HOLTEC DECOMMISSIONING INTERNATIONAL

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November 16, 2018

U.S. Nuclear Regulatory Commission
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Pilgrim Nuclear Power Station
Renewed Facility Operating License No. DPR-35
NRC Docket Nos. 50-293 and 72-1044

Subject: Notification of Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for Pilgrim Nuclear Power Station

Reference:
[1] Letter from ENOI to US NRC, Pilgrim Nuclear Power Station Post-Shutdown Decommissioning Activities Report, dated November 16, 2018

[2] Letter, Entergy Nuclear Operations, Inc. to USNRC, "Notification of Permanent Cessation of Power Operations," 2.15.080, dated November 10, 2015 (ML15328A053)

[3] Letter from ENOI to US NRC, Application for Order Consenting to Direct and Indirect Transfers of Control of Licenses and Approving Conforming License Amendment; Notification of Amendment to Decommissioning Trust Agreement; and Request for Exemption from 10 CFR 50.82(a)(8)(i)(A) Pilgrim Nuclear Power Station, dated November 16, 2018.

Pursuant to 10 CFR 50.82(a)(4)(i), Entergy Nuclear Operations, Inc. (ENOI), on behalf of itself and Entergy Nuclear Generation Company (ENGC) submitted to the U.S. Nuclear Regulatory Commission (NRC) the Pilgrim Nuclear Power Station (PNPS) Post-Shutdown Decommissioning Activities Report (herein referred to as the SAFSTOR PSDAR (Reference 1). By letter dated November 10, 2015, ENO notified the NRC of its intent to permanently cease power operations at PNPS no later than June 1, 2019 (Reference 2). The PSDAR submitted by ENOI selected the SAFSTOR method for decommissioning PNPS and assumed license termination in 2079 and site restoration in 2080. The site-specific decommissioning cost estimate (DCE) for the radiological decommissioning, spent fuel management, and site restoration for PNPS following the cessation of plant operations was included as Attachment 1 in the SAFSTOR PSDAR.

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On November 16, 2018, ENOI, on behalf of itself and ENGC (to be named Holtec Pilgrim, LLC after the transaction closing), Holtec International (Holtec) and Holtec Decommissioning International, LLC (HDI) submitted a License Transfer Application (LTA) to the NRC requesting approval for the transfer of the PNPS Renewed Facility Operating License and the general license for the PNPS Independent Spent Fuel Storage Installation (ISFSI) to Holtec Pilgrim and HDI (Reference 3). Holtec Pilgrim will own and HDI will operate (i.e. conduct licensed activities at) Pilgrim and will proceed with the accelerated decommissioning of the Station.

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 PNPS 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 PNPS 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 PNPS.

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 SAFSTOR PSDAR (Reference 1) submitted by ENOI will remain in effect.

ENOI has reviewed the contents of this letter and is aligned.

In accordance with 10 CFR 50.82(a)(4)(i), a copy of the DECON PSDAR is being provided to the State of Massachusetts 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 (724) 493-1833 or via email at a.sterdis@cdi-decom.com.

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 Pilgrim Nuclear Power Station

cc: w/ Enclosure

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Acronyms

ACM	Asbestos Containing Material
ALARA	As Low As Reasonably Achievable
BMP	Best Management Practice
BOE	Basis of Estimate
BWR	Boiling Water Reactor
CDI	Comprehensive Decommissioning International, LLC.
CFR	Code of Federal Regulations
CPM	Critical Path Method
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
DSAR	Defueled Safety Analysis Report
EC	European Commission
ENGC	Entergy Nuclear Generation Company
ENOI	Entergy Nuclear Operations, Inc.
ENTERGY	Entergy Corporation
ENTOMB	A Method of Decommissioning defined by the NRC
FSS	Final Status Survey
GE	General Electric
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
IPaC	Information for Planning and Consultation
ISDC	International Structure for Decommissioning Costing
ISFSI	Independent Spent Fuel Storage Installation
LLMW	Low-Level Mixed Waste
LLRW	Low-Level Radioactive Waste
LSA	Low Specific Activity
LTA	License Transfer Application
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MADEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
MHC	Massachusetts Historical Commission
Mrem	Millirem
MSS	Master Summary Schedule
MWt	Megawatts- Thermal

NDT	Nuclear Decommissioning Trust
NEA	Nuclear Energy Agency
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Services
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulatory Commission technical report designation
OCA	Owner Controlled Area
OECD	Organization for Economic Cooperation and Development
OSHA	Occupational Safety and Health Association
PDTS	Permanently Defueled Technical Specifications
PNPS	Pilgrim Nuclear Power Station
PSDAR	Post-Shutdown Decommissioning Activities Report
PSEP	Permanently Shutdown Emergency Plan
RCRA	Resource Conservation and Recovery Act
ROW	Right-of-Way
RPV	Reactor Pressure Vessel
RVI	Reactor Vessel Internals
SAFSTOR	A Method of Decommissioning defined by the NRC
SCO	Surface Contaminated Object
SEIS	Supplemental Environmental Impact Statement
SFP	Spent Fuel Pool
SME	Subject Matter Expert
SNF	Spent Nuclear Fuel
SSC	Structures, Systems and Components
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VLLW	Very Low-Level Waste
WBS	Work Breakdown Structure
WCS	Waste Control Specialists
WMP	Waste Management Plan
WP	Work Package

1 INTRODUCTION AND SUMMARY

1.1 Introduction

On November 16, 2018, Entergy Nuclear Operations, Inc. (ENOI), on behalf of itself and Entergy Nuclear Generation Company (ENGC) submitted to the U.S. Nuclear Regulatory Commission (NRC) the Pilgrim Nuclear Power Station (PNPS) Post-Shutdown Decommissioning Activities Report (herein referred to as the SAFSTOR PSDAR) pursuant to Title 10 of the Code of Federal Regulations (10 CFR), Section 50.82(a)(4) (Reference 1). The ENGC PSDAR in Reference 1 selected the SAFSTOR method for decommissioning PNPS and assumed license termination in 2079 and site restoration in 2080. The site-specific decommissioning cost estimate (DCE) for the radiological decommissioning, spent fuel management, and site restoration for PNPS following the cessation of plant operations was included as Attachment 1 in the SAFSTOR PSDAR.

Pursuant to 10 CFR 50.54(bb), ENOI submitted the Update to the Spent Fuel Management Plan for PNPS on November 16, 2018 (Reference 5).

On November 16, 2018, ENOI, on behalf of itself and ENGC (to be renamed Holtec Pilgrim, LLC after the transaction closing), Holtec International (Holtec) and Holtec Decommissioning International, LLC (HDI) submitted a License Transfer Application (LTA) to the U.S. Nuclear Regulatory Commission (NRC) requesting approval for the transfer of the PNPS Renewed Facility Operating License No. DPR-35 and the general license for the PNPS Independent Spent Fuel Storage Installation (ISFSI) to Holtec Pilgrim and HDI (Reference 2).

Upon closing of the transaction, indirect control of ENGC will be transferred from ENGC's parent companies to Holtec and its subsidiary, while ENOI's operating authority will be transferred to HDI. Thereafter, Holtec Pilgrim will own and HDI will operate (i.e. conduct licensed activities at) Pilgrim and will proceed with the prompt decommissioning of the Station. HDI was formed by Holtec to operate and decommission all Holtec owned decommissioning nuclear power plant sites, including Pilgrim. HDI's mission is to assume licensed operator responsibilities for decommissioning nuclear power plants that Holtec acquires including Pilgrim. Holtec is a global turnkey supplier of equipment and systems for the nuclear, solar, geothermal, and fossil power generation sectors of the energy industry. Among other services, Holtec has specialized in the development of spent nuclear fuel management technologies, including wet and dry storage, for over thirty years.

After the closing of the transaction and license transfer, ENGC, renamed Holtec Pilgrim, will continue to own the Pilgrim Station as well as its associated assets and real estate (with the exception of certain excluded assets), including its nuclear decommissioning trust fund ("NDT"), title to spent nuclear fuel, and rights pursuant to the terms of its Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level

Radioactive Waste with the U.S. Department of Energy ("Standard Contract"). Holtec Pilgrim will continue to hold the NDT assets in a trust segregated form from its other assets and outside of its administrative control.

Holtec Pilgrim will enter into a Decommissioning Operator Services Agreement with HDI, which will provide for HDI to act as Holtec Pilgrim's agent and for Holtec Pilgrim to pay HDI's costs of post-shutdown operations, including 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 (DGC). CDI is majority-owned by HDI. SNC-Lavalin holds its interest in CDI through a wholly-owned U.S. subsidiary, Kentz USA Inc. Holtec and SNC-Lavalin are transferring employees into CDI. SNC-Lavalin is transferring commercial nuclear personnel and capabilities into CDI from other subsidiaries including Atkins Energy, Inc., which is based in Columbia South Carolina. Pursuant to a Decommissioning General Contractor Agreement between HDI and CDI, following license transfer, CDI will manage and perform the day-to-day Pilgrim licensed activities to maintain compliance with the licenses and the NRC regulations including decommissioning activities, subject to HDI's direct oversight and control as the decommissioning licensed operator and majority owner of CDI.

In accordance with the requirements of Title 10 of the Code of Federal Regulations (CFR) 50.82, "Termination of license," paragraph (a)(7), the revised Post-Shutdown Decommissioning Activities Report (herein referred to as the DECON Revised PSDAR) for PNPS is being submitted to notify the NRC of changes to accelerate the schedule for the prompt decommissioning of PNPS and unrestricted release of all portions of the site other than the ISFSI, if the license transfer is approved by the NRC.

HDI is actively engaged in discussions with the Commonwealth of Massachusetts related to the establishment of an independent voluntary agreement regarding radiological release standards.

The DECON Revised PSDAR is contingent upon NRC approval of the LTA and the transfer of the PNPS licenses. If the licenses are not transferred, this DECON Revised PSDAR will be ineffective, and ENGC's November 16, 2018 SAFSTOR PSDAR (Reference 1) will remain in effect.

Prior to plant shutdown, ENOI, in coordination with the Holtec Pilgrim and HDI, is preparing for the safe and orderly transition from permanent shutdown to dismantlement and decontamination. After transfer of the licenses is complete, the facility will be dismantled and decontaminated to levels that permit license termination. This DECON Revised 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.

This DECON Revised PSDAR has been developed consistent with Regulatory Guide 1.185, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report" (Reference 4). The DECON Revised 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 Commonwealth of Massachusetts, before performing any decommissioning activity inconsistent with, or making any significant schedule change from, those actions and schedules described in the DECON Revised PSDAR, including changes that significantly increase the decommissioning cost.

1.2 Background

The PNPS site is located on the western shore of Cape Cod Bay in the Town of Plymouth, Plymouth County, Massachusetts. The nearest large cities are Boston, Massachusetts, approximately 38 miles to the northwest and Providence, Rhode Island, approximately 44 miles to the west. The PNPS facility occupies approximately 140 acres. ENGC also owns an additional 1,500 acres adjacent to the plant site that is in a forest management trust.

PNPS employs a General Electric (GE) boiling water reactor nuclear steam supply system licensed to generate 2,028 megawatts - thermal (MWt). The renewed facility operating license for PNPS expires at midnight, June 8, 2032. The principal structures of PNPS are the reactor and turbine buildings, the off-gas retention building, the radwaste building, the diesel generator building, the intake structure, the switchyard, the main stack, administration buildings, and the former recreational facilities. PNPS structures are primarily located within the fenced owner-controlled area (OCA) with the exception of the wastewater treatment facility.

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

- Construction Permit Issued: August 26, 1968
- Operating License Issued: June 8, 1972
- Commercial Operation: December 1, 1972
- Initial Operating License Expiration: June 8, 2012
- Renewed Operating License Expiration: June 8, 2032

By letter dated November 10, 2015, ENOI notified the NRC that it intended to permanently cease power operations of PNPS no later than June 1, 2019 (Reference 3). ENOI will submit a supplement to this letter certifying the date on which operations have ceased, in accordance with 10 CFR 50.82(a)(l)(i) and 10 CFR 50.4(b)(8). Upon docketing of the certifications required by 10 CFR 50.82(a)(l)(i) and 10 CFR 50.82(a)(l)(ii), pursuant to 10 CFR 50.82(a)(2), the 10 CFR Part 50 renewed facility operating license for PNPS will no longer authorize operation of the reactor, or emplacement or retention of fuel in the reactor vessel.

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 50.51(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 6). 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 shut down 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 equity sale closure, HDI plans to decommission and dismantle PNPS using the DECON method. This DECON Revised PSDAR describes the selected methods to be for the decontamination and dismantlement of the site after the license transfer and equity sale closure. The decommissioning strategy for the project is to initiate the prompt decommissioning of PNPS following shutdown, reactor defueling, and license transfer to support partial release of the PNPS site, except for the ISFSI within eight years of license transfer and equity sale closure. To meet this goal, once the license is transferred, the decommissioning objectives are:

a. Decommissioning of PNPS and site restoration of all areas, except for the ISFSI, for unrestricted use.
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 PNPS 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 HDI 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 equity 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 for 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 decommissioning of the ISFSI.

The HDI decommissioning approach for PNPS 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 PNPS are bounded by the NRC GEIS related to decommissioning.
- Section 6.0 provides the list of references.
- Enclosure 1: PNPS Site-Specific Decommissioning Cost Estimate

2 DESCRIPTION OF PLANNED DECOMMISSIONING ACTIVITIES

HDI will contract with CDI to decommission PNPS using the DECON method, as defined in Section 1.3 of this report. Use of the DECON method will require HDI to manage the spent fuel because of the DOE's failure to perform its contractual obligation to remove spent fuel 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.

Prior to the equity sale and license transfer, ENOI will perform activities to permanently shutdown and defuel the reactor and place the plant in a safe storage condition. To facilitate efficient transition of the plant to DECON, ENOI, in coordination with HDI, will direct the activities that will facilitate transitioning to the HDI decommissioning plan.

In conjunction with HDI, CDI developed the decommissioning scope, schedule, and associated cost estimate for PNPS. CDI adopted the International Structure for Decommissioning Costing (ISDC) Work Breakdown Structure (WBS) (Reference 7) and corresponding WBS dictionary to develop the PNPS 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 that is identified as the international standard cost structure for nuclear facility decommissioning and 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 PNPS decommissioning.

Because the ISDC WBS is organized differently than those traditionally used for US domestic decommissioning estimates, to facilitate a comparison of projected PNPS decommissioning costs to the NRC Reference BWR decommissioning costs contained in NUREG/CR 6174, “Revised Analyses of Decommissioning for the Reference Boiling Water Reactor Power Station,” the decommissioning activities have been organized into periods similar to those described in NRC guidance. (Reference 8).

For consistency with the DCE format found in Regulatory Guide 1.202, “Standard Format and Content of Decommissioning Cost Estimates for Nuclear Reactors,” (Reference 9) the ISDC WBS has also been mapped into project periods. In addition to the periods described in the Regulatory Guide, Period 5 was established to account for costs that fall into the Spent Fuel Management and Site Restoration phases, and Period 6 was established for instances where costs that are applicable to multiple periods are identified and quantified. The mapping of the 11 ISDC WBS elements to the project periods, is shown in Table 2-1.

Table 2-1 WBS Elements Mapped to Periods

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 & Preparation

2.1.1 Pre-Decommissioning Planning and Preparation (Pre-License Transfer)

HDI and CDI are working with ENOI to understand and support the PNPS plan for permanent shutdown, reactor defueling, and preparations for safe storage. These efforts are focused on facilitating the safe, compliant, and efficient license transfer and transition to prompt radiological decommissioning (i.e., DECON) once the license transfer is complete.

The transition activities ensure that the decommissioning organization is fully prepared to assume the responsibilities of PNPS decommissioning. Alignment with ENOI will begin well in advance of license transfer and equity 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 ENOI to HDI.

2.1.2 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 equity sale and license transfer, PNPS will be in a safe storage condition. HDI's decommissioning planning takes into account the PNPS 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 equity sale/closure 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 PNPS 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 PNPS will begin by completing the following activities:

- Finalize the decommissioning organization, including integration of incumbent plant staff and CDI personnel. PNPS personnel will be incorporated into the decommissioning organization according to their expertise and the position that they held within ENOI. 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 PNPS 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 PNPS policies, programs, procedures, and work instructions, where applicable, since these documents have been used by PNPS 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 ENOI. In the period between permanent reactor defueling and equity sale closure/license transfer, ENOI will execute activities to deactivate the plant. The plant deactivation activities include the following:

1. Continuing operation and maintenance of the systems required to maintain the spent fuel management and safe storage within NRC regulations and facility license requirements.
2. Isolating power equipment and installation of temporary power systems in preparation for decommissioning of the turbine generator.
3. Removing combustibles and chemicals to permit fire protection system modifications.

Following the equity sale closure/license transfer, deactivation activities and other activities required to prepare the PNPS for decommissioning will continue, as necessary.

2.3 Period 3 - Safe Storage Operation

Since HDI has chosen the DECON method has chosen for PNPS 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 at the ISFSI.
- Operation and maintenance of the ISFSI until the spent fuel is removed from the SFP

and placed in the ISFSI.

2.4 Period 4 - Dismantlement

The scope of 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. The end state of this work scope is to have the buildings cleared of all radioactive components and declared ready for free release or demolition. However, decontamination activities such as surface wipe-down will be performed as required to maintain worker exposure ALARA.

2.4.1 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 the proper containers for transportation to the appropriate disposal facility.

2.4.2 Site Characterization

To supplement plant historical knowledge and the PNPS 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. The 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.

[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 (USEPA) universal waste regulations streamline the hazardous waste management standards for these wastes. It is identified in 40 CFR 273.9 by the USEPA 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.

2.4.3 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, until it meets the dry storage criteria. At that point it 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 be performed in two (2) phases. The first phase will start shortly after the license transfer and will include segmenting and packaging the highly activated core grid segments into the dry storage casks used for GTCC waste. When the spent fuel cooling period is met, the packaging and transfer of spent fuel from the SFP to the ISFSI will begin. Following completion of the spent fuel to dry storage movement, the RVI segmentation will resume, followed by RPV segmentation.

The GTCC waste that is generated during segmentation activities will be placed in dry storage canisters, transported away from the reactor building and stored at the PNPS ISFSI.

2.4.4 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 segmentation contractor will perform the fuel pool and equipment pool removal. 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 removed after the pools have been drained and decontaminated. Any GTCC waste generated from these activities will be placed in a dry storage cask, transported from the area, and stored on the ISFSI.

2.4.5 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, CDI will either place the segments in an appropriate shipping container or send the component 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 dismantled 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 Rector Building.

The auxiliary plant boilers, storage tanks, and the diesel generators will be removed.

2.4.6 Radioactive Waste Management

A major component of the decommissioning work scope for PNPS is the packaging, transportation, and disposing of contaminated/activated equipment, piping, concrete, and soil. A Waste Management Plan (WMP) will be developed in Period 1 to 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. PNPS 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 approved WMP and commercial disposal facility requirements. This includes characterizing contaminated materials, packaging, transporting, and disposal at a licensed LLRW disposal facility.

For Class B and C waste, an import petition will be filed with the Texas Compact Commission to gain approval to dispose of out-of-compact waste at the Waste Control Specialists (WCS) facility in Texas. The guidance in NUREG-2155, “Implementation Guidance for Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material” (Reference 10) 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.”

2.4.7 Waste Transportation

The transportation approach for Class A, LSA, or SCO classes of waste is to use a combination of truck and rail to support bulk quantity removal of waste. Since there is no

active rail at PNPS, 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.

2.4.8 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 PNPS will be transported by authorized and licensed transporters and shipped to authorized and licensed facilities.

2.4.9 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: a site characterization, 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), designation of the end use of the site, 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 site release criteria are defined by the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (Reference 18) protocol will be used to demonstrate that the site release criteria have been met. The license will be amended to limit the NRC renewed facility operating license to the onsite ISFSI.

2.4.10 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 will then be performed in the remainder of the below ground structures and any areas with activity exceeding established DCGLs will be removed. Final Status Surveys, including NRC verification surveys, will be conducted. Once the NRC approves the Final Status Surveys, the affected area(s) will 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

The HDI decommissioning plan includes the construction of a consolidated ISFSI pad on the

PNPS site that will include capacity for the existing dry casks on the PNPS site as well as the spent nuclear fuel currently in the reactor and the spent fuel pool. The relocated consolidated ISFSI will also include storage capacity for the GTCC waste. The 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. 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 LTP. Following FSS and NRC approval, final 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 equity sale closure, the management team will be comprised of HDI corporate leadership resources, supported by CDI leadership resources. The CDI management team will be comprised of Atkins/Holtec personnel and incumbent site personnel. This includes PNPS personnel who transfer to CDI upon closure of the sale. These personnel will be integrated into the decommissioning organization according to their expertise and previous positions held while the plant was operating. Additionally, corporate support from Atkins, SNC-Lavalin and/or Holtec will be provided in areas such as legal, financial reporting systems, IT, procurement, and human resources.

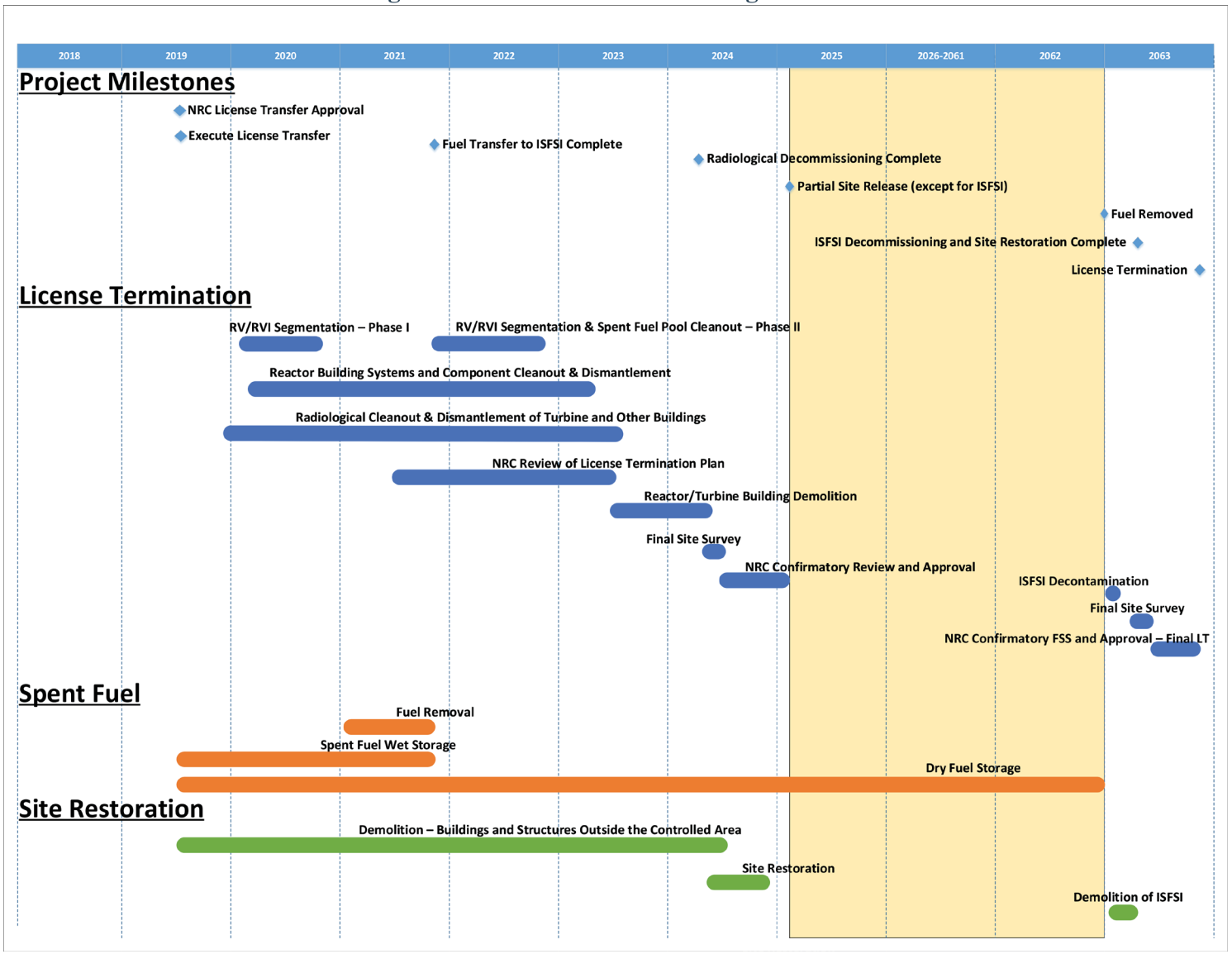
The number of site personnel will vary throughout the life of the project, with increased or decreased staffing levels required as decommissioning activities ramp up or down, or as requirements for security and emergency planning are reduced. The staffing projections after license transfer and equity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

3 SCHEDULE OF PLANNED DECOMMISSIONING ACTIVITIES

3.1 Pilgrim Decommissioning Schedule

Figure 3-1 PNPS Decommissioning Schedule, provides a project timeline that presents the high-level project schedule and milestones for decommissioning, including spent fuel storage and licensing. The schedule provided herein assumes that the equity sale closure and license transfer are executed on July 31, 2019, and ends following ISFSI decommissioning and final license termination. The dates for license transfer and closing on the equity sale agreement are targeted to occur by the end of 2019.

Figure 3-1 PNPS Decommissioning Schedule



4 ESTIMATE OF EXPECTED DECOMMISSIONING AND SPENT FUEL MANAGEMENT COSTS

The HDI 2018 site-specific DCE for the decommissioning of PNPS following the scheduled cessation of plant operations and an assumed license transfer date of July 31, 2019 is included as Enclosure 1 to this DECON Revised PSDAR. Costs in the DCE were determined based on the selection of the DECON method for decommissioning PNPS. CDI prepared the site-specific DECON Revised DCE and schedule for HDI using several sources including the following:

- Information compiled by HDI and CDI during an extensive due diligence period.
- The site-specific decommissioning cost estimate in the ENGC SAFSTOR PSDAR (Reference 1)
- Input and professional judgment of experienced specialty subcontractors and SMEs.

The site-specific DCE is based on regulatory requirements, site conditions, Basis of Estimate (BOE) 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 presented in this report 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 (CPM) 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 site-specific DCE for decommissioning PNPS 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, 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 $1.134 billion in 2018 dollars. The summary of the costs estimated for License Termination, Spent Fuel Management, and Site Restoration activities are presented in Table 4-1.

Table 4-1 PNPS Decommissioning DECON Cost Summary (thousands of 2018 dollars)

Cost Category	License Termination	Spent Fuel	Site Restoration	Total
Decontamination				
Removal	172,108		16,654	188,762
Packaging	21,866			21,866
Transportation	32,321		1,316	33,638
Disposal	152,217		15,874	168,091
Off-site Waste Processing				
Program Management	141,913	27,404	4,221	173,538
Corporate A&G				
Spent Fuel (Direct Expenditures)		458,180		458,180
Insurance and Regulatory Fees	17,902	1,418	261	19,581
Energy	16,376	7,491	1,144	25,011
Characterization and Licensing Surveys	6,051			6,051
Property Taxes	11,276	6,973	609	18,858
Miscellaneous Equipment / Site Services	20,523			20,523
Spent Fuel Pool Isolation				
Grand Total	**592,553**	**501,467**	**40,079**	**1,134,099**

5 ENVIRONMENTAL IMPACTS

5.1 Environmental Impact of PNPS Decommissioning

HDI has concluded that the environmental impacts associated with planned PNPS 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 previously issued environmental impact statements listed below:

NUREG-0586, Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors (Reference 6) (herein referred to as the GElS).

NUREG-1496, Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities (Reference 11).

NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 29, Regarding Pilgrim Nuclear Power Station, Final Report, July 2007 (Reference 12) (herein referred to as the SEIS)

NUREG-1437, Revision 1, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, June 2013 (Reference 13) (herein referred to as the SEIS, Rev. 1)

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

Fact Sheet issued by US Environmental Protection Agency (USEPA) and the Massachusetts Department of Environmental Protection (MADEP) in the draft National Pollutant Discharge Elimination System (NPDES) Permit No. MA0003557, 2016, (Reference 14).

Pilgrim Nuclear Power Station (PNPS) Post-Shutdown Decommissioning Activities Report, November 16, 2018 (herein referred to as SAFSTOR PSDAR) (Reference 1).

5.1.1 Onsite/Offsite Land Use

The NRC concluded in the GEIS (Reference 6) 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.

PNPS has sufficient previously disturbed area onsite (due to construction or operations activities) for use during decommissioning. Storm water discharges from the site are currently regulated by existing NPDES Permit No. MA0003557 (Reference 14), and any construction activities that would disturb one acre or greater of soil not covered by the existing permit would require a storm water permit from the MADEP or USEPA prior to proceeding with the activity. The NPDES permit, and any storm water permit contain best management practices (BMPs) to control sediment and erosion effect on water courses and wetlands.

Decommissioning activities will completion of a stand-alone ISFSI at an on-site previously disturbed location. Decommissioning activities may also include upgrading on-site roadways. Upgrading roadways is consistent with the types of temporary onsite and offsite land use changes described in the GEIS for decommissioning that do not include needs for additional land offsite.

The DECON schedule and DECON Revised DCE conservatively assume that wastes are removed from the site and transported to disposal sites using truck transportation. Use of barge transportation to remove waste and provide waste disposal transportation could provide an opportunity for improving project schedule and costs. If HDI decides to pursue this opportunity, a barge slip and if needed, dredging to allow navigation of vessels to the slip for loading and transport of selected wastes may be constructed within the intake embayment. The slip will be evaluated, designed, permitted, constructed and operated in accordance with applicable federal, state and local permits, and required certifications. If constructed, applicable BMPs will be implemented during construction and operation of the slip. Further preliminary evaluation of the environmental impacts of a barge slip is presented in Sections 5.1.5 and 5.1.17.

HDI concludes that the impacts of PNPS decommissioning on onsite/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 lSFSI.

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 GElS (Reference 6) concluded that water use at decommissioning nuclear reactor facilities is significantly smaller than water use during operation.

The GElS 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 PNPS that are not addressed by the evaluation of the reference facility in the GElS.

Therefore, HDI concludes that the impacts of PNPS 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.

PNPS will continue to receive potable water from the City of Plymouth.

Industrial and stormwater discharges to surface water from the facility are subject to the terms and conditions of the existing NPDES Permit, and areas of one acre or more disturbed during decommissioning that are not covered by the existing permit will require stormwater permits from the MADEP or USEPA. 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.

Treated sanitary wastewater discharged to an onsite leach field is regulated by MADEP Groundwater Discharge Permit SE #2-329 (Reference 15). 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, HDI 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.

Remedial activities needed to meet Massachusetts Contingency Plan (MCP) and other applicable state environmental response and remediation requirements will be addressed in a timely manner in consultation MADEP.

As discussed previously, if HDI pursues the opportunity to utilize barge transportation to

remove waste from the site, a barge slip and, if needed, dredging to allow navigation of vessels to the slip for loading and transport of selected wastes may be constructed within the intake embayment. Design, permitting, construction and operation of the barge slip will be conducted 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 SEIS, Revision 1 (Reference 13), that the impact of dredging to remove accumulated sediments in the vicinity of intake and discharge structures, and to maintain barge shipping, has not been found to be a problem for surface water quality.

The GEIS (Reference 6) 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 12) found that that there would be no impacts on water quality associated with PNPS decommissioning beyond those discussed in the GEIS.

Therefore, HDI concludes that the impacts of PNPS decommissioning on water quality are bounded by the GEIS and SEIS Revision 1.

5.1.4 Air Quality

There are many types of decommissioning activities listed in Section 4.3.4 of the GEIS (Reference 6) that have the potential to affect non-radiological air quality. For those activities applicable to the DECON method, HDI 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 PNPS 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, and the SEIS (Reference 12) found that there would be no impacts on air quality associated with PNPS decommissioning beyond those discussed in the GEIS.

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

5.1.5 Aquatic Ecology

Aquatic ecology encompasses the plants and animals in Cape Cod Bay near PNPS. Aquatic ecology also includes the interaction of those organisms with each other and the environment. Section 4.3.5 of the GEIS (Reference 6) 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. PNPS'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.

The intake and discharge structures, including wing walls and breakwaters, at PNPS will be abandoned in place, reducing the potential for environmental impacts to the aquatic ecology that would occur from demolition, dismantlement, and removal of the structures.

As previously described in Sections 5.1.1 and 5.1.3, a barge slip may be constructed in or near the intake embayment to accommodate vessels suitable for transport of selected wastes from the site. If constructed, the slip will be designed, built, and operated in accordance with applicable federal, state, and local permits, and certifications that include consideration and protection of environmental impacts to aquatic ecosystems.

Abandonment of the intake and discharge facilities and other shoreline structures, as needed, and construction of the barge slip, including dredging if needed, will be conducted in accordance with BMPs defined in permits issued by the MADEP and USACE. The NRC concluded in the SEIS Revision 1, (Reference 13) 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 Cape Cod Bay will dramatically decrease after the plant is shut down and defueled, thus reducing the potential impacts from impingement and entrainment and thermal differential on aquatic species during the period when spent fuel continues to be stored in the SFP. 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 NPDES permit, or in stormwater permits obtained from the MADEP or USEPA.

The GEIS concludes that for decommissioning activities that do not disturb lands beyond operational and previously disturbed areas, the effects on aquatic ecology are not detectable or destabilizing, and that effects on aquatic ecology related to the construction and use of a barge slip and dredging for barge navigation are small.

Therefore, HDI concludes that the impacts of PNPS decommissioning on aquatic ecology are bounded by the GEIS and SEIS Revision 1.

5.1.6 Terrestrial Ecology

Terrestrial ecology considers the plants and animals near PNPS, 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 6) 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 and previously disturbed area of the site. Also, the MADEP 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 MADEP or USEPA 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.

Section 4.3.6 of the GEIS concludes that if BMPs are used to control indirect disturbances and habitat disturbance is limited to areas that were previously disturbed during construction or operations, 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 PNPS.

Therefore, HDI concludes that the impacts of PNPS decommissioning on terrestrial ecology, including those outside of the operational area, are small and are bounded by the GEIS.

5.1.7 Threatened and Endangered Species

Section 4.3.7 of the GEIS (Reference 6) 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 areas previously disturbed during construction and operations.

Anadromous and Marine Aquatic Species

The NRC is required to consult with appropriate agencies for an evaluation of potential environmental impacts on listed species at the time of license renewal. The NRC consulted with the United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) during development of the SEIS (Reference 12), and at the time of PNPS license renewal in 2012.

The SEIS for PNPS includes a narrative listing, and environmental impact evaluations, for federal and state threatened and endangered anadromous and marine aquatic species with some potential to occur near PNPS. The listed species are:

- Sea turtles - loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempi*),

leatherback (*Dermochelys coriacea*), and green (*Chelonia mydas*) turtles have all been observed within Cape Cod Bay, but none have been documented at the PNPS site.

- Great whales - North Atlantic right whale (*Eubalaena glacialis*), | humpback whale (*Megaptera novaeangliae*), fin whale (*Balaenoptera physalus*), sei whale (*B. borealis*), and sperm whale (*Physter catadon*).

- Anadromous fish – Shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus*).

The SEIS concluded that continued operation of PNPS was not likely to affect any federally listed anadromous and marine aquatic species, and decommissioning, whether conducted after the initial operating period or after a 20-year license renewal period, was not expected to have any direct ecological impacts.

Potential environmental impacts from operation and shutdown of PNPS were again evaluated in 2016 as part of the public comment process for renewal of NPDES Permit No. MA0003557 (Reference 14) for PNPS. The Fact Sheet prepared by the USEPA and included in the draft permit issued for public comment referred to the 2012 findings of a consultation letter from the National Marine Fisheries Service (NMFS) concluding that effects of the continued operation of PNPS to listed species would be insignificant and discountable. USEPA stated in the Fact Sheet that it agreed with the NMFS conclusion that continued operation of PNPS was not likely to adversely affect any listed species. The list of anadromous and marine aquatic species reviewed in the 2016 Fact Sheet was unchanged from the list considered in the 2012 NMFS consultation.

The USEPA acknowledged in the Fact Sheet that ENOI had announced its intention to cease electricity generation at PNPS and tailored the proposed draft permit to reflect post-shutdown operations and discharges. However, because the permittee could not fully anticipate all changes in permitted flows that will take place post shutdown, USEPA noted that the permit may be modified post-shutdown if warranted by any new or increased discharges.

A current review of the USFWS Information for Planning and Consultation (IPaC) identified no new threatened or endangered anadromous or marine aquatic species for the PNPS area listed after the 2012 NMFS consultation, or the 2016 USEPA Fact Sheet.

The endangered North Atlantic Right Whale and Sei Whale have recently been sighted in the shallow waters of Cape Cod Bay. PNPS has adopted procedures for reporting whale sightings in response to this development in cooperation with the USACE. A live loggerhead turtle sighting was also reported in the bay approximately 4 miles offshore from the Pilgrim Plant in August 2018. Considering these new developments and in keeping with our commitment to environment and endangered species, HDI acknowledges that it is possible for any of the listed species to occasionally appear in the vicinity of the Pilgrim

Station.

In the GEIS (Reference 6), 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.

The environmental impact analyses conducted as part of the license renewal in 2012 and NPDES permit renewal public notice process in 2016 encompassed consideration of potential impacts on marine aquatic and anadromous threatened and endangered species and critical habitat associated with continued operation of the cooling water intake and discharge structures, including thermal effects, and concluded that the impacts would be insignificant.

After reactor shutdown and defueling, the potential for environmental impacts will be further 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 storm water. Flow rates will be further reduced after transfer of the spent fuel from the SFP to the ISFSI and shutdown of the SFP. Discharges will continue to be regulated by the NPDES permit or under state or federally-issued general discharge permits, as applicable.

The cooling water intake and discharge structures will be abandoned in place, and the discharge canal and breakwater also will be left in place; consequently, the potential for impacts to threatened and endangered species that would be associated with removal of these structures is eliminated.

If HDI elects to construct a barge slip in the intake embayment for transport of selected materials from PNPS, slip construction and dredging for navigation to and from the slip (if needed), will be conducted in accordance with BMPs defined in permits issued by the MADEP and USACE. The NRC concluded in the final SEIS, Revision 1, 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.

Terrestrial and Freshwater Aquatic Resources

Based on consultation with the USFWS, the NRC reported in the SEIS (Reference 12) that no federal or state listed threatened or endangered terrestrial species (birds) have been observed on the PNPS site or in the transmission line Right-of-Way (ROW). However, three (3) federally listed bird species were identified in the Town of Plymouth; the piping plover (*Charadrius melodus*), roseate tern (*Sterna dougallii*), and bald eagle (*Haliaeetus leucocephalus*).

Also identified was Population 1 of the northern red-bellied cooter (Pseudemys rubriventris), a freshwater turtle, and the dwarf wedgemussel (Alasmidonta heterodon), a

federal and state listed endangered species identified as occurring in the town, but not having habitat or the potential to occur in the site area. Based on a current review of the USFWS IPaC database, the listing status of these species remains unchanged from the designations in place at the time of SEIS evaluation. None of the identified species are dependent on habitats within the facility and were found unlikely to be affected by facility operations in the SEIS.

The northern red-bellied cooter, also referred to as the plymouth redbelly turtle (*Pseudomys rubriventis bangsi*) remains federally listed as an endangered species and is also state listed as endangered. An offsite area encompassing, but not including, the transmission line ROW that is not part of the PNPS, has been designated as critical habitat for the red-bellied cooter. The northern red-bellied cooter inhabits freshwater ponds that have abundant aquatic vegetation. Sandy soil with an open canopy on land surrounding the ponds is required for successful nesting (SEIS, Section 2.2.6.3). No such habitat exists in the PNPS operational area; therefore, this species will not be affected by decommissioning activities.

A current review of the USFWS IPaC database for the PNPS area indicates that the northern long-eared bat (*Myotis septentrionalis*) was federally listed as threatened in May 2015 and is also listed as threatened by the state. The red knot (*Calidrus canutus rufa*), a migratory bird, was federally listed in the PNPS area as threatened in December 2014. The red knot is not listed by the state.

The red knot prefers coastal beaches and rocky shores, sand and mud flats. However, this bird species is migratory only, scattered along the coast in small numbers. (USFWS 2016) The northern long-eared bat prefers mines and caves during the winter, and forested habitats during the summer. Since suitable habitat for the red knot and northern long-eared bat does not exist on the PNPS operational area, they are unlikely to be affected by decommissioning activities.

Based on the SEIS, there were approximately 73 additional species within the Town of Plymouth that are State-listed as endangered, threatened, or of special concern in Massachusetts. Approximately 22 of the State-listed species potentially could utilize habitats available on the PNPS site or the transmission line ROW based on their preferred habitat characteristics; however, their presence was not confirmed (SEIS, Section 2.2.6.3 and Table 2.5).

HDI does not anticipate disturbing habitat beyond the operational areas of the plant for decommissioning and construction activities. As discussed in Section 5.1.1, land within the operational area is sufficient to provide space for laydown yards, equipment or materials storage, temporary offices, and other decommissioning support areas or structures. Current parking facilities have been adequate to support refueling and maintenance outages over the years and are assumed to be adequate to support decommissioning.

Disturbance within the operational area will continue to be regulated under federal and state permits that require implementation of BMPs to control sediment and the effects of erosion. Federal and state regulations pertaining to listed species will also remain in effect, which will further ensure that impacts to listed species and their habitats are minimized.

Conclusion

Based on the above, the planned decommissioning of PNPS is not expected to adversely affect any threatened or endangered species. HDI has determined that none of the planned decommissioning activities at PNPS would encroach on the habitat of any state or federally listed species. Any indirect (disturbance-related) impacts from construction noise and human activity would be localized, of short duration, and ecologically insignificant. Birds and mammals that are intolerant of noise and human activity are expected to simply avoid (or move away from) noisy construction sites. Therefore, HDI concludes that the impacts of PNPS decommissioning on threatened and endangered species are bounded by the GEIS, as supplemented by the SEIS, and NMFS consultation adopted in the Fact Sheet included in the 2016 draft NPDES permit for PNPS (Reference 14).

5.1.8 Radiological

The GEIS (Reference 6) considered radiological doses to workers and members of the public when evaluating the potential consequences of decommissioning activities.

Occupational Dose

The occupational radiation exposure to PNPS 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 PNPS using the DECON alternative. It is expected that the occupational dose required to complete the decommissioning activities at PNPS 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 PNPS 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.

Public Dose

Section 4.3.8 of the GEIS (Reference 6) 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.

The expected radiation dose to the public from PNPS 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 (Reference 12) concluded that there would be no radiation dose impacts associated with decommissioning of PNPS.

Therefore, HDI concludes that the impacts of PNPS 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 PNPS is shut down 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 6) 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 USEPA'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 PNPS 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 6) evaluates physical, chemical, ergonomic, and biological hazards. HDI has reviewed these occupational hazards in the GEIS and concluded that the decommissioning approach chosen for PNPS 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 PNPS decommissioning on occupational issues are bounded by the GEIS.

5.1.11 Cost

Decommissioning costs for PNPS are discussed in Section 4.0 and in Enclosure 1 to this report. Section 4.3.11 of the GEIS (Reference 6) 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 PNPS is expected to result in negative socioeconomic impacts. As PNPS ceases operation and transitions through the phases of decommissioning, an overall decrease in plant staff will occur. The lost wages of 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.

Section 4.3.12 of the GEIS (Reference 6) evaluated changes in workforce and population, changes in local tax revenues, and changes in public services. The decommissioning method selected for PNPS 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 PNPS decommissioning on socioeconomic impacts are bounded by the GEIS.

5.1.13 Environmental Justice

Executive Order 12898 dated February 16, 1994 (Reference 19), 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 of the SEIS (Reference 12) analyzed 2000 census data within 50 miles of PNPS to identify minority and low-income populations. No minority communities or low-income populations were identified within a six (6) mile radius of PNPS. The nearest minority community was located approximately 25 miles from PNPS.

In August 2018, HDI determined the geographic distribution of minority and low-income populations within a 50-mile radius of the PNPS site using the U.S. Census Bureau 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 Boston and Providence. The nearest minority population is located in a small area about 4.3 miles west of PNPS in the city of Plymouth. Census block groups containing low-income populations are also concentrated in the larger metropolitan areas. The nearest low-income population is located approximately 14 miles northwest of PNPS.

Section 4.3.13.3 of the GEIS (Reference 6) reviewed environmental justice decommissioning impacts related to land use, environmental and human health, and socioeconomics. HDI does not anticipate any offsite land disturbances during decommissioning, thus the land use impacts are not applicable for PNPS.

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 PNPS, the SEIS 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 PNPS decommissioning on environmental justice are small and are bounded by the GEIS.

5.1.14 Cultural, Historic and Archeological Resources

Section 4.3.1.4 in the GEIS (Reference 6) 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.

Based on a review of the PNPS property through the Massachusetts Historical Commission (MHC) files, the NRC concluded in Section 4.4.5.2 of the SEIS (Reference 12) that the potential impacts from decommissioning of PNPS on historic and archaeological resources would be small. An archeological survey of the 517-acre portion of the PNPS site, including the area where the station and the transmission line were constructed, identified 25 archeological sites (24 historic and 1 pre-historic), all of which were found to be ineligible for listing on the National Historic Register. The survey also revealed no evidence of prehistoric occupation of the area.

In Section 4.4.5.2 of the SEIS, it is reported that the MHC notified Entergy in 2005 of a determination that no National Register eligible historic or archaeological resources on the PNPS site would likely be impacted through continuing operations at the station.

Decommissioning activities will be conducted within the existing operations area and no activities are planned that would result in disturbance of offsite areas.

Therefore, HDI concludes that no impacts to cultural, historical, and archeological resources during decommissioning are expected, and that the potential for impacts is bounded by the GEIS and SEIS.

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 6) 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 PNPS 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 6) 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 PNPS, HDI concludes that the impacts of PNPS 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 wastes and nonradioactive wastes associated with dismantlement and disposal of SSCs.

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

- Class A: 1,415,546 cubic feet
- Class B: 1,556 cubic feet
- Class C: 1,033 cubic feet
- GTCC: 1,428 cubic feet

The estimated LLRW volume (Class A, B, and C) for PNPS that is destined for land disposal will be approximately 1,418,135 cubic feet using the DECON method. The anticipated waste volume for PNPS decommissioning is bounded by the high-end estimate of 1.5 million cubic feet listed in Table 4-7 of the GEIS (Reference 6), associated with decommissioning of a facility to unrestricted release 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 PNPS that would alter these findings.

Therefore, HDI concludes that the impacts of PNPS 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 PNPS 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 6) that the impacts of decommissioning on irreversible and irretrievable commitments of resources are small. Therefore, HDI concludes that the impacts of PNPS 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 PNPS 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 the NUREG-1496 (Reference 11).

5.3 Discussion of Decommissioning in the SEIS

Postulated impacts associated with decommissioning are discussed in Section 7.0 of the SEIS (Reference 12), 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 PNPS license renewal environmental report (Reference 16) 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 6) 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 PNPS 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.
- PNPS 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 NPDES permit and applicable MADEP 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 17) 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 PNPS site-specific decommissioning activities will be bounded by appropriate, previously issued environmental impact statements. Specifically, the environmental impacts are bounded by the GEIS (Reference 6) and SEIS (Reference 12), and the Fact Sheet issued as part of draft NPDES Permit MA0003557 (Reference 14).

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 PNPS, 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 PNPS 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 PNPS 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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18. NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual. August

2000.
19. Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994

Enclosure 1: PNPS Site-Specific Decommissioning Cost Estimate

Pilgrim Nuclear Power Station
DECON Site-Specific Decommissioning Cost Estimate

Prepared for
Holtec Decommissioning International, LLC

Prepared by
Comprehensive Decommissioning International, LLC

Table of Contents

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
CPM	Critical Path Method
DCE	Decommissioning Cost Estimate
DECON	A Method of Decommissioning defined by the NRC
DGC	Decommissioning General Contractor
DOE	Department of Energy
ENTOMB	A Method of Decommissioning defined by the NRC
ENGC	Entergy Nuclear Generation Company
ENOI	Entergy Nuclear Operations, Inc.
GEIS	Generic Environmental Impact Statement
GTCC	Greater Than Class C
HDI	Holtec Decommissioning, International, LLC
Holtec	Holtec International
HSA	Historical Site Assessment
IAEA	International Atomic Energy Agency
ISDC	International Structure for Decommissioning Costing
ISFSI	Independent Spent Fuel Storage Installation
LLRW	Low Level Radioactive Waste
LTA	License Transfer Application
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MPC	Multi-Purpose Canister
MSS	Master Summary Schedule
MWt	Megawatts-Thermal
NDT	Nuclear Decommissioning Trust
NEA	Nuclear Energy Agency
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulatory Commission technical report designation
OPRA	Oracle Primavera Risk Analysis
O&M	Operations and Maintenance
PNPS	Pilgrim Nuclear Power Station
RPV	Reactor Pressure Vessel
PSDAR	Post Shutdown Decommissioning Activities Report
RCRA	Resource Conservation and Recovery Act
RRR	Real Rate of Return
RV	Reactor Vessel

RVI	Reactor Vessel Internals
SAFSTOR	A Method of Decommissioning defined by the NRC
SFMP	Spent Fuel Management Plan
SFP	Spent Fuel Pool
SME	Subject Matter Expert
SNF	Spent Nuclear Fuel
SSC	Structures, Systems and Components
TSCA	Toxic Substances Control Act
US	United States
WBS	Work Breakdown Structure
WCS	Waste Control Specialists

SUMMARY

This report presents a revised Site-Specific Decommissioning Cost Estimate (DCE), as required by 10 CFR 50.82(a)(7), for the decommissioning of the Pilgrim Nuclear Power Station (Pilgrim or PNPS). This revised DCE provides the Holtec Decommissioning International (HDI) site-specific DCE using the DECON method for decommissioning that is planned to be implemented following the equity sale of PNPS from Entergy to Holtec. This DECON Revised DCE is included as an attachment to the revised Pilgrim Post-Shutdown Decommissioning Activities Report (PSDAR) that describes HDI's decommissioning plan using the DECON method.

On November 16, 2018, ENOI, on behalf of itself and ENGC (to be renamed Holtec Pilgrim, LLC after the transaction closing), Holtec International (Holtec) and Holtec Decommissioning International, LLC (HDI) submitted a License Transfer Application (LTA) to the U.S. Nuclear Regulatory Commission (NRC) requesting approval for the transfer of the PNPS Renewed Facility Operating License No. DPR-35 and the general license for the PNPS Independent Spent Fuel Storage Installation (ISFSI) to Holtec Pilgrim and HDI (Reference 4). Following the equity sale and transfer of the facility licenses HDI intends to initiate decommissioning activities using the DECON method. 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 DCE were determined based on the selection of the DECON method for decommissioning PNPS. CDI prepared this cost estimate and schedule for HDI using several sources, including Pilgrim plant data and historical information obtained from Entergy Nuclear Operations, Inc. (ENOI), the site-specific DCE included in the Entergy Nuclear Generation Company (ENGC) SAFSTOR PSDAR (Reference 2) 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 and the 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 13) Work Breakdown Structure (WBS) and corresponding WBS dictionary.

This DECON Revised DCE 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. The HDI request for NRC approval of an exemption from the requirements of 10 CFR 50.82(a)(8)(i)(A) to use NDT funds for spent fuel management and site restoration activities is included as Enclosure 2 to the License Transfer Application (Reference 4).

HDI's 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 $1.134 billion in 2018 dollars. The summary of the costs estimated for License Termination, Spent Fuel Management and Site Restoration activities are presented in the summary table below.

PNPS Decommissioning DECON Cost Summary (thousands of 2018 dollars)

Cost Category	License Termination	Spent Fuel	Site Restoration	Total
Decontamination				
Removal	172,108		16,654	188,762
Packaging	21,866			21,866
Transportation	32,321		1,316	33,638
Disposal	152,217		15,874	168,091
Off-site Waste Processing				
Program Management	141,913	27,404	4,221	173,538
Corporate A&G				
Spent Fuel (Direct Expenditures)		458,180		458,180
Insurance and Regulatory Fees	17,902	1,418	261	19,581
Energy	16,376	7,491	1,144	25,011
Characterization and Licensing Surveys	6,051			6,051
Property Taxes	11,276	6,973	609	18,858
Miscellaneous Equipment / Site Services	20,523			20,523
Spent Fuel Pool Isolation				
Grand Total	**592,553**	**501,467**	**40,079**	**1,134,099**

1 INTRODUCTION

This report presents a revised site-Specific Decommissioning Cost Estimate (DCE), as required by 10 CFR 50.82(a)(7), for the decommissioning of the Pilgrim Nuclear Power Station (Pilgrim or PNPS) following the scheduled cessation of plant operations. This update provides the Holtec Decommissioning International (HDI) site-specific DCE using the DECON method for decommissioning that is planned to be implemented following the equity sale of PNPS from Entergy to Holtec. This DECON Revised DCE is included as an attachment to the Revised Pilgrim Post-Shutdown Decommissioning Activities Report (PSDAR) that describes HDI's decommissioning plan using the DECON method.

By letter dated November 10, 2015, Entergy Nuclear Operations, Inc. (ENOI) submitted to the U.S. Nuclear Regulatory Commission (NRC) a Notification of Permanent Cessation of Power Operations (Reference 1) for PNPS notifying the NRC of its intent to permanently cease power operations no later than June 1, 2019.

On November 16, 2018, ENOI submitted the PNPS Post-Shutdown Decommissioning Activities Report (herein referred to as the SAFSTOR PSDAR) on behalf of itself and Entergy Nuclear Generation Company (ENGC), pursuant to Title 10 of the Code of Federal Regulations (10 CFR), Section 50.82(a)(4) (Reference 2). The ENGC PSDAR selected the SAFSTOR method for decommissioning PNPS and assumed license termination in 2079 and site restoration in 2080. The site-specific DCE for the radiological decommissioning, spent fuel management, and site restoration for PNPS following the cessation of plant operations was included as Attachment 1 in the ENGC SAFSTOR PSDAR.

Pursuant to 10 CFR 50.54(bb), ENOI submitted an PNPS Updated Spent Fuel Management Plan on November 16, 2018 (Reference 3).

On November 16, 2018, ENOI, on behalf of itself and ENGC (to be renamed Holtec Pilgrim, LLC after the transaction closing), Holtec International (Holtec) and HDI submitted a License Transfer Application (LTA) to the NRC requesting approval for the transfer of the PNPS Renewed Facility Operating License DPR-35 and the general license for the PNPS Independent Spent Fuel Storage Installation (ISFSI) to Holtec Pilgrim and HDI (Reference 4).

Upon closing of the transaction, indirect control of ENGC will be transferred from ENGC's parent companies to Holtec and its subsidiary, while ENOI's operating authority will be transferred to HDI. Thereafter, Holtec Pilgrim will own and HDI will operate (i.e. conduct licensed activities at) Pilgrim and will proceed with the prompt decommissioning of the Station. HDI was formed by Holtec to operate and decommission all Holtec owned decommissioning nuclear power plant sites, including Pilgrim. HDI's mission is to assume licensed operator responsibilities for decommissioning nuclear power plants that Holtec acquires including Pilgrim. Holtec is a global turnkey supplier of equipment and systems for the nuclear, solar, geothermal, and fossil power generation sectors of the energy industry. Among other services,

Holtec has specialized in the development of spent nuclear fuel management technologies, including wet and dry storage, for over thirty years.

After the closing of the transaction and license transfer, ENGC, renamed Holtec Pilgrim, will continue to own the Pilgrim Station as well as its associated assets and real estate (with the exception of certain excluded assets), including its nuclear decommissioning trust fund , title to spent nuclear fuel, and rights pursuant to the terms of its Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste with the U.S. Department of Energy ("Standard Contract"). Holtec Pilgrim will continue to hold the NDT assets in a trust segregated form from its other assets and outside of its administrative control.

Holtec Pilgrim will enter into a Decommissioning Operator Services Agreement with HDI, which will provide for HDI to act as Holtec Pilgrim's agent and for Holtec Pilgrim to pay HDI's costs of post-shutdown operations, including 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 (DGC). CDI is majority-owned by HDI. SNC-Lavalin holds its interest in CDI through a wholly-owned U.S. subsidiary, Kentz USA Inc. Holtec and SNC-Lavalin are transferring employees into CDI. SNC-Lavalin is transferring commercial nuclear personnel and capabilities into CDI from other subsidiaries including Atkins Energy, Inc., which is based in Columbia, South Carolina. Pursuant to a Decommissioning General Contractor Agreement between HDI and CDI, following license transfer, CDI will manage and perform the day-to-day Pilgrim licensed activities to maintain compliance with the licenses and the NRC regulations including decommissioning activities, subject to HDI's direct oversight and control as the decommissioning licensed operator and majority owner of CDI.

The initiation of decommissioning activities will occur immediately following the equity sale closure and license transfer. The sale closure and license transfer are targeted to complete by the end of 2019, following cessation of plant operations and permanent reactor defueling. In addition, HDI is submitting a request for NRC approval of an exemption to use NDT funds for spent fuel management and site restoration activities.

Following the equity sale closure and transfer of the facility licenses, HDI will initiate decommissioning activities using the DECON method. Decommissioning is expected to 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 partial site release and issuance of a license amendment reducing the Pilgrim 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 PNPS following shutdown and permanent reactor defueling leading ultimately to the termination of the NRC licenses. Decommissioning objectives are:

a. Decommissioning of PNPS 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 PNPS 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 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

Pilgrim is a single unit boiling water nuclear reactor with a licensed thermal power of 2028 MWt. Pilgrim is located on a 517-acre site along the western shore of Cape Cod Bay in the Town of Plymouth, Plymouth County, Massachusetts, and consists of the boiling water nuclear reactor, other associated plant equipment, and related site facilities. Pilgrim is also the site of the generally-licensed Pilgrim ISFSI. Pilgrim is currently owned by ENGC and operated by ENOI.

1.3 Regulatory Guidance

Current regulations governing decommissioning, waste management, and 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 in writing 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)(7) the licensee is required to notify the NRC before performing any decommissioning activity inconsistent with, or making any significant changes from, those action and schedules described in the PSDAR.
- 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 DCE.
- 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 DCE is submitted to the NRC.
- Regulatory Guide 1.202, Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Plants, (Reference 6) provides the standard format and content to facilitate preparation and NRC review of required cost estimates.

2 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 5). 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

PNPS decommissioning activities will be planned and executed using the DECON method and will proceed following equity 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 Revised PSDAR and this DECON Revised DCE provides an estimate of the costs to decommission the PNPS facility utilizing the DECON method. Immediately following the equity sale and license transfer, HDI 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 PNPS project. Activity 03-Additional activities for safe enclosure and entombment is not applicable to the prompt decommissioning approach used by HDI for the PNPS 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 6) 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 7), and NUREG/CR-6174, Revised Analyses of Decommissioning for the Reference Boiling Water Reactor Power Station, (Reference 8) divides decommissioning activities associated with the DECON method into similar periods.

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

Periods 1 through 4 are generally consistent with the decommissioning periods 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 2062, a fifth period is included in the PNPS cost estimate and is identified as Ongoing Independent Spent Fuel Storage Installation (ISFSI) Operations. This fifth period captures the costs associated with storing spent fuel and Greater Than Class C (GTCC) waste following completion of PNPS dismantlement activities in addition to the costs of the eventual decommissioning of the storage facility.

<u>Period 1 – Pre-decommissioning Planning & Preparation</u>

In the time leading up to and immediately following the equity 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 equity sale and license transfer, ENOI will defuel the reactor in preparation for decommissioning. Following license transfer, HDI 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 HDI, 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 PNPS 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 (ACM), 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 landworks
15. Landscaping and site finishing

Period 5 – Ongoing ISFSI Operations

Ongoing ISFSI Operations activities are associated with storing spent fuel and GTCC waste following completion of PNPS 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 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 Pilgrim 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 2021 end date.
- Period 4, Dismantlement, maps to principal work groups 04-Dismantling Activities Within the Radiologically 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 2063.
- 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	5/7/2018 - 12/15/2020
2. Plant Deactivation	01.02.02 Facility Shutdown Activities	5/31/2019 - 11/26/2021
3. Safe Storage Operations	01.02.10 Fuel and Nuclear Material	9/23/2018 - 11/26/2021
4. Dismantlement	01.02.04 Dismantling Activities Within the Radiological Controlled Area	9/23/2018 - 1/28/2025
	01.02.05 Waste Processing, Storage and Disposal	3/4/2019 - 1/27/2025
	01.02.07 Conventional Dismantling, Demolition, and Site Restoration	9/23/2018 - 3/5/2025
5. Ongoing ISFSI Operations	01.02.10 Fuel and Nuclear Material	11/26/2021 - 9/7/2063
Program Management	01.02.06 Site Infrastructure and Operation	5/31/2019 - 1/27/2025
	01.02.08 Project Management, Engineering and Support	9/23/2018 - 1/27/2025
	01.02.11 Miscellaneous Expenditures	8/1/2019 - 1/27/2025

[1] Planning and preparation may begin for work activities prior to the closing of the equity sale and the transfer of the Pilgrim licenses

3 DECOMMISSIONING COST ESTIMATE

The DECON Revised DCE for decommissioning PNPS 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 non-radiological licensing estimates are segregated and listed separately. To demonstrate the adequacy of this estimate, this section also presents a comparison of this DCE with the site-specific decommissioning cost estimate included in the ENGC SAFSTOR PSDAR. In addition, this section provides a cash flow analysis demonstrating the adequacy of decommissioning funding.

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.

The cost estimate summary and a comparison with the ENGC SAFSTOR DCE are presented, followed by a discussion of the site-specific matters that were taken into consideration while developing this DCE. Site-specific matters include items that are applicable to the DECON method for Boiling Water Reactors (BWRs). Section 4.0 discusses the estimating methodology, basis of estimate 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 DECON Revised DCE conforms with the guidance provided in NRC Regulatory Guide 1.202. The estimate was developed and organized 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 PNPS 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 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 costs 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 equity 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.

3.2 Comparison with the ENGC SAFSTOR DCE

HDI reviewed the ENGC Site-Specific Decommissioning Cost Estimate for Pilgrim Nuclear Station employing the SAFSTOR method submitted to the NRC by ENOI (Reference 2). To the extent that the ENGC SAFSTOR estimate in the Pilgrim DCE was applicable to the HDI prompt decommissioning approach, the ENOI basis of estimate and the resulting cost estimate details are a reference condition for the HDI cost estimate development effort.

At a high level, differences between the HDI DECON and ENGC SAFSTOR estimates are attributable to the prompt DECON decommissioning method that will be employed by HDI 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 ENGC estimate. In addition, the HDI cost estimate reflects a methodology that emphasizes bulk removal and disposal of plant equipment and structures with minimal decontamination and no offsite processing operations, resulting in a significant difference in the characterization and survey costs and the amount of low level waste requiring packaging, transportation and disposal

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 to decommission the plant, but many have significant cost impacts as well.

- Management after License Transfer, DECON Labor Requirements and Costs

  Following approval of license transfer and closing on the equity sale, the management team will be comprised of HDI and CDI personnel as well as certain site incumbent

personnel who accept offers of employment and are 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 Pilgrim employees, assigning qualified personnel from the HDI and CDI parent companies, and seeking qualified personnel from industry staff augmentation firms.

Table 3-4 presents the labor costs and the annualized labor requirements and Table 3-5 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 3-4 or Table 3-5 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, HDI 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 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 HDI staffing changes (excluding subcontractor resources) are expected to occur at the following milestones:

- The spent fuel emergency planning zone is reduced following the spent fuel cooling period
- All spent fuel has been moved from the SFP to the ISFSI
- Major demolition start

- Characterization

Characterization will be performed with systems and components in place, maximizing the use of non-destructive assay techniques and direct reading survey instrumentation readings correlated with analytical data gathered via direct smears and sampling. The

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, SFP, 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 DOE.

  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 they 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
  Turbine and condenser components will be segmented in a radiologically controlled area by a specialty subcontractor. 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 later 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 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 the complete removal of large components at the PNPS 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 PNPS decommissioning records required by 10 CFR 50.75(g), HDI 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, HDI will review the Historical Site Assessment (HSA) prepared for ENOI and confirm contamination estimates and assumptions.

- Final Radiological Surveys
  After completing site 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 is in general 25 mrem/year from all pathways. Adherence to the NRC-approved License

Termination Plan (LTP) and MARSSIM guidance will ensure that the surveys are conducted so that applicable regulatory criteria are satisfied.

- Spent Fuel Management
  At the time of shutdown, there will be a total of 4,114 spent fuel assemblies at the PNPS site including 580 fuel assemblies residing in the reactor as part of the current operating cycle, 2,378 spent fuel assemblies in the spent fuel pool, and 1,156 assemblies stored in 17 dry storage casks on the ISFSI. 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 fuel and GTCC waste will ultimately be transferred to the DOE's storage facility when such a facility is in operation.

  DOE's repository program assumes that spent fuel allocations will be accepted for disposal from the nation's commercial nuclear plants, with limited exceptions, in the order (the "queue") in which it was discharged from the reactor. Pilgrim 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 10), for capacity allocations beginning in the second year of the operation of any DOE fuel storage or disposal facility.

  Consistent with ENOI's Spent Fuel Management Plan (SFMP) for PNPS (Reference 3), HDI assumes a spent fuel management plan for the Pilgrim spent fuel that is based on the assumption that DOE will commence acceptance of PNPS's spent fuel in 2030 and, assuming a maximum rate of transfer described in the DOE Acceptance Priority Ranking & Annual Capacity Report (Reference 10), the spent fuel is projected to be fully removed the Pilgrim site in 2062, consistent with the current DOE spent fuel management and acceptance strategy (References 9 and 10). This DCE identifies the details, schedules, and costs of spent fuel management activities associated with the SFMP, along with license termination and site restoration activities and costs.

  Spent fuel management activities will be funded from the NDT following receipt of an exemption from current NRC restrictions on use of the fund.

- ISFSI Only License Amendment
  The dry fuel storage capacity will be expanded to accommodate all of the fuel stored in the SFP. Once all spent fuel is removed from the SFP and stored at the ISFSI, the PNPS 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 the

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.

  The design and capacity of the Pilgrim ISFSI is based upon the Holtec HI-STORM 100S dry cask storage system. The system consists of a MPC with a nominal capacity of 68 fuel assemblies and a steel-lined concrete storage overpack. The current spent fuel management plan for the Pilgrim spent fuel would result in 61 spent fuel storage casks being placed in dry storage at the site. The 17 casks that are currently stored on the existing ISFSI pad will be relocated to a consolidated ISFSI facility. The 61 casks projected to be in dry storage after shutdown excludes any additional casks that may be used for GTCC storage.

  The decommissioning estimate is based on the configuration of the consolidated ISFSI expected after all spent fuel and GTCC material has been removed from the site. The configuration of the ISFSI(s) is based on the station operating until mid-2019 and the DOE's spent fuel acceptance assumptions, as previously described.

  The canister overpack assemblies are not expected to have any interior or exterior radioactive surface contamination. Any neutron activation of the steel and concrete is expected to be extremely small. The decommissioning estimate assumes that some of the inner steel liners and the concrete overpacks will contain low levels of neutron-induced residual radioactivity that would necessitate remediation at the time of decommissioning. As an allowance, nine of the 61 overpacks are assumed to be affected, i.e., contain residual radioactivity. The allowance quantity is based upon the number of casks required for the final core off-load (i.e., 580 offloaded assemblies, 68 assemblies per cask) which results in 9 overpacks. It is assumed that these are the final casks offloaded; consequently, they have the least time for radioactive decay of the neutron activation products.

  No contamination or activation of the ISFSI pads is assumed. As such, only verification surveys are included for the pad in the decommissioning estimate. The estimate is limited to costs necessary to terminate the ISFSI's NRC license and meet the §20.1402 criteria for unrestricted use

  The estimated cost to decommission the ISFSI and release the facility for unrestricted use is provided in Appendix A. The ISFSI decommissioning cost estimate Contingency Allowance has been added at an overall rate of 25%. This is consistent with the

contingency evaluation criteria referenced by the NRC in NUREG-1757. Costs are reported in 2018 dollars.

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.

- Waste Management
  To estimate waste management costs, CDI reviewed the 2018 ENGC SAFSTOR PSDAR Decommissioning Cost Analysis estimates of volumes of waste by type. Using the ENGC information as a reference condition, CDI increased 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 selected, 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 periods.

  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 present in the SFP and generated during reactor internal segmentation. 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 PNPS decommissioning activities.

  Low-Level Radioactive Waste (LLRW)

  A major component of the decommissioning work scope for PNPS 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.

  HDI will consider novating contracts that are currently in place, including “life of plant” agreements for disposal of low-level waste, but will also seek bids from the

Energy*Solutions* Clive facility and Waste Control Specialist (WCS) to find optimum disposal terms.

For Class B and C waste, the HDI intends to file an import petition with the Texas Compact Commission to gain approval to dispose of out-of-compact waste at the WCS site in Andrews, Texas. Holtec currently holds a contract with WCS that permits disposal of radioactive waste from any decommissioning project in the United States.

One or more disposal facilities licensed in accordance with 10 CFR 20.2002 will be utilized for disposal of low activity waste since it is estimated that approximately 25% of the heterogeneous bulk debris will be compatible with these facilities. In addition to lower disposition costs, the transportation route is shorter than the route to 10 CFR 61 licensed facilities, offering reduced shipping costs and better cycling efficiency for reusable bulk containers.

Mixed Wastes

Mixed Low-Level Waste 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, treatment needs will be procured 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 PNPS 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, GTCC, hazardous, and mixed), as well as the transportation of the spent fuel 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 3-6 presents PNPS waste volume and weight estimates by Class. The HDI estimate of waste volumes is significantly higher than the ENGC estimate due to a decommissioning strategy that utilizes bulk removal with minimal decontamination. Additionally, the HDI 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 by Period

Period:	Period 1	Period 2	Period 3	Period 4	Period 5		
Activities	Pre-decommissioning Planning & Preparation	Plant Deactivation	Safe Storage Operations	Dismantlement	Ongoing ISFSI Operations	Program Management Costs	Total
License Termination (Decommissioning) Activities	**22,220**	**2,289**		**369,780**	**13,921**	**184,344**	**592,553**
Radioactive Component Removal				60,555			60,555
Dismantling of main process systems, structures and components				20,390			20,390
Dismantling of reactor internals				10,868			10,868
Dismantling of other primary loop components				2,340			2,340
Dismantling of main process systems in fuel cycle facilities				26,957			26,957
Decontamination and Dismantlement				41,169			41,169
Procurement of equipment for decontamination and dismantling				38,220			38,220
Procurement of general site-dismantling equipment				2,925			2,925
Procurement of special tools for dismantling the reactor systems				35,295			35,295
Dismantling of other systems and components				2,950			2,950
Dismantling of remaining components				980			980
Conventional dismantling, demolition and site restoration				56,978			56,978
Demolition of buildings and structures				56,462			56,462
Demolition of buildings and structures from the formerly controlled area				56,462			56,462
Final radioactivity survey of site				516			516
Final survey				516			516
Fuel and nuclear material					13,921		13,921
Dedicated ISFSI for fuel and/or nuclear material					12,870		12,870
Transfer of fuel and/or nuclear material away from the ISFSI					12,870		12,870
Decommissioning of ISFSI					1,051		1,051
Decommissioning of ISFSI					1,051		1,051
Decommissioning of ISFSI - Decommissioning of ISFSI - License Termination costs					1,051		1,051
Waste				211,077			211,077
Waste management system				4,673			4,673
Maintenance, surveillance and operational support for waste management system				4,673			4,673
Management of decommissioning intermediate-level waste/GTCC				6,581			6,581
Containers				6,581			6,581
Management of decommissioning low-level waste				154,551			154,551
Management of decommissioning exempt waste and materials				45,272			45,272
Management and Support	22,220	2,289				184,344	208,852
Pre-decommissioning actions	22,220						22,220
Decommissioning planning	15,406						15,406
Facility characterization	5,536						5,536

Pilgrim Nuclear Power Station
Site-Specific Decommissioning Cost Estimate

Period:	Period 1	Period 2	Period 3	Period 4	Period 5		
Activities	**Pre-decommissioning Planning & Preparation**	**Plant Deactivation**	**Safe Storage Operations**	**Dismantlement**	**Ongoing ISFSI Operations**	**Program Management Costs**	**Total**
Safety, security and environmental studies	1,278						1,278
Facility shutdown activities		2,289					2,289
Plant shutdown and inspection		2,289					2,289
Site infrastructure and operation						79,246	79,246
Site security and surveillance						33,332	33,332
Site operation and maintenance						11,441	11,441
Operation of support systems						2,120	2,120
Radiation and environmental safety monitoring						32,352	32,352
PI - PIL - Project management, engineering and support						75,920	75,920
Project management						38,965	38,965
Support services						30,494	30,494
Health and safety						6,461	6,461
Miscellaneous expenditures						29,178	29,178
Owner costs						14,590	14,590
Payments (fees) to authorities						14,590	14,590
Taxes						11,276	11,276
Local, community, federal taxes						11,276	11,276
Insurances						3,313	3,313
Nuclear related insurances						3,132	3,132
Other insurances						181	181
Spent Fuel Management Activities		**6,990**	**172,750**		**278,441**	**43,286**	**501,467**
Fuel and nuclear material			172,750		278,441		451,191
Removal of fuel or nuclear material from facility to be decommissioned			60,227				60,227
Transfer of fuel or nuclear material to dedicated ISFSI			60,227				60,227
Dedicated ISFSI for fuel and/or nuclear material			112,522		276,000		388,523
Construction of ISFSI			106,147				106,147
Operation of ISFSI			6,376		234,465		240,841
Transfer of fuel and/or nuclear material away from the ISFSI					41,535		41,535
Decommissioning of ISFSI					2,441		2,441
Decommissioning of ISFSI					2,050		2,050
Decommissioning of ISFSI - Decommissioning of ISFSI - Spent Fuel Management costs					2,050		2,050
Management of waste					391		391
Decommissioning of ISFSI - Management of waste - Spent Fuel Management costs					391		391
Waste							
Management and Support		6,990				43,286	50,276
Facility shutdown activities		6,990					6,990
Plant shutdown and inspection		6,990					6,990

Pilgrim Nuclear Power Station
Site-Specific Decommissioning Cost Estimate

Period:	Period 1	Period 2	Period 3	Period 4	Period 5		
Activities	**Pre-decommissioning Planning & Preparation**	**Plant Deactivation**	**Safe Storage Operations**	**Dismantlement**	**Ongoing ISFSI Operations**	**Program Management Costs**	**Total**
PI - PIL - Project management, engineering and support						34,895	34,895
Project management						17,807	17,807
Support services						14,426	14,426
Health and safety						2,662	2,662
Miscellaneous expenditures						8,391	8,391
Taxes						6,973	6,973
Local, community, federal taxes						6,973	6,973
Insurances						1,418	1,418
Nuclear related insurances						1,202	1,202
Other insurances						216	216
Site Restoration Activities				**33,139**	**706**	**6,235**	**40,079**
Conventional dismantling, demolition and site restoration				15,949			15,949
Demolition of buildings and structures				11,761			11,761
Demolition of buildings and structures outside the controlled area				11,761			11,761
Final cleanup, landscaping and refurbishment				4,188			4,188
Earthworks, landworks				253			253
Landscaping and other site finishing activities				3,935			3,935
Fuel and nuclear material					706		706
Decommissioning of ISFSI					706		706
Decommissioning of ISFSI					625		625
Decommissioning of ISFSI - Decommissioning of ISFSI - Site Restoration costs					625		625
Management of waste					81		81
Decommissioning of ISFSI - Management of waste - Site Restoration costs					81		81
Waste				17,190			17,190
Management of decommissioning waste and materials generated outside controlled areas				17,190			17,190
Management and Support						6,235	6,235
PI - PIL - Project management, engineering and support						5,365	5,365
Project management						2,826	2,826
Support services						2,050	2,050
Health and safety						488	488
Miscellaneous expenditures						870	870
Taxes						609	609
Local, community, federal taxes						609	609
Insurances						261	261
Nuclear related insurances						260	260
Other insurances						1	1
Grand Total	**22,220**	**9,278**	**172,750**	**402,919**	**293,067**	**233,865**	**1,134,099**

Table 3-2 Program Management Cost Detail

Cost by Year by WBS - Program Management Cost		2018	2019	2020	2021	2022	2023	2024	2025	
WBS_Code	WBS_Name									Total
01.02	Pilgrim		31,651	61,684	50,290	34,844	32,612	21,555	1,230	**233,865**
01.02.06	Site infrastructure and operation		10,862	24,847	20,980	9,437	8,892	4,046	181	79,246
01.02.06.01	Site security and surveillance		5,543	14,154	11,237	781	778	784	56	33,332
01.02.06.01.03	Security fencing and protection of remaining entrances against trespassing		13	1,523						1,536
01.02.06.01.04	Deployment of security forces		5,530	12,631	11,237	781	778	784	56	31,797
01.02.06.02	Site operation and maintenance		1,220	2,981	2,849	1,733	1,726	932		11,441
01.02.06.02.01	Inspection and maintenance of buildings and systems		1,220	2,981	2,849	1,733	1,726	932		11,441
01.02.06.02.02	Site upkeep activities									
01.02.06.03	Operation of support systems		569	596	332	333	291			2,120
01.02.06.03.01	Electricity supply systems		77	47						124
01.02.06.03.02	Ventilation systems		342	459	332	333	291			1,756
01.02.06.03.07	Other systems		149	91						240
01.02.06.04	Radiation and environmental safety monitoring		3,530	7,116	6,563	6,590	6,098	2,330	126	32,352
01.02.06.04.02	Radiation protection and monitoring		3,462	6,949	6,397	6,424	5,932	2,162	114	31,439
01.02.06.04.03	Environmental protection and radiation environmental monitoring		68	167	166	166	166	167	12	913
01.02.08	PI - PIL - Project management, engineering and support		14,878	25,758	21,920	20,327	19,409	13,198	689	116,180
01.02.08.02	Project management		6,818	13,047	11,635	10,402	10,029	7,202	465	59,598
01.02.08.02.01	Core management group		4,023	8,388	7,724	6,474	6,298	4,737	291	37,934
01.02.08.02.02	Project implementation planning, detailed ongoing planning		367	492	356	357	334	179	13	2,099
01.02.08.02.03	Scheduling and cost control		1,426	2,506	2,165	2,174	2,006	883	63	11,222
01.02.08.02.04	Safety and environmental analysis, ongoing studies		68	167	166	166	166	167	12	913
01.02.08.02.05	Quality assurance and quality surveillance		483	753	607	609	607	612	43	3,714
01.02.08.02.06	General administration and accounting		387	588	466	468	466	470	33	2,880
01.02.08.02.07	Public relations and stakeholders involvement		63	153	152	153	152	153	11	837
01.02.08.03	Support services		7,274	10,788	8,377	8,010	7,499	4,836	186	46,970
01.02.08.03.01	Engineering support		2,031	1,417	245	246	245	248	18	4,450
01.02.08.03.02	Information system and computer support		183	447	443	445	443	369	20	2,351
01.02.08.03.03	Waste management support		241	589	584	586	584	315		2,899
01.02.08.03.04	Decommissioning support including chemistry, decontamination		88	215	213	214	213	115		1,059
01.02.08.03.05	Personnel management and training		613	981	803	807	789	694	49	4,737
01.02.08.03.06	Documentation and records control		154	377	374	376	360	258	18	1,918
01.02.08.03.07	Procurement, warehousing, and materials handling		597	1,199	1,067	689	642	330	23	4,547
01.02.08.03.08	Housing, office equipment, support services		3,366	5,563	4,647	4,647	4,223	2,506	58	25,011
01.02.08.04	Health and safety		787	1,923	1,907	1,915	1,881	1,160	37	9,611
01.02.08.04.01	Health physics		305	744	738	741	712	529	37	3,806

Cost by Year by WBS - Program Management Cost		2018	2019	2020	2021	2022	2023	2024	2025	Total
WBS_Code	WBS_Name									
01.02.08.04.02	Industrial safety		483	1,179	1,169	1,174	1,169	631		5,805
01.02.11	Miscellaneous expenditures		5,911	11,079	7,390	5,079	4,311	4,311	359	38,439
01.02.11.01	Owner costs		2,397	3,791	2,864	2,315	1,547	1,547	129	14,590
01.02.11.01.03	Payments (fees) to authorities		2,397	3,791	2,864	2,315	1,547	1,547	129	14,590
01.02.11.02	Taxes		3,094	6,283	3,534	1,928	1,928	1,928	161	18,858
01.02.11.02.02	Local, community, federal taxes		3,094	6,283	3,534	1,928	1,928	1,928	161	18,858
01.02.11.03	Insurances		419	1,006	991	835	835	835	70	4,991
01.02.11.03.01	Nuclear related insurances		348	835	835	835	835	835	70	4,594
01.02.11.03.02	Other insurances		71	170	156					397

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

Cost Category	License Termination	Spent Fuel	Site Restoration	Total
Decontamination				
Removal	172,108		16,654	188,762
Packaging	21,866			21,866
Transportation	32,321		1,316	33,638
Disposal	152,217		15,874	168,091
Off-site Waste Processing				
Program Management	141,913	27,404	4,221	173,538
Corporate A&G				
Spent Fuel		458,180		458,180
Insurance and Regulatory Fees	17,902	1,418	261	19,581
Energy	16,376	7,491	1,144	25,011
Characterization and Licensing Surveys	6,051			6,051
Property Taxes	11,276	6,973	609	18,858
Miscellaneous Equipment / Site Services	20,523			20,523
Spent Fuel Pool Isolation				
Grand Total	**592,553**	**501,467**	**40,079**	**1,134,099**

Table 3-4 Labor Costs and Labor Requirements by Year (thousands of 2018 dollars)

Labor Category	Labor (FTEs) and Labor Costs																						
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Management Labor Cost	3,881	8,743	8,420	7,206	7,027	5,128	971	732	729	732	732	732	732	732	732	729	732	735	732	729	732	732	732
Management Labor FTEs	12.0	27.3	26.5	22.4	22.0	16.6	2.8	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Professional Labor Cost	19,545	36,593	31,453	17,042	15,096	10,899	2,922	2,488	2,478	2,488	2,488	2,488	2,488	2,488	2,488	2,478	2,488	2,499	2,488	2,478	2,488	2,488	2,488
Professional Labor FTEs	118.2	238.5	211.9	97.1	88.2	65.3	26.2	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Craft Labor Cost	3,515	11,220	11,040	13,386	4,731	1,513	59																
Craft Labor FTEs	21.0	66.3	65.7	77.5	28.5	8.8	0.4																
Total Labor Cost	**26,942**	**56,556**	**50,913**	**37,634**	**26,853**	**17,540**	**3,952**	**3,221**	**3,207**	**3,221**	**3,221**	**3,221**	**3,221**	**3,221**	**3,221**	**3,207**	**3,221**	**3,234**	**3,221**	**3,207**	**3,221**	**3,221**	**3,221**
Total Labor FTEs	**151.2**	**332.0**	**304.1**	**197.0**	**138.8**	**90.7**	**29.3**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**

Labor Category	Labor (FTEs) and Labor Costs																						
	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	Total Cost
Management Labor Cost	732	732	732	729	732	732	735	729	732	729	735	732	732	729	732	732	732	732	732	732	729	272	**68,727**
Management Labor FTEs	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.7	
Professional Labor Cost	2,488	2,488	2,488	2,478	2,488	2,488	2,499	2,478	2,488	2,478	2,499	2,488	2,488	2,478	2,488	2,488	2,488	2,488	2,488	2,568	2,557	308	**226,033**
Professional Labor FTEs	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.3	24.3	2.8	
Craft Labor Cost																							**45,465**
Craft Labor FTEs																							
Total Labor Cost	**3,221**	**3,221**	**3,221**	**3,207**	**3,221**	**3,221**	**3,234**	**3,207**	**3,221**	**3,207**	**3,234**	**3,221**	**3,221**	**3,207**	**3,221**	**3,221**	**3,221**	**3,221**	**3,221**	**3,300**	**3,286**	**580**	**340,224**
Total Labor FTEs	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.0**	**26.3**	**26.3**	**3.5**	

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

	Labor (FTEs) and Labor Costs													
	Period 1		Period 2		Period 3		Period 4		Period 5		Program Management		Total	
	Labor FTE	Labor Cost	Labor FTE	Labor Cost	Labor FTE	Labor Cost	Labor FTE	Labor Cost	Labor FTE	Labor Cost	Labor FTE	Labor Cost	Labor FTE	Labor Cost
BWR DECON														
Decommissioning Crews	0.0	0	2.0	357	0.0	0	112.1	19,462	0.0	0	154.1	25,647	268.1	45,465
Management/Support Staff	2.8	730	33.1	8,922	990.1	122,827	46.5	7,680	109.6	11,368	758.7	143,233	1940.9	294,760
Total	**2.8**	**730**	**35.1**	**9,278**	**990.1**	**122,827**	**158.6**	**27,142**	**109.6**	**11,368**	**912.8**	**168,880**	**2209.0**	**340,224**

Table 3-6 PNPS Waste Volumes

Waste	Class	Waste Volume (cubic feet)	Weight (pounds)
Low-Level Radioactive Waste	A	1,415,546	60,719,470
	B	1,556	185,464
	C	1,033	75,210
Greater than Class C Waste	GTCC	1428	291,100
Total		**1,419,563**	**61,271,244**

4 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 (BOE) 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 Oracle Primavera, P6
- Identifying quantities, resources, and cost elements to accomplish the detailed scope of work in alignment with the Oracle Primavera, 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 PNPS was organized into 39 Level 4 WBS elements, and an individual 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
- Bottom Up: A detailed takeoff 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 SAFSTOR decommissioning cost estimate included in the PSDAR submitted to the NRC by ENOI in November 2018. The ENGC basis of estimate and the resulting cost estimate details are a reference condition for the CDI cost estimate development effort.

CDI used plant data and historical information obtained from ENOI 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.

The estimates of costs associated with license termination in NUREG/CR-6174, Revised Analyses of Decommissioning for the Reference Boiling Water Reactor Power Station (Reference 8) were reviewed in order to evaluate the reasonableness of the PNPS 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 PNPS license termination, spent fuel management and site restoration to nine comparable decommissioning projects. CDI also compared the PNPS decommissioning cost estimate for license termination, spent fuel management and site restoration activities to costs from similar activities from seven decommissioned BWR nuclear power plants.

The estimate includes provisions for storage of spent fuel and GTCC wastes on the Pilgrim site until acceptance by the DOE. 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 PNPS rely on a set of assumptions regarding the type and quality of inputs and the nature of the work.

Pre-Decommissioning Planning

- ENOI has provided reasonable and accurate information in good faith regarding the history and current condition of the plant and site
- No decontamination efforts 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 effort

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 offsite 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 PNPS site security is adequate for transition and CDI decommissioning activities
- The existing PNPS O&M procedures are available and adequate for all active plant systems
- SMEs are available in the existing PNPS 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 equity sale and transfer of the facility licenses

Fuel and Nuclear Material

- All PNPS 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 are 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 affect 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 also for making well-informed decisions during the decommissioning project lifecycle.

A Monte-Carlo simulation risk modeling tool, Oracle Primavera Risk Analysis (OPRA), is used 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 effectiveness 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 effort 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, 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, a quantitative analysis is performed 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 effects 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 17 percent was determined to be reasonable for the Pilgrim 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 11).

The Contingency Allowance is an integral part of the cost to complete the PNPS 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.

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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 DECOMMISSIONING SCHEDULE AND FUNDING

5.1 Decommissioning Schedule

The schedule and cost estimate to decommission PNPS 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 PNPS schedule baseline is a detailed 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 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 Entergy completes defueling by June 29, 2019, and the license is transferred to HDI by August 1, 2019.

As described in Subsection 3.2, ENGC's current spent fuel management plan for the Pilgrim spent fuel is based in general upon: 1) a 2030 start date for DOE initiating transfer of commercial spent fuel to a federal facility (not necessarily a final repository), and 2) expectations for spent fuel receipt by the DOE for the Pilgrim fuel beginning in 2030. All spent fuel is expected to be removed from the site by 2062.

5.2 Decommissioning Funds

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.

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 latest 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 12) will be put in place.

Figure 5-1 Pilgrim Master Summary Schedule

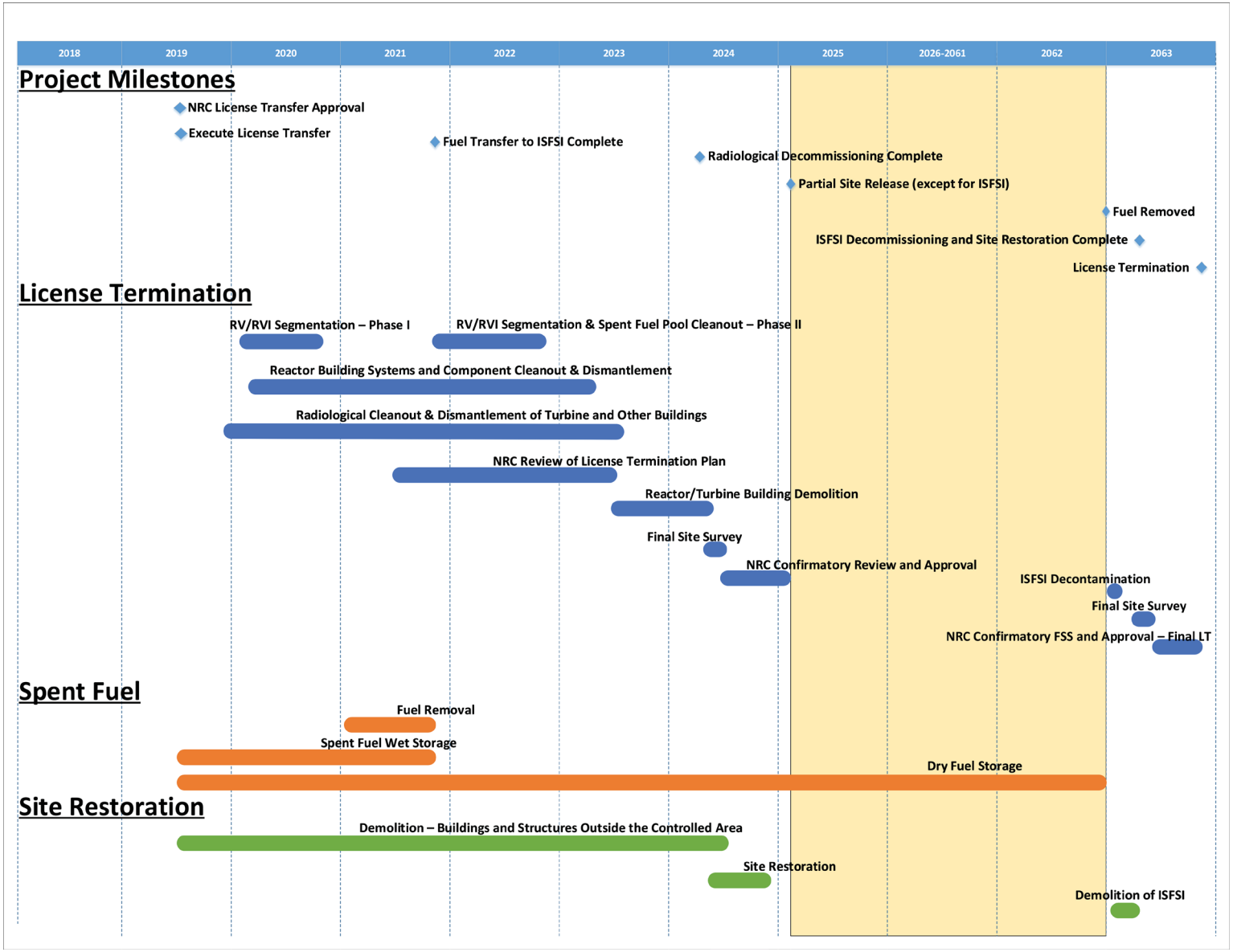

Table 5-1 Decommissioning Funding Cash Flow Analysis

Pilgrim Nuclear Power Station - DECON Method
Annual Cash Flow in Thousands of 2018 Dollars
No DOE Reimbursement of Spent Fuel Management Costs

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	84,927	53,920	18	138,865	1,030,000	(138,865)	5,273	896,408
2020	79,292	84,905	28	164,225	896,408	(164,225)	10,397	742,579
2021	46,759	82,500	637	129,896	742,579	(129,896)	8,700	621,384
2022	103,197	3,332	23,630	130,159	621,384	(130,159)	6,975	498,200
2023	167,453	3,135	1,700	172,288	498,200	(172,288)	4,628	330,540
2024	95,694	3,225	9,236	108,155	330,540	(108,155)	3,158	225,543
2025	1,310	6,306	4,127	11,742	225,543	(11,742)	3,036	216,837
2026		5,952		5,952	216,837	(5,952)	2,995	213,879
2027		5,939		5,939	213,879	(5,939)	2,953	210,893
2028		5,952		5,952	210,893	(5,952)	2,910	207,851
2029		5,952		5,952	207,851	(5,952)	2,867	204,766
2030		7,212		7,212	204,766	(7,212)	2,805	200,359
2031		7,212		7,212	200,359	(7,212)	2,743	195,891
2032		7,212		7,212	195,891	(7,212)	2,679	191,358
2033		7,212		7,212	191,358	(7,212)	2,615	186,762
2034		7,193		7,193	186,762	(7,193)	2,550	182,119
2035		7,212		7,212	182,119	(7,212)	2,484	177,391
2036		7,230		7,230	177,391	(7,230)	2,416	172,577
2037		7,212		7,212	172,577	(7,212)	2,348	167,713
2038		7,193		7,193	167,713	(7,193)	2,279	162,800
2039		7,212		7,212	162,800	(7,212)	2,209	157,798
2040		7,212		7,212	157,798	(7,212)	2,138	152,724
2041		7,212		7,212	152,724	(7,212)	2,066	147,579
2042		7,212		7,212	147,579	(7,212)	1,993	142,361
2043		7,212		7,212	142,361	(7,212)	1,919	137,068
2044		7,212		7,212	137,068	(7,212)	1,844	131,701
2045		7,193		7,193	131,701	(7,193)	1,768	126,276
2046		7,212		7,212	126,276	(7,212)	1,691	120,755
2047		7,212		7,212	120,755	(7,212)	1,612	115,156
2048		7,230		7,230	115,156	(7,230)	1,533	109,458
2049		7,193		7,193	109,458	(7,193)	1,452	103,717
2050		7,212		7,212	103,717	(7,212)	1,370	97,876
2051		7,193		7,193	97,876	(7,193)	1,288	91,971
2052		7,230		7,230	91,971	(7,230)	1,203	85,944
2053		7,212		7,212	85,944	(7,212)	1,118	79,851

[1] The 2019 Beginning of Year NDT balance reflects the fund value post-closure of the equity sale. The value used does not include deductions for ENOI pre-closure costs. 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

Pilgrim Nuclear Power Station - DECON Method

Annual Cash Flow in Thousands of 2018 Dollars
No DOE Reimbursement of Spent Fuel Management Costs

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]
2054		7,212		7,212	79,851	(7,212)	1,031	73,671
2055		7,193		7,193	73,671	(7,193)	944	67,422
2056		7,212		7,212	67,422	(7,212)	855	61,065
2057		7,212		7,212	61,065	(7,212)	765	54,618
2058		7,212		7,212	54,618	(7,212)	673	48,080
2059		7,212		7,212	48,080	(7,212)	580	41,449
2060	4,296	7,212		11,507	41,449	(11,507)	425	30,367
2061	4,375	7,212		11,587	30,367	(11,587)	267	19,047
2062	4,358	7,193		11,551	19,047	(11,551)	106	7,602
2063	892	2,441	706	4,038	7,602	(4,038)	51	3,615
Total[4]	592,553	501,467	40,079	1,134,099		(1,134,099)	107,714	

[4] Columns may not add due to rounding

6 CONCLUSION

The submittal of this DECON Revised DCE complies with NRC requirements set forth in 10 CFR 50.82(a)(7), which require the licensee to notify the NRC before making any significant schedule change from those actions and schedules described in the PSDAR. CDI prepared this cost estimate and schedule on behalf of HDI using several sources, including information compiled during a due diligence period, the site-specific decommissioning cost estimate included in the Pilgrim SAFSTOR PSDAR submitted to the NRC by ENOI on November 16, 2018 (Reference 2) 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 $1.134 billion. 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, as well as the duration.

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 12) 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				
01.00	Summary				
01.02	Pilgrim	592,553	501,467	40,079	**1,134,099**
01.02.01	Pre-decommissioning actions	22,220			**22,220**
01.02.01.01	Decommissioning planning	15,406			**15,406**
01.02.01.01.03	Final planning	15,406			**15,406**
01.02.01.02	Facility characterization	5,536			**5,536**
01.02.01.02.01	Detailed facility characterization	4,190			**4,190**
01.02.01.03	Safety, security and environmental studies	1,278			**1,278**
01.02.01.03.01	Decommissioning safety analysis	730			**730**
01.02.02	Facility shutdown activities	2,289	6,990		**9,278**
01.02.02.01	Plant shutdown and inspection	2,289	6,990		**9,278**
01.02.02.01.03	Cooling down of spent fuel	2,289			**2,289**
01.02.02.01.04	Management of fuel, fissile and other nuclear materials		6,990		**6,990**
01.02.04	Dismantling activities within the controlled area	101,725			**101,725**
01.02.04.01	Procurement of equipment for decontamination and dismantling	38,220			**38,220**
01.02.04.01.01	Procurement of general site-dismantling equipment	2,925			**2,925**
01.02.04.01.03	Procurement of special tools for dismantling the reactor systems	35,295			**35,295**
01.02.04.05	Dismantling of main process systems, structures and components	60,555			**60,555**
01.02.04.05.01	Dismantling of reactor internals	10,868			**10,868**
01.02.04.05.03	Dismantling of other primary loop components	2,340			**2,340**
01.02.04.05.04	Dismantling of main process systems in fuel cycle facilities	26,957			**26,957**
01.02.04.06	Dismantling of other systems and components	2,950			**2,950**
01.02.04.06.02	Dismantling of remaining components	980			**980**
01.02.05	Waste processing, storage and disposal	211,077		17,190	**228,268**
01.02.05.01	Waste management system	4,673			**4,673**
01.02.05.01.04	Maintenance, surveillance and operational support for waste management system	4,673			**4,673**
01.02.05.08	Management of decommissioning intermediate-level waste/GTCC	6,581			**6,581**
01.02.05.08.07	Containers	6,581			**6,581**
01.02.05.09	Management of decommissioning low-level waste	154,551			**154,551**
01.02.05.12	Management of decommissioning exempt waste and materials	45,272			**45,272**
01.02.05.13	Management of decommissioning waste and materials generated outside controlled areas			17,190	**17,190**
01.02.06	Site infrastructure and operation	79,246			**79,246**
01.02.06.01	Site security and surveillance	33,332			**33,332**
01.02.06.01.03	Security fencing and protection of remaining entrances against trespassing	1,536			**1,536**
01.02.06.01.04	Deployment of officers' forces	31,797			**31,797**
01.02.06.02	Site operation and maintenance	11,441			**11,441**
01.02.06.02.01	Inspection and maintenance of buildings and systems	11,441			**11,441**
01.02.06.03	Operation of support systems	2,120			**2,120**
01.02.06.03.01	Electricity supply systems	124			**124**
01.02.06.03.02	Ventilation systems	1,756			**1,756**
01.02.06.03.07	Other systems	240			**240**
01.02.06.04	Radiation and environmental safety monitoring	32,352			**32,352**
01.02.06.04.02	Radiation protection and monitoring	31,439			**31,439**
01.02.06.04.03	Environmental protection and radiation environmental monitoring	913			**913**
01.02.07	Conventional dismantling, demolition and site restoration	56,978		15,949	**72,927**

Cost by Cost Element by WBS		License Termination	Spent Fuel	Site Restoration	TOTAL
WBS_Code	WBS_Name				
01.02.07.03	Demolition of buildings and structures	56,462		11,761	**68,224**
01.02.07.03.01	Demolition of buildings and structures from the formerly controlled area	56,462			**56,462**
01.02.07.03.01.10	Phase II Demolition	56,462			**56,462**
01.02.07.03.02	Demolition of buildings and structures outside the controlled area			11,761	**11,761**
01.02.07.03.02.10	Phase I Demolition			10,927	**10,927**
01.02.07.03.02.20	Phase III Demolition			834	**834**
01.02.07.04	Final cleanup, landscaping and refurbishment			4,188	**4,188**
01.02.07.04.01	Earthworks, landworks			253	**253**
01.02.07.04.02	Landscaping and other site finishing activities			3,935	**3,935**
01.02.07.05	Final radioactivity survey of site	516			**516**
01.02.07.05.01	Final survey	516			**516**
01.02.08	PI - PIL - Project management, engineering and support	75,920	34,895	5,365	**116,180**
01.02.08.02	Project management	38,965	17,807	2,826	**59,598**
01.02.08.02.01	Core management group	24,703	11,447	1,784	**37,934**
01.02.08.02.02	Project implementation planning, detailed ongoing planning	1,352	656	90	**2,099**
01.02.08.02.03	Scheduling and cost control	7,300	3,399	523	**11,222**
01.02.08.02.04	Safety and environmental analysis, ongoing studies	623	238	51	**913**
01.02.08.02.05	Scheduling and cost control	7,300	3,399	523	**11,222**
01.02.08.02.06	Safety and environmental analysis, ongoing studies	623	238	51	**913**
01.02.08.02.07	Public relations and stakeholders involvement	572	218	47	**837**
01.02.08.03	Support services	30,494	14,426	2,050	**46,970**
01.02.08.03.01	Engineering support	2,636	1,738	76	**4,450**
01.02.08.03.02	Information system and computer support	1,597	628	126	**2,351**
01.02.08.03.03	Waste management support	1,949	808	142	**2,899**
01.02.08.03.04	Decommissioning support including chemistry, decontamination	712	295	52	**1,059**
01.02.08.03.05	Personnel management and training	3,154	1,347	235	**4,737**
01.02.08.03.06	Documentation and records control	1,287	529	102	**1,918**
01.02.08.03.07	Procurement, warehousing, and materials handling	2,782	1,591	173	**4,547**
01.02.08.03.08	Housing, office equipment, support services	16,376	7,491	1,144	**25,011**
01.02.08.04	Health and safety	6,461	2,662	488	**9,611**
01.02.08.04.01	Health physics	2,558	1,044	204	**3,806**
01.02.08.04.02	Industrial safety	3,903	1,618	285	**5,805**
01.02.10	Fuel and nuclear material	13,921	451,191	706	**465,817**
01.02.10.01	Removal of fuel or nuclear material from facility to be decommissioned		60,227		**60,227**
01.02.10.01.02	Transfer of fuel or nuclear material to dedicated ISFSI		60,227		**60,227**
01.02.10.02	Dedicated ISFSI for fuel and/or nuclear material	12,870	388,523		**401,393**
01.02.10.02.01	Construction of ISFSI		106,147		**106,147**
01.02.10.02.02	Operation of ISFSI		240,841		**240,841**
01.02.10.02.03	Transfer of fuel and/or nuclear material away from the ISFSI	12,870	41,535		**54,405**
01.02.10.02.03.01	Transfer of fuel and/or nuclear material away from the ISFSI - License Termination costs	12,870			**12,870**
01.02.10.02.03.02	Transfer of fuel and/or nuclear material away from the ISFSI - Spent Fuel Management costs		41,535		**41,535**
01.02.10.03	Decommissioning of ISFSI	1,051	2,441	706	**4,197**
01.02.10.03.01	Decommissioning of ISFSI	1,051	2,050	625	**3,726**
01.02.10.03.01.01	Decommissioning of ISFSI - License Termination costs	1,051			**1,051**
01.02.10.03.01.02	Decommissioning of ISFSI- Spent Fuel Management costs		2,050		**2,050**
01.02.10.03.01.03	Decommissioning of ISFSI- Site Restoration costs			625	**625**
01.02.10.03.02	Management of waste		391	81	**471**
01.02.10.03.02.02	Decommissioning of ISFSI - Management of waste - Spent Fuel Management costs		391		**391**
01.02.10.03.02.03	Decommissioning of ISFSI - Management of waste - Site Restoration costs			81	**81**

Cost by Cost Element by WBS		License Termination	Spent Fuel	Site Restoration	TOTAL
WBS_Code	WBS_Name				
01.02.11	Miscellaneous expenditures	29,178	8,391	870	**38,439**
01.02.11.01	Owner costs	14,590			**14,590**
01.02.11.01.03	Payments (fees) to authorities	14,590			**14,590**
01.02.11.02	Taxes	11,276	6,973	609	**18,858**
01.02.11.02.02	Local, community, federal taxes	11,276	6,973	609	**18,858**
01.02.11.03	Insurances	3,313	1,418	261	**4,991**
01.02.11.03.01	Nuclear related insurances	3,132	1,202	260	**4,594**
01.02.11.03.02	Other insurances	181	216	1	**397**

REFERENCES

1. Letter, ENOI to US NRC, “Notification of Permanent Cessation of Power Operations,” dated November 10, 2015
2. Letter, ENOI to US NRC, “Pilgrim Nuclear Power Station Post-Shutdown Decommissioning Activities Report,” dated November 16, 2018
3. Letter, ENOI to US NRC, Update to Spent Fuel Management Plan Pursuant to 10 CFR 50.54(bb) Pilgrim Nuclear Power Station, November 16, 2018
4. Letter, ENOI to US NRC, Application for Order Consenting to Direct and Indirect Transfers of Control of Licenses and Approving Conforming License Amendment; Notification of Amendment to Decommissioning Trust Agreement; and Request for Exemption from 10 CFR 50.82(a)(8)(i)(A) Pilgrim Nuclear Power Station, November 16, 2018
5. NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors," (GEIS)
6. Regulatory Guide 1.202, Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Plants
7. NUREG-1713, Standard Review Plan for Decommissioning Cost Estimates for Nuclear Reactors,
8. NUREG/CR-6174, Revised Analyses of Decommissioning for the Reference Boiling Water Reactor Power Station
9. “Strategy for the Management and Disposal of Used Nuclear Fuel and High Level Radioactive Waste,” U.S. DOE, January 11, 2013
10. “Acceptance Priority Ranking & Annual Capacity Report,” DOE/RW-0567, July 2004
11. 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.
12. Regulatory Guide 1.159, “Assuring the Availability of Funds for Decommissioning Nuclear Reactors”
13. International Structure for Decommissioning Costing (ISDC) of Nuclear Installations, ISBN 978-92-64-99173-6, Joint NEA/EC/IAEA Publication, 2012

Appendix A

ISFSI Decommissioning Cost Estimate

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

Pilgrim Activity	Removal Costs	LLRW Disposal Costs	Other Costs	Burial Volume Class A (ft^3)	FTE	License Termination	Spent Fuel	Site Restoration	Total Costs
ISFSI Demolition Non-Radiological	625							625	**625**
ISFSI Final Site Survey			31			31			**31**
ISFSI NRC Confirmatory Survey			12			12			**12**
ISFSI Demolition Radiological	849					849			**849**
ISFSI Waste Class A/Hazardous/Exempt		471		6000			391	81	**471**
NRC License Termination Support			159		0.50	159			**159**
Operations Staff			308		2.78		308		**308**
Operations Management			272		0.70		272		**272**
Property Tax			609				609		**609**
Insurance			632				632		**632**
NRC Regulatory Fees			229				229		**229**
Totals	**1,474**	**471**	**2,251**		**3.98**	**1,051**	**2,441**	**706**	**4,197**