the OCNGS estimate.

CDI assembled and analyzed available decommissioning data from several plants in the United States that have ceased operations and have started and/or completed

decommissioning activities and compared the estimated costs for OCNGS license termination, spent fuel management and site restoration to nine (9) comparable decommissioning projects. CDI also compared the OCNGS decommissioning cost estimate for license termination, spent fuel management and site restoration activities to costs from similar activities from seven (7) decommissioned BWR nuclear power plants.

This estimate includes provisions for storage of spent fuel and GTCC wastes on the OCNGS site until acceptance by the Department of Energy. Escalation of future decommissioning costs over the remaining decommissioning project life-cycle are excluded.

### 4.3 Assumptions

Work planning, schedule development and cost estimating for the decommissioning of OCNGS rely on a set of assumptions regarding the type and quality of inputs and the nature of the work.

Pre-Decommissioning Planning

- Exelon Generation has provided reasonable and accurate information in good faith regarding the history and current condition of the plant and site
- Minimal decontamination and no offsite processing will be carried out to free release contaminated material
- In determining the waste management strategy and volume estimates, all contaminated material will be characterized as LLRW, or its respective waste classification
- Waste classification for transport will be supported by an initial site waste characterization e□ort

Facility Shutdown Activities

- All wastes and waste streams generated during decommissioning have a disposition path
- No orphan waste will be generated during decommissioning

Dismantling Activities within the Radiologically Controlled Area

- Local ventilation will be required for most tasks and building ventilation is adequate for these tasks and will not require upgrading or replacement
- The reinforced reactor building overhead crane will be available and has adequate lift capacity for casks containing RPV internals, water and the shielding cover
- The turbine building overhead crane has adequate lift capacity for the low-pressure turbines and the generator

Waste Processing, Storage and Disposal

- Several waste streams will have sub streams that reflect non-radiological (regulated) hazards

- Transportation of waste o□site will include truck conveyance to rail
- No radioactive waste systems or processing areas will be refurbished or refit for use during decommissioning
- The estimated RCRA/TSCA/demolition debris waste streams and waste soils represent multiple waste profiles from this element (outside the Radiological Controlled Area)
- Waste sampling and data verification/validation is accomplished by a subcontractor

Site Infrastructure and Operation

- Existing OCNGS site security is adequate for transition and CDI decommissioning activities
- The existing OCNGS O&M procedures are available and adequate for all active plant systems
- SMEs are available in the existing OCNGS work force and a sufficient number will transition to CDI to support decommissioning

Project Management, Engineering, and Support

- The CDI project management team will mobilize to the site during the pre-decommissioning planning phase to be ready to begin decommissioning following the asset sale and transfer of the facility licenses

Fuel and Nuclear Material

- All OCNGS plant systems required to carry out the spent fuel to ISFSI pad transfer campaign are operational

### 4.4 Inflation

The decommissioning cost estimates presented in this report were developed and reported in 2018 dollars. Escalation of future decommissioning costs over the remaining decommissioning project life-cycle is excluded.

### 4.5 Contingency

Any project has inherent uncertainty in the estimated quantities, unit rates, productivity, pricing, and schedule durations. Concurrently there are also a vast number of project specific discrete risks, e.g., risk events that may also a□ect cost and schedule estimates. A sound risk management approach is used to establish the appropriate levels of cost and schedule contingency reserves for establishing achievable target schedules and budgets, and for making well-informed decisions during the decommissioning project lifecycle.

CDI uses a Monte-Carlo simulation risk modeling tool, Oracle Primavera Risk Analysis (OPRA) to quantitatively evaluate the integrated impact of uncertainty and discrete risk events on the project objectives and baseline schedule and costs. OPRA integrates directly with project schedules and cost estimates and provides simple techniques to model uncertainty and discrete risk events and forecast the cost and schedule impacts.

OPRA output is used with expert judgement to provide an objective view to validate the integrity of the schedule model, evaluate the e□ectiveness of risk response plans, identify and prioritize key risk drivers, quantify schedule and cost reserves based on desired levels of confidence, and publish risk-adjusted schedules.

Estimate Uncertainty

Uncertainty in estimates is generally a function of the level of maturity in the project definition. Estimate uncertainty is also a function of various factors including:

- expected site conditions (physical and radiological)
- decommissioning processes and tools
- new and/or non-familiar technology
- complexity
- labor skills and productivity
- stakeholder/regulatory requirements
- quality of cost estimating assumptions and data;
- experience and skill level of the estimator
- pricing
- estimating techniques
- time and level of e□ort allowed to prepare the cost estimate and schedule.

To provide a basis to account for the uncertainty in a decommissioning project schedule duration and/or cost, CDI estimating and technical subject matter experts assigned one of the three estimate types (Conceptual, Budget, or Definitive) to each WBS and corresponding BOE. This assignment was based on estimate methodology, available data, and professional judgement.

Estimate uncertainty profiles were developed to show the cumulative impacts from the estimate type and level of accuracy on schedules and costs. These estimate uncertainty profiles were used to establish the schedule and cost Uncertainty Allowance that is added to the decommissioning project baseline schedule and cost estimate to address the estimate uncertainty within the defined decommissioning scope of work and execution strategy.

Uncertainty Allowance is included in the baseline cost and schedule to cover ill-defined work scope or elements of costs and schedules expected to be incurred, which cannot be explicitly foreseen or estimated because of a lack of complete, accurate or detailed information. The amount of time/duration and costs to be included in the schedule and cost baselines for Uncertainty Allowance to account for these uncertainties is derived using the quantitative risk model in OPRA for the 85% probability or level of confidence.

Discrete Risk Events

Discrete risks events on a project can be either threats or opportunities. Discrete risk events are considered a threat when the risk event may negatively impact the project baseline objectives, such as schedule delays and cost increases. Discrete risk events are

considered an opportunity when the event may positively impact the project objectives, such as schedule and/or cost savings. Unlike uncertainty, discrete risk events may or may not occur. The risk analysis process used to evaluate discrete risk events is both qualitative and quantitative.

Qualitative risk analysis is the process of examining each identified risk event to refine the description of the risk event, isolate the contributing factors, define the risk event probability of occurrence, measure impacts (positive or negative) to the cost and schedule baseline should the risk event occur, and assessment of the manageability of exposure to the risk event. CDI uses a risk event scoring matrix to qualitatively grade/prioritize the discrete risk events as extremely high, high, medium, and low based on the probability of occurrence and impacts. This qualitative assessment is used to prioritize the discrete risk events for more detailed risk analysis and risk response planning with primary focus on the medium, high and extremely high-risk events.

In addition to a qualitative analysis of discrete risk events, CDI also performs a quantitative analysis on all the active discrete risk events classified as threats. The quantitative risk analysis process relies on risk modeling/risk simulation tools to evaluate the individual and cumulative e□ects of the identified discrete risk events in concert with estimate uncertainty on overall project objectives and baseline schedule and costs. The primary goal of quantitative analysis is to produce measurable risk information to establish appropriate levels of reserves in the cost and schedule baselines and to support management decision making to increase project certainty.

Risk Allowance is funds added to the baseline schedule and estimate to account for discrete risk events (both threats and opportunities) that may or may not occur during the decommissioning project lifecycle. The amount of time/duration and costs to be included in the schedule and cost baselines for Risk Allowance to account for discrete risk events that may materialize during the decommissioning project lifecycle is also derived from the quantitative risk model in OPRA for the 85% probability or level of confidence.

Contingency Allowance

Based on an integrated evaluation of estimate uncertainty and discrete risk events utilizing industry accepted risk modeling tools and techniques in addition to a review of industry experience with similar decommissioning projects, a Contingency Allowance of 15 percent was determined to be reasonable for the Oyster Creek decommissioning project. This Contingency Allowance is incorporated into the estimate of License Termination, Spent Fuel Management and Site Restoration costs presented herein, with the exception of ISFSI decommissioning costs, which include a 25% Contingency Allowance consistent with the contingency evaluation criteria referenced by the NRC in NUREG-1757 (Reference 18).

The Contingency Allowance is an integral part of the cost to complete the OCNGS decommissioning and is expected to be fully consumed. Contingency does not account

for inflation or escalation of the price of goods and services over the course of the project.

## Table 4-1 Work Breakdown Structure

| WBS Code | WBS Name |
|---|---|
| 01.02.01.01 | Decommissioning planning |
| 01.02.01.02 | Facility characterization |
| 01.02.01.03 | Safety, security and environmental studies |
| 01.02.01.04 | Waste management planning |
| 01.02.01.05 | Authorization |
| 01.02.01.06 | Preparing management group and contracting |
| 01.02.02.01 | Plant shutdown and inspection |
| 01.02.02.02 | Drainage and drying of systems |
| 01.02.02.05 | Removal of system fluids, operational waste and redundant material |
| 01.02.04.01 | Procurement of equipment for decontamination and dismantling |
| 01.02.04.02 | Preparations and support for dismantling |
| 01.02.04.04 | Removal of materials requiring specific procedures |
| 01.02.04.05 | Dismantling of main process systems, structures and components |
| 01.02.04.06 | Dismantling of other systems and components |
| 01.02.04.08 | Removal of contamination from areas outside buildings |
| 01.02.04.09 | Final radioactivity survey for release of buildings |
| 01.02.05.01 | Waste management system |
| 01.02.05.08 | Management of decommissioning intermediate-level waste/GTCC |
| 01.02.05.09 | Management of decommissioning low-level waste |
| 01.02.05.12 | Management of decommissioning exempt waste and materials |
| 01.02.05.13 | Management of decommissioning waste and materials generated outside controlled areas |
| 01.02.06.01 | Site security and surveillance |
| 01.02.06.02 | Site operation and maintenance |
| 01.02.06.03 | Operation of support systems |
| 01.02.06.04 | Radiation and environmental safety monitoring |
| 01.02.07.02 | Dismantling of systems and building components outside the controlled area |
| 01.02.07.03 | Demolition of buildings and structures |
| 01.02.07.04 | Final cleanup, landscaping and refurbishment |
| 01.02.07.05 | Final radioactivity survey of site |
| 01.02.08.01 | Mobilization and preparatory work |
| 01.02.08.02 | Project management |
| 01.02.08.03 | Support services |
| 01.02.08.04 | Health and safety |
| 01.02.10.01 | Removal of fuel or nuclear material from facility to be decommissioned |
| 01.02.10.02 | Dedicated storage for fuel and/or nuclear material |
| 01.02.10.03 | Decommissioning of the ISFSI |
| 01.02.11.01 | Owner costs |
| 01.02.11.02 | Taxes |
| 01.02.11.03 | Insurances |

# 5.0 DECOMMISSIONING SCHEDULE AND FUNDING

The schedule and financial information contained in this section is based on the HDI decommissioning plan for Oyster Creek. The schedule, decommissioning costs, and cash flow analysis assume a fuel cooling period based on the existing Certificate of Compliance (CoC) for the spent fuel canisters planned to be used at Oyster Creek. Holtec has submitted a request to amend the CoC for these canisters and anticipates NRC approval of the amendment in mid-2020. However, the schedule, costs, and cash flow analysis in presented herein do not rely on the earlier loading time that would be allowed by the CoC amendment upon NRC approval. Under the currently approved CoC, the Oyster Creek fuel can all be loaded into the dry cask system within 4.5 years of permanent shutdown, which results in a completion of the Oyster Creek fuel pool-to-pad milestone by July 2023. This timeframe is the basis for the cost estimates and cash flow analysis. However, Holtec expects that the amendment request will be approved to allow the Oyster Creek fuel to be loaded into the dry cask system on or before July 2021. The estimated decommissioning costs and cash flow data bound the costs and cash flow analysis for an earlier fuel loading date.

## 5.1 Decommissioning Schedule

The schedule and cost estimate to decommission OCNGS is based on the DECON method. The detailed decommissioning project schedule, developed in Primavera P6, is used as the foundation for developing the decommissioning cost estimate and risk model. The OCNGS schedule baseline is a detailed Critical Path Method (CPM) schedule model built with input from the key decommissioning subcontractors and subject matter experts. The schedule currently contains about 1,500 schedule activities organized by WBS element.

The major steps in the decommissioning project schedule development methodology include the following:

1. Identify and define the major decommissioning project milestones
2. Develop a decommissioning project Master Summary Schedule (MSS) in Oracle Primavera P6, capturing the relationship and sequencing of the key project milestones
3. Prepare milestone-focused, activity-based schedule fragnets by WBS, comprised of detailed activities, durations, sequencing, and constraints in alignment with the technical solutions and MSS
4. Capture all the activity-based schedule fragnets into an integrated, logically linked master decommissioning project schedule model in Oracle Primavera P6
5. Verify and validate the integrated master decommissioning project schedule model in Oracle Primavera P6 against the MSS. Confirm the schedule integrity/reasonableness of the overall project primary/secondary critical paths as well as for each MSS milestone
6. Confirm schedule quality using OPRA

Figure 5-1 provides the Master Summary Schedule, which is based on the assumptions that the licenses are transferred to HDI in July of 2019.

Transfer of spent nuclear fuel to the ISFSI is finalized in 2023, allowing completion of dismantlement of the Reactor Building and Turbine Building and the cleanout and dismantlement of the SFP structures and components, in addition to the packaging and storage of GTCC waste generated from SFP cleanout, if required. Radiological decommissioning is completed in 2024, leading to a release of all portions of the OCNGS site except for the ISFSI (partial site release) by 2025.

As described in Subsection 3.3, the Oyster Creek spent fuel is projected to be accepted by the DOE for shipment away from the Oyster Creek site in the years 2034 and 2035.

Spent fuel storage operations continue at the site, independent of decommissioning operations, until the transfer of the fuel to the DOE is complete. At that time, the ISFSI is decommissioned and the site released for unrestricted use.

## 5.2 Decommissioning Funding

10 CFR 50.82(a)(6)(iii) states that, "Licensees shall not perform any decommissioning activities," as defined in 10 CFR 50.2 that, "Result in there no longer being reasonable assurance that adequate funds will be available for decommissioning." HDI does not intend to perform any decommissioning activities that would jeopardize the availability of adequate funds for the completion of decommissioning.

Table 5-1 shows the amount of decommissioning funds currently available, the accumulation of additional funds, and the expenditure of the funds.

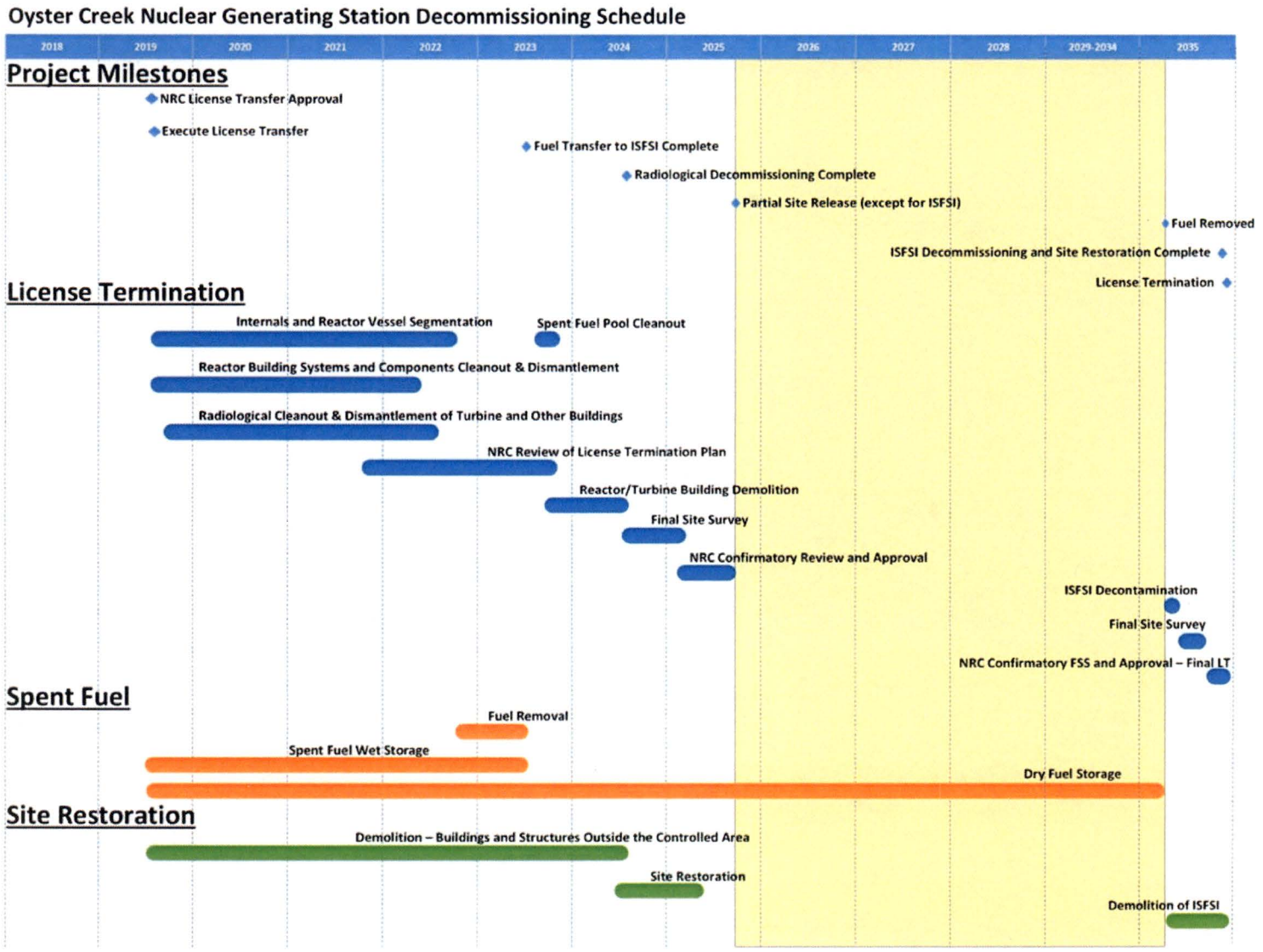
Prior to the transfer to OCEP and HDI, Exelon Generation will make withdrawals from the NDT to pay for Exelon Generation's accrued but unpaid decommissioning expenses, including decommissioning planning and other decommissioning activities. The 2019 beginning of year (BOY) Trust Fund Value (analysis starting trust fund balance) in Table 5-1 is the fund amount expected to be specified in the Asset Purchase and Sales Agreement (PSA) for the transfer of the NDT funds from Exelon Generation to OCEP as the licensed owner. This value is exclusive of approximately $94 million expected to be withdrawn from the NDT by Exelon for reimbursement of license termination expensed incurred prior to the asset sale and license transfer.

The 10 CFR 50.75(c) minimum formula amount for OCNGS as of December 31, 2017 is $585 million (Reference 14). As indicated in Table 5-1, the HDI estimated cost of radiological decommissioning (License Termination) at OCNGS, not including costs incurred by Exelon prior to the closure of the asset sale, is $618 million, exceeding the minimum formula amount.

In accordance with 10 CFR 50.82(a)(8)(v), decommissioning funding assurance will be reviewed and reported to the NRC annually until residual radioactivity has been reduced to a level that permits termination of the licenses. The site-specific DCE adjusted for inflation, in accordance with applicable regulatory requirements, will be used to demonstrate funding assurance. In addition, actual radiological and spent fuel management expenses will be included in the annual report in accordance with applicable regulatory requirements. If the funding assurance demonstration shows the NDT is not

sufficient, then an alternate funding mechanism allowed by 10 CFR 50.75(e) and the guidance provided in Regulatory Guide 1.159 (Reference 17) will be put in place.

## Figure 5-1 Oyster Creek Master Summary Schedule



## Table 5-1 Cash Flow Analysis

**Oyster Creek Nuclear Generating Station - DECON Method**

Annual Cash Flow in Millions of 2018 Dollars

No DOE Reimbursement of Spent Fuel Management Costs

| | Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 | Column 7 | Column 8 |
|---|---|---|---|---|---|---|---|---|
| Year | License Termination Cost | Spent Fuel Management Cost | Site Restoration Cost | Total Costs | Beginning of Year NDT Balance[1] | Withdrawals | NDT Earnings[2] | Year Ending NDT Balance[3] |
| 2019 | 95 | 2 | 3 | 99 | 848 | (99) | 5 | 754 |
| 2020 | 89 | 64 | 17 | 170 | 754 | (170) | 8 | 592 |
| 2021 | 76 | 4 | 7 | 87 | 592 | (87) | 7 | 512 |
| 2022 | 81 | 12 | | 93 | 512 | (93) | 6 | 425 |
| 2023 | 121 | 16 | | 136 | 425 | (136) | 4 | 293 |
| 2024 | 134 | 3 | 13 | 150 | 293 | (150) | 2 | 145 |
| 2025 | 10 | 9 | 1 | 20 | 145 | (20) | 2 | 127 |
| 2026 | | 8 | | 8 | 127 | (8) | 2 | 121 |
| 2027 | | 8 | | 8 | 121 | (8) | 2 | 115 |
| 2028 | | 8 | | 8 | 115 | (8) | 2 | 108 |
| 2029 | | 8 | | 8 | 108 | (8) | 1 | 102 |
| 2030 | | 8 | | 8 | 102 | (8) | 1 | 96 |
| 2031 | | 8 | | 8 | 96 | (8) | 1 | 89 |
| 2032 | | 8 | | 8 | 89 | (8) | 1 | 83 |
| 2033 | 9 | 27 | | 35 | 83 | (35) | 1 | 48 |
| 2034 | 2 | 27 | | 29 | 48 | (29) | | 20 |
| 2035 | 1 | 8 | 1 | 10 | 20 | (10) | | 10 |
| **Total[4]** | **618** | **225** | **41** | **884** | | (884) | 46 | |

[1] The 2019 Beginning of Year NDT balance reflects the fund value post-closure of the asset sale. The value used includes deductions for the estimated Exelon pre-closure costs of approximately $94 million. The 2019 costs include HDI estimated pre-closure and post closure costs.

[2] NDT earnings reflect an assumed 2% Real Rate of Return (RRR)

[3] The Year Ending NDT Balance is net of taxes

[4] Columns may not add due to rounding

## 6.0 CONCLUSION

The submittal of this cost estimate with the PSDAR complies with NRC requirements set forth in 10 CFR 50.82(a)(8)(iii), which require the licensee to submit a site-specific decommissioning cost estimate within two (2) years following permanent cessation of operations. CDI prepared this cost estimate and schedule on behalf of HDI using several sources, including information compiled by CDI during an extensive due diligence period, the site-specific decommissioning cost estimate in the Post-Shutdown Decommissioning Activities report submitted by Exelon on May 21, 2018 and the input and professional judgment of experienced specialty subcontractors and SMEs.

The estimate is based on regulatory requirements, site conditions, baseline assumptions, low-level radioactive waste disposal standards, high-level radioactive waste management options and site restoration requirements. The cost to decommission the site, safeguard the spent fuel until it can be transferred to the DOE and restore the affected area of the site is estimated to be $885 million. The majority of this cost is associated with decommissioning and license termination. A significant amount of the remaining cost is associated with spent fuel management since the fuel will be removed from the SFP and remain in storage at the ISFSI until acceptance by DOE. A relatively small amount of the decommissioning cost is for the demolition of uncontaminated structures and restoration of the site. The summary of the costs estimated for License Termination, Spent Fuel Management and Site Restoration activities are presented in Table 6-1.

The largest contributors to the overall decommissioning costs are removal of contaminated components and buildings, disposal costs, and program management costs. Removal costs reflect the labor-intensive nature of the decommissioning process, as well as the management controls required to ensure a safe and successful program. **The disposal of low-level radioactive waste that is generated from dismantling activities makes up the bulk of the disposal cost category.** The magnitude of the program management costs is a function of both the size of the organization needed to manage the decommissioning and the duration of decommissioning activities.

The 10 CFR 50.75(c) minimum formula amount for OCNGS as of December 31, 2017 is $585 million (Reference 14). As shown in Table 6-1, the estimated cost of radiological decommissioning (License Termination) at OCNGS is $618 million, which is greater than the minimum formula amount.

In accordance with 10 CFR 50.82(a)(8)(v), decommissioning funding assurance will be reviewed and reported to the NRC annually until residual radioactivity has been reduced to a level that permits termination of the licenses. The site-specific DCE adjusted for inflation, in accordance with applicable regulatory requirements, will be used to demonstrate funding assurance. In addition, actual radiological and spent fuel management expenses will be included in the annual report in accordance with applicable regulatory requirements.

If the funding assurance demonstration shows that the NDT is not sufficient, then an alternate funding mechanism allowed by 10 CFR 50.75(e) and the guidance provided in Regulatory Guide 1.159 (Reference 17) will be put in place.

## Table 6-1 Estimated Decommissioning Cost (thousands of 2018 dollars)

| Cost By Cost Element By WBS | | License Termination | Spent Fuel | Site Restoration | TOTAL |
|---|---|---|---|---|---|
| WBS_Code | WBS_Name | | | | |
| 01.02 | OC | 617,832 | 225,807 | 41,365 | **885,004** |
| 01.02.01 | Pre-decommissioning actions | 20,553 | | | **20,553** |
| 01.02.01.01 | Decommissioning planning | 14,537 | | | **14,537** |
| 01.02.01.02 | Facility characterization | 5,177 | | | **5,177** |
| 01.02.01.03 | Safety, security and environmental studies | 838 | | | **838** |
| 01.02.02 | Facility shutdown activities | 1,092 | | | **1,092** |
| 01.02.02.01 | Plant shutdown and inspection | 1,092 | | | **1,092** |
| 01.02.04 | Dismantling activities within the controlled area | 92,166 | | | **92,166** |
| 01.02.04.01 | Procurement of equipment for decontamination and dismantling | 39,163 | | | **39,163** |
| 01.02.04.04 | Removal of materials requiring specific procedures | 151 | | | **151** |
| 01.02.04.05 | Dismantling of main process systems, structures and components | 48,954 | | | **48,954** |
| 01.02.04.06 | Dismantling of other systems and components | 3,897 | | | **3,897** |
| 01.02.05 | Waste processing, storage and disposal | 198,447 | | 16,227 | **214,674** |
| 01.02.05.01 | Waste management system | 3,695 | | | **3,695** |
| 01.02.05.08 | Management of decommissioning intermediate-level waste/GTCC | 6,210 | | | **6,210** |
| 01.02.05.09 | Management of decommissioning low-level waste | 145,848 | | | **145,848** |
| 01.02.05.12 | Management of decommissioning exempt waste and materials | 42,695 | | | **42,695** |
| 01.02.05.13 | Management of decommissioning waste and materials generated outside controlled areas | | | 16,227 | **16,227** |
| 01.02.06 | Site infrastructure and operation | 72,015 | | | **72,015** |
| 01.02.06.01 | Site security and surveillance | 33,328 | | | **33,328** |
| 01.02.06.02 | Site operation and maintenance | 13,837 | | | **13,837** |
| 01.02.06.03 | Operation of Support Systems | 879 | | | **879** |
| 01.02.06.04 | Radiation and environmental safety monitoring | 23,972 | | | **23,972** |
| 01.02.07 | Conventional dismantling, demolition and site restoration | 59,740 | | 16,425 | **76,165** |
| 01.02.07.03 | Demolition of buildings and structures | 58,147 | | 12,112 | **70,259** |
| 01.02.07.04 | Final cleanup, landscaping and refurbishment | | | 4,313 | **4,313** |
| 01.02.07.05 | Final radioactivity survey of site | 1,593 | | | **1,593** |
| 01.02.08 | PI - OC - Project management, engineering and support | 86,405 | 16,759 | 5,557 | **108,721** |
| 01.02.08.02 | Project management | 44,003 | 9,249 | 2,957 | **56,209** |
| 01.02.08.03 | Support services | 35,085 | 6,134 | 2,128 | **43,347** |
| 01.02.08.04 | Health and safety | 7,317 | 1,376 | 472 | **9,165** |
| 01.02.10 | Fuel and nuclear material | 11,732 | 201,474 | 732 | **213,938** |
| 01.02.10.01 | Removal of fuel or nuclear material from facility to be decommissioned | | 16,567 | | **16,567** |
| 01.02.10.02 | ISFSI Storage fuel and/or nuclear material | 10,574 | 182,855 | | **193,429** |
| 01.02.10.03 | ISFSI Decommissioning | 1,159 | 2,051 | 732 | **3,942** |
| 01.02.11 | Miscellaneous expenditures | 75,683 | 7,574 | 2,423 | **85,680** |
| 01.02.11.01 | Owner costs | 42,740 | | | **42,740** |
| 01.02.11.02 | Taxes | 27,503 | 6,441 | 2,074 | **36,018** |
| 01.02.11.03 | Insurances | 5,440 | 1,133 | 349 | **6,922** |

## REFERENCES

1. Letter from Keith R. Jury, Vice President, Licensing & Regulatory Affairs (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "Permanent Cessation of Operations at Oyster Creek Nuclear Generating Station," dated January 7, 2011
2. Letter from Michael P. Gallagher Vice President, License Renewal & Decommissioning (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "Certification of Permanent Cessation of Power Operations for Oyster Creek Nuclear Generating Station", dated February 14, 2018
3. Letter from Exelon Generation, Oyster Creek Environmental Protection, LLC and Holtec Decommissioning International, "Application for Order Approving Direct Transfer of Renewed Facility Operating License and General License and Proposed Conforming License Amendment Oyster Creek Nuclear Generating Station License No. DPR-16 Docket Nos. 50-219 & 72-15," dated August 31, 2018
4. Letter from Michael P. Gallagher Vice President, License Renewal & Decommissioning (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "Certification of Permanent Removal of Fuel from the Reactor Vessel for Oyster Creek Nuclear Generating Station," dated September 25, 2018
5. "International Structure for Decommissioning Costing (ISDC) of Nuclear Installations," ISBN 978-92-64-99173-6, Joint NEA/EC/IAEA Publication, 2012
6. Regulatory Guide 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report"
7. NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors," (GEIS)
8. Regulatory Guide 1.202, "Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Plants"
9. NUREG-1713, "Standard Review Plan for Decommissioning Cost Estimates for Nuclear Reactors"
10. NUREG/CR-6174, "Revised Analyses of Decommissioning for the Reference Boiling Water Reactor Power Station"
11. Letter from James Barstow, (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission - "Submittal of Updated Decommissioning Cost Analysis for Oyster Creek Nuclear Generation Station," dated March 30, 2016
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13. Letter from Michael P. Gallagher, (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission - "Update to Spent Fuel Management Plan for Oyster Creek Nuclear Generating Station," dated May 21, 2018.
14. Letter from Patrick Simpson, (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission - "Report on Status of Decommissioning Funding for Shutdown

Reactors, Reactors within 5 Years of Shutdown, and Reactor Involved in an Acquisition," dated March 28, 2018

15. "Strategy for the Management and Disposal of Used Nuclear Fuel and High Level Radioactive Waste," U.S. DOE, January 11, 2013
16. "Acceptance Priority Ranking & Annual Capacity Report," DOE/RW-0567, July 2004
17. Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors"
18. NUREG-1757, "Consolidated Decommissioning Guidance, Financial Assurance, Recordkeeping, and Timeliness," U.S. Nuclear Regulatory Commission's Office of Nuclear Material Safety and Safeguards, Volume 3, Revision 1, February 2012.

# Appendix A

## ISFSI Decommissioning Cost Estimate

## Table A-1 ISFSI Decommissioning Cost Estimate (thousands of 2018 dollars)

| Oyster Creek Activity | Removal Costs | Transport Costs | Disposal Costs | Other Costs | Burial Volume Class A (cubic feet) | Labor (FTE) | License Termination | Spent Fuel | Site Restoration | Total Costs |
|---|---|---|---|---|---|---|---|---|---|---|
| ISFSI Demolition Non-Radiological | 655 | | | | | | | | 655 | **655** |
| ISFSI Clean Waste | | | 77 | | | | | | 77 | **77** |
| ISFSI Final Site Survey | | | | 33 | | | 33 | | | **33** |
| ISFSI NRC Confirmatory Survey | | | | 11 | | | 11 | | | **11** |
| ISFSI Demolition Radiological | 890 | | | | | | 890 | | | **890** |
| ISFSI Radiological Waste | | 75 | 300 | | 6,000 | | | 375 | | **375** |
| NRC License Termination Support | | | | 225 | | 1 | 225 | | | **225** |
| Security Staff | | | | 313 | | 3 | | 313 | | **313** |
| Security Management | | | | 276 | | 1 | | 276 | | **276** |
| Property Tax | | | | 738 | | | | 738 | | **738** |
| Insurance | | | | 128 | | | | 128 | | **128** |
| NRC Regulatory Fees | | | | 221 | | | | 221 | | **221** |
| **Totals**[1] | **1,545** | **75** | **377** | **1,945** | | | **1,159** | **2,051** | **732** | **3,942** |

[1]Costs include application of contingency of 25% consistent with the evaluation criteria referenced by the NRC in NUREG-1757, "Consolidated Decommissioning Guidance, Financial Assurance, Recordkeeping and Timeliness".