Constellation

4300 Winfield Road
Warrenville, IL 60555
630 657 2000 Office

RS-22-055
April 18, 2022

10 CFR 50.54(bb)
10 CFR 50.75(f)(3)

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

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket Nos. 50-461, 71-0008, and 72-1046

Subject: Submittal of Preliminary Decommissioning Cost Estimate and Spent Fuel Management Plan

Reference: Letter from P. Simpson (Exelon Generation Company, LLC) to U.S. NRC, "Report on Status of Decommissioning Funding for Reactors and Independent Spent Fuel Storage Installations," dated February 24, 2021 (Adams Accession No. ML21055A776)

In accordance with 10 CFR 50.75, "Reporting and recordkeeping for decommissioning planning," paragraph (f)(3), "Each power reactor licensee shall at or about 5 years prior to the projected end of operations submit a preliminary decommissioning cost estimate which includes an up-to-date assessment of the major factors that could affect the cost to decommission." Constellation Generation Company, LLC (CEG) is submitting this letter to provide a preliminary decommissioning cost estimate in accordance with 10 CFR 50.75(f)(3) and spent fuel management plan in accordance with 10 CFR 50.54(bb) for Clinton Power Station, Unit 1 (CPS), as the Facility Operating License (FOL) expires in five (5) years (April 17, 2027).

CEG has not made a final determination of the decommissioning approach for CPS. For purposes of this submittal, the SAFSTOR option has been selected. CEG reserves the right to choose an alternative decommissioning option at the actual time of decommissioning in accordance with its business needs, recognizing that it needs to assure the chosen option meets NRC requirements for decommissioning funding.

Attachment 1 of this submittal contains a preliminary decommissioning cost estimate (DCE) for CPS. The cost estimate is a preliminary estimate of anticipated costs and will be updated at various times as deemed appropriate by CEG and/or in compliance with regulatory requirements. The attached preliminary decommissioning cost estimate assumes that CPS permanently terminates operations on April 17, 2027, in accordance with the CPS FOL.

The latest Decommissioning Funding Report for CPS was submitted as Attachment 8 of the referenced letter. The minimum formula cost amount using the formula in 10 CFR 50.75(c) was calculated assuming the labor, energy, and burial factors described in Attachment 1 of the

referenced letter. The site-specific cost amount reported in the DCE is greater than the minimum formula cost amount, as required by 10 CFR 50.75(b)(1).

The major factors that could affect the cost estimate as well as contingencies to allow for unknown or unplanned occurrences during decommissioning are included in the attached preliminary DCE in Attachment 1. Additionally, soil and groundwater remediation costs are included in the cost estimate. The required soil remediation is based on evaluation of 10 CFR 50.75(g)(1) reports.

As discussed in 10 CFR 50.54(bb), "Conditions of licenses," paragraph (bb), a licensee shall "…5 years before expiration of the reactor operating license, …. submit written notification to the Commission for its review and preliminary approval of the program by which the licensee intends to manage and provide funding for the management of all irradiated fuel at the reactor following permanent cessation of operation of the reactor until title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its ultimate disposal in a repository." Accordingly, Attachment 2 of this submittal includes the CPS Spent Fuel Management Plan for NRC review and preliminary approval.

Attachment 3 contains the projected annual cash flow from the CPS decommissioning trust fund for decommissioning the site based on the Attachment 1 DCE. Attachment 1, Table 6-1 costs have been escalated from June 2021 dollars to the December 31, 2021 dollars shown in Attachment 3 using an escalation rate of 1.33% (which corresponds to an APR of 2.6681%). The costs for radiological decommissioning (license termination costs) and Independent Spent Fuel Storage Installation (ISFSI) decommissioning are reflected in Attachment 3 consistent with the definition of decommissioning in 10 CFR 50.2. The cash flow analysis conservatively assumes all expenses in a year are incurred at the beginning of year (i.e., beginning of year convention) during the decommissioning period.

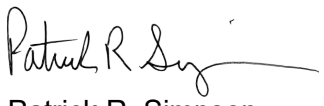
As of December 31, 2021, CPS decommissioning trust fund balances totaled $719.0 million, which exceeds the amount required to complete decommissioning of the site in the attached preliminary DCE.

In accordance with 10 CFR 50.75(f)(1) and 10 CFR 50.82(8)(v), the financial assurance summary report will be updated and submitted to the NRC annually starting in 2023. The cost estimates and financial levels will be adjusted in accordance with Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors," and will be used to demonstrate funding assurance. If the funding assurance demonstration shows the decommissioning trust fund is not sufficient, then an alternate funding mechanism allowed by 10 CFR 50.75(e) and the guidance provided in the Regulatory Guide, will be put in place at an appropriate time.

In accordance with 10 CFR 50.54(bb), a copy of this notification will be maintained until the expiration of the CPS FOL. Additionally, CPS will notify the NRC of any significant changes in the proposed Spent Fuel Management Plan described in Attachment 2.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Mrs. Linda M. Palutsis at (630) 657-2821.

Respectfully,



Patrick R. Simpson
Sr. Manager – Licensing
Constellation Energy Generation, LLC

Attachments: 1. Preliminary Decommissioning Cost Estimate for Clinton Power Station
2. Spent Fuel Management Plan for Clinton Power Station
3. Decommissioning Cash Flow Analysis for Clinton Power Station

cc: Regional Administrator - NRC Region III
NRC Senior Resident Inspector - Clinton Power Station
Illinois Emergency Management Agency - Division of Nuclear Safety

# Attachment 1

# Preliminary Decommissioning Cost Estimate for Clinton Power Station

# 2021 DECOMMISSIONING COST ANALYSIS REPORT

*Clinton Power Station*

*March 2022*

# APPROVALS

**PREPARER:**

Jill Fisher

Fisher, Jill T.

Digitally signed by Fisher, Jill T.
DN: cn=Fisher, Jill T.
Date: 2022.03.09 08:47:15 -06'00'

| PREPARER | SIGNATURE | DATE |
|---|---|---|

**REVIEWER:**

Michael Baker

Baker, Michael

Digitally signed by Baker, Michael
DN: cn=Baker, Michael
Date: 2022.03.09 10:06:30 -05'00'

| REVIEWER | SIGNATURE | DATE |
|---|---|---|

**APPROVER:**

Jeff Dunlap

Dunlap, Jeffrey A.

Digitally signed by Dunlap, Jeffrey A.
DN: cn=Dunlap, Jeffrey A.
Date: 2022.03.09 16:58:29 -06'00'

| APPROVER | SIGNATURE | DATE |
|---|---|---|

# EXECUTIVE SUMMARY

This report presents the cost to decontaminate and dismantle Clinton Power Station. The primary objectives of the decommissioning project are to remove the facility from service, and reduce residual radioactivity to levels permitting unrestricted release, so that the plant's operating license can be terminated within 60-years after permanent cessation of operations. The costs to restore the site to a greenfield condition are included in the cost estimate.

This report presents the SAFSTOR method for Clinton. In the SAFSTOR scenario, active decommissioning is deferred as long as possible while still meeting the required 60-year license termination.

The selection of a preferred decommissioning alternative is influenced by numerous factors including the cost of each decommissioning alternative, minimization of occupational radiation exposure, availability of a high-level waste (spent fuel) repository or an interim storage facility, the status of other units at the site, regulatory requirements, and public concerns. Based on these factors, the SAFSTOR alternative has been selected at this time. The alternative and/or plan may differ from the assumptions made in this analysis based on facts that exist at the actual time of decommissioning

The cost elements are assigned to one of five subcategories: Radiological Decommissioning (radiological remediation), Spent Fuel Management, Site Restoration, ISFSI Radiological Decommissioning, Radiological Decommissioning Planning. The Radiological Decommissioning and Radiological Decommissioning Planning subcategories are used to accumulate costs that are consistent with "decommissioning" as defined by the NRC in its financial assurance regulations (i.e., 10 CFR 50.75). The cost reported for this subcategory is generally sufficient to terminate the unit's operating license, recognizing that there may be some additional cost impact from spent fuel management.

Section 2 of this report, *Decommissioning Scenario and Schedule*, discusses three decommissioning scenarios, and provides the schedule for the selected SAFSTOR scenario. The methodology used to develop the estimated costs, including financial aspects, is discussed in Section 3, *Cost Estimate Methodology*. Section 4, *Assumptions*, provides a discussion of the assumptions used in developing the various costs elements and considerations; including the cost associated with decontamination and component removal, waste disposal, and labor. These assumptions serve as the foundation in the development of the anticipated cost to decommission Clinton.

Based on the SAFSTOR scenario, the major milestones associated with the decommissioning time periods are discussed in Section 5, *Schedule Estimate*.

The following tables summarize the estimated costs for the SAFSTOR alternative reflecting the various cost elements. Additional detail regarding the estimated costs is provided in Section 6 of this report.

**SAFSTOR Alternative for Clinton**

*(thousands, June 2021 dollars)*

| Cost Element | Total |
|---|---|
| Decontamination | 31,206 |
| Removal | 202,487 |
| Packaging | 26,663 |
| Transportation | 11,757 |
| Waste Disposal | 89,715 |
| Waste Processing | 16,069 |
| Program Management[1] | 479,779 |
| Security | 212,402 |
| Spent Fuel Storage | 141,746 |
| Insurance and Regulatory Fees | 61,976 |
| Energy | 25,726 |
| Characterization and Licensing Surveys | 9,453 |
| Property Taxes | 120,591 |
| Miscellaneous Equipment and Supplies | 59,057 |
| **Total**[2] | 1,488,626 |

| Cost Element | Total |
|---|---|
| Radiological Decommissioning | 1,159,064 |
| Spent Fuel Management | 209,683 |
| Site Restoration | 98,528 |
| ISFSI Radiological Decommissioning | 9,912 |
| Radiological Decommissioning Planning | 11,440 |
| **Total**[2] | 1,488,626 |

1 Includes engineering costs.

2 Columns may not add up due to rounding.

# ACRONYMS

| | |
|---|---|
| AE | Architect Engineer |
| AIF/NESP | Atomic Industrial Forum/National Environmental Studies Project |
| ALARA | As Low as Reasonably Achievable |
| BWI | Babcock & Wilcox International |
| BWR | Boiling Water Reactor |
| CE | Combustion Engineering |
| CEA | Control Element Assembly |
| CFR | Code of Federal Regulations |
| D.C. | District of Columbia |
| DCE | Decommissioning Cost Estimate |
| DOC | Decommissioning Operations Contractor |
| DOE | Department of Energy |
| DSAR | Defueled Safety Analysis Report |
| Constellation | Constellation Energy Company |
| FEMA | Federal Emergency Management Agency |
| FOL | Facility Operating License |
| GAO | Government Accountability Office |
| GTCC | Greater than Class C [Waste] |
| HTGR | High Temperature Gas-Cooled Reactor |
| IP | Industrial Package |
| ISFSI | Independent Spent Fuel Storage Installation |
| LLW | Low Level Waste |
| LSA | Low Specific Activity |
| LTP | License Termination Plan |
| MPC | Multi-Purpose Canister |
| MTHM | Metric Tons Heavy Metal |
| NMPC | Niagara Mohawk Power Corporation |
| NRC | United States Nuclear Regulatory Commission |
| NSSS | Nuclear Steam Supply System |
| NUREG | Nuclear Regulatory Report (NRC) |
| NWPA | Nuclear Waste Policy Act (1982) |
| PDCE | Preliminary Decommissioning Cost Estimate |
| PERT | Program Evaluation and Review Technique |
| PSDAR | Post Shutdown Decommissioning Activities Report |
| PWR | Pressurized Water Reactor |
| RCS | Reactor Coolant System |
| RPV | Reactor Pressure Vessel |
| SCO | Surface Contaminated Object |
| S&L | Sargent and Lundy |
| SWEC | Stone and Webster Engineering Corporation |
| UFSAR | Updated Final Safety Analysis Report |
| U.S. | United States |
| WDF | Work Difficulty [Adjustment] Factor |

## TABLE OF CONTENTS

## Tables and Figures

## 1. OVERVIEW

This report presents decommissioning cost estimates for Clinton Power Station. The Clinton site is located in east central Illinois, in DeWitt County. The site is approximately six miles east of the city of Clinton and approximately 60 miles northeast of Springfield. The station consists of a single boiling water reactor. The site consists of approximately 14,182 acres, of which approximately 452 acres are not station property. The station property of approximately 13,730 acres is owned by Constellation. Clinton station with its associated approximately 4900-acre man-made cooling reservoir (Lake Clinton) is an irregular U-shaped site.

Clinton is a General Electric Boiling Water Reactor (BWR), owned and operated by Constellation. Clinton is licensed to generate 3473 megawatts-thermal (MWt).

The primary objectives of the decommissioning project are to remove the facility from service and reduce residual radioactivity to levels permitting unrestricted release, so that the plant's operating license can be terminated within 60-years after permanent cessation of operations. The costs to restore the site to a greenfield condition are included in the decommissioning cost estimate.

This analysis is not a detailed engineering evaluation, but an estimate prepared in advance of the detailed engineering processes required to carry out the decommissioning of the nuclear units. It also may not reflect the actual plan to decommission once Clinton is shutdown; the plan may differ from the assumptions made in this analysis based on facts that exist at the actual time of decommissioning.

The cost elements are assigned to one of five subcategories:

(1) **Radiological Decommissioning** – this subcategory is used to accumulate costs that are consistent with "decommissioning" as defined by the Nuclear Regulatory Commission (NRC) in its financial assurance regulations (i.e., 10 CFR 50.75) and separately address the cost of radiological decommissioning as defined by 10 CFR 50.2. The cost reported for this subcategory along with the Radiological Decommissioning Planning subcategory is generally sufficient to terminate the unit's operating license, recognizing that there may be some additional cost impact from spent fuel management.

(2) **Spent Fuel Management** – this subcategory contains costs associated with the containerization and transfer of spent fuel from the wet storage pool to a Department of Energy (DOE) transport cask or to the ISFSI for interim storage, as well as the transfer of the spent fuel in storage at the ISFSI to the DOE. Costs are included for management of the ISFSI until such time that the transfer is complete. It does not include any costs related to the final storage of the spent fuel at a national repository.

(3) **Site Restoration** – this subcategory is used to capture costs associated with the dismantling and demolition of buildings and facilities demonstrated to be free from contamination. This includes structures never exposed to radioactive materials, as well as those facilities that have been decontaminated to appropriate levels. Structures are removed to a depth of three feet below grade and backfilled to conform to local surface elevation.

(4) **ISFSI Radiological Decommissioning** – this subcategory is used to capture costs associated with activities directly related to radiological decontamination or dismantlement of the spent fuel dry storage facility as required by 10 CFR 72.30.

(5) **Radiological Decommissioning Planning** - this subcategory is used to accumulate costs associated with planning for radiological decommissioning that are incurred prior to the cessation of plant operations.

It should be noted that the costs assigned to these subcategories are allocations. Delegation of cost elements is for the purposes of comparison (e.g., with NRC financial guidelines) or to permit specific financial treatment (e.g., Asset Retirement Obligation determinations). In reality, there can be considerable interaction between the activities in the five subcategories. For example, Constellation may decide to remove non-contaminated structures early in the project to improve access to highly contaminated facilities or plant components. In these instances, the non-contaminated removal costs could be reassigned from Site Restoration to a Radiological Decommissioning support activity. However, in general, the allocations represent a reasonable accounting of those costs that can be expected to be incurred for the specific subcomponents of the total estimated program cost, if executed as described.

The estimates were developed, and costs are presented in 2021 dollars. As such, the estimates do not reflect the escalation of costs (due to inflationary and market forces) over the remaining operating life of the station or during the decommissioning period.

# 2. DECOMMISSIONING SCENARIO AND SCHEDULE

## 2.1. DECOMMISSIOING METHODS

Constellation evaluated the following decommissioning scenarios:

(1) **DECON** – spent fuel is transferred to the ISFSI shortly after shutdown and decommissioning and dismantlement is performed concurrently with the spent fuel campaign.

(2) **Shortened SAFSTOR (SHORTSTOR)** – spent fuel is transferred to the ISFSI and the plant facility is left intact until decommissioning starts approximately 30 years after permanent shutdown.

(3) **SAFSTOR** – spent fuel is transferred to the ISFSI and the plant facility is left intact until the decommissioning starts sometime in the future (dormancy phase), with structures maintained in a sound condition. Decommissioning commences such that license termination is completed within the required 60-years.

The scenarios also recognize that spent fuel will be stored at the site in the spent fuel storage pool(s) and/or in an ISFSI until such time that it can be transferred to a DOE facility. The estimates also include the cost to operate and eventually decommission the ISFSI.

The selection of a preferred decommissioning alternative is influenced by numerous factors at the time of plant shutdown. These factors include the cost of each decommissioning alternative, minimization of occupational radiation exposure, availability of a high-level waste (spent fuel) repository or an interim storage facility, the status of other units at the site, regulatory requirements, and public concerns.

## 2.2. DECOMMISSIONING SCHEDULE

The conceptual approach that the NRC has described in its regulations divides decommissioning into three phases; 1) the initial phase begins with the permanent shutdown and through the transition to storage or decommissioning activities, 2) the next phase encompasses activities during the storage period or during major decommissioning activities, or a combination of the two; and 3) the final phase pertains to the activities involved in radiological decommissioning and license termination. The decommissioning estimates developed herein are also divided into phases or periods; however, demarcation of the phases is based upon major milestones within the project or significant changes in the projected expenditures and differs from those presented by the NRC.

The major phases as defined by the Constellation Nuclear Management Model are:

**Decommissioning Planning** - begins 2 years prior to shutdown when a small utility staff, the Decommissioning Transition Organization (DTO), is established to perform planning and licensing activities and ends at plant shutdown.

**Shutdown through Permanent Defuel** – This is a short period (< 1 month) where the plant staff defuels the reactor. The only decommissioning activity during this period is continued planning by the DTO.

**Permanent Defuel through Zirconium Fire Window** – this period runs from permanent defuel until the end of the Zirconium fire (Zirc fire) window when the fuel no longer has enough heat to generate Zirc fire conditions in less than 10 hours. A Decommissioning

Organization (DO) is established during this period to meet all security, emergency planning, and fire protection requirements, but also performs activities to deenergize and deactivate plant systems and initiate the pool to pad activities required to move all the spent fuel from the SFP to the ISFSI.

**End of Zirc Fire Window through All Fuel on Pad** – Fuel is moved from the pool to the pad, and emergency planning and insurance requirements are reduced due to the end of the Zirc fire window.

**All Fuel on the Pad through License Termination** – Further reduction in emergency planning and security requirements due to the fact that all fuel is in dry storage at the ISFSI. This period ends when the NRC license has been terminated.

**Site Restoration** – after the license has been terminated, final demolition of any non-radiological structures, site grading and preparation for reuse of the land can be completed.

### 2.2.1. SAFSTOR Schedule

2.2.1.1. Pre-shutdown and Period 1 (Shutdown through Transition) – Preparations

Prior to the permanent shutdown and defueling, detailed preparations are undertaken to provide a smooth transition from plant operations to site decommissioning. Preparations include the planning for permanent defueling of the reactor, revision of technical specifications applicable to the operating conditions and requirements, characterization of the facility and major components, and the development of the Post Shutdown Decommissioning Activities Report (PSDAR).

Following the final shutdown and defueling, the site will be prepared to minimize operation and maintenance to those systems/components/areas that are required to support the safe handling and management of spent fuel. Those systems/components that will not be required will be isolated and removed from service. Radiation controls will be put in place to reduce radiation and contamination in areas that will need to be accessed to support decommissioning. Areas not needed will have access restricted to minimize radiation/contamination exposure and potential safety hazards. ISFSI expansion will occur and spent fuel in the spent fuel storage pool will be transferred to the ISFSI. The security area will be adjusted to reflect protection of equipment and areas necessary to support the safe handling and management of spent fuel.

2.2.1.2. Period 2 – Dormancy Phase

The second phase identified by the NRC in its rule addresses licensed activities during a storage period and is applicable to the dormancy phase of the SAFSTOR scenario. Dormancy activities include a 24-hour security force, preventive and corrective maintenance on security systems, maintenance of necessary area lighting, general building maintenance, heating and ventilation of buildings, routine radiological inspections of contaminated structures, maintenance of structural integrity, and a site environmental and radiation monitoring program. Resident maintenance personnel will perform maintenance and inspection activities to maintain safe conditions. The transfer of the spent fuel from the spent fuel pool to the ISFSI continues during this period until complete. Additionally, the transfer of the spent fuel to a DOE facility occurs during this period.

2.2.1.3. Period 3 – Site Reactivation and Decommissioning Preparations

Prior to the commencement of decommissioning operations, preparations are undertaken to reactivate site services and prepare for decommissioning. Preparations include engineering and planning, a detailed site characterization, and the assembly of a decommissioning management

organization. Final planning for decommissioning activities and the writing of work packages, activity specifications and decommissioning procedures are initiated. The environmental impact associated with the planned decommissioning activities is also considered. If the consequences of a planned decommissioning activity are predicted to be greater than what is bounded by previously evaluated environmental assessments or impact statements, a license amendment would have to be submitted to the NRC for the specific activity and the environmental report would have to be updated.

2.2.1.4. Period 4 – Decommissioning Operations

This period includes the physical decommissioning activities associated with the removal and disposal of contaminated and activated components and structures. Existing facilities will be modified, and/or temporary facilities will be constructed to support decommissioning, decontamination, and dismantling activities. Components and piping systems will be decontaminated as necessary to control (minimize) worker exposure and facilitate packaging and transportation. Piping and components no longer essential to support decommissioning operations will be removed. The reactor internal and external components will be removed. Some larger Nuclear Steam Supply System (NSSS) components may be decontaminated and sealed in such a manner as to serve as their own shipping/burial containers. The reactor will be segmented, removed, and placed in shielded casks. Activated portions of the reactor and other biological shield walls will be demolished by controlled processes.

The License Termination Plan (LTP), which includes the Final Survey Plan, is developed and submitted to the NRC. Once the survey is complete, the results are provided to the NRC for their review and evaluation. Once the NRC approves the LTP, the final remediation of site facilities and services may start. Subsequently, the NRC independently confirms the radiological site conditions and approves a license amendment that releases the property, inclusive of the ISFSI, for unrestricted use.

2.2.1.5. Period 5 – Site Restoration

Following completion of decommissioning operations, site restoration activities will begin. Remaining structures are removed, exterior walls and foundations are removed to a nominal depth of three feet below grade, and non-contaminated concrete rubble produced by demolition activities is processed and then used to backfill foundation voids. The plant area is graded and vegetation is established to inhibit erosion.

# 3. COST ESTIMATE METHODOLOGY

## 3.1. METHODOLOGY BASES

The systematic approach used herein for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting costs. The costs and schedules follow the general guidance and sequence in Regulatory Guide 1.184, "Decommissioning of Nuclear Power Reactors" (Reference 7.1). The format and content of the estimates is consistent with the recommendations of Regulatory Guide 1.202, "Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Reactors" (Reference 7.2). The methodology used to develop the estimates follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates" (Reference 7.3) and the DOE "Decommissioning Handbook" (Reference 7.4).

The unit cost factors used in this analysis incorporate site-specific costs and the latest available information about worker productivity in decommissioning. The detail provided in the unit cost factors, including activity duration, labor costs (by craft), and equipment and consumable costs, ensures that essential elements have not been omitted. The activity-dependent costs were estimated with the item quantities based on plant drawings and inventory documents. Removal rates and material costs for the conventional disposition of components and structures are based on cost data from RSMeans (Reference 7.5).

Critical path was used to determine the total decommissioning program schedule and establish carrying costs, which include program management, administration, field engineering, equipment rental, quality assurance, and security.

## 3.2. FINANCIAL COMPONENTS OF THE COST MODEL

The cost model used provides distinct cost elements, however these distinct cost elements do not comprise the total estimated cost to accomplish the project goal. Additional factors as described below are also taken into consideration.

### 3.2.1. Contingency

Contingencies are necessary to provide assurance that sufficient funding will be available since the cost elements are based on ideal conditions and maximum efficiency. They are an integral part of the total cost to complete the decommissioning process and are expected to be fully expended. A contingency is then applied on a line-item basis. Contingency, in this analysis, is not intended to address changes in price escalation and inflation in the cost of decommissioning over the remaining operating life of the station, or duration of the decommissioning program and dry fuel storage period.

Constellation examined the major activities (decontamination, segmentation, equipment handling, packaging, transport, and waste disposal) that necessitate a contingency. Individual activity contingencies ranged from 10% to 75%, depending on the degree of difficulty judged to be appropriate. The contingency values used in this study are as follows:

| | |
|---|---|
| Engineering | 15% |
| Staffing - Utility and DOC Staff | 15% |
| Decontamination | 50% |
| Contaminated Removal (includes contaminated component removal and contaminated concrete removal) | 25% |
| NSSS Component Removal | 25% |
| Reactor Segmentation | 75% |
| Reactor Waste Packaging | 25% |
| Reactor Waste Transport | 25% |
| Reactor Vessel Component Disposal | 50% |
| Contaminated Component Packaging | 10% |
| Contaminated Component Transport | 15% |
| Low-Level Radioactive Waste Disposal | 25% |
| Non-Radioactive Component Removal | 15% |
| Supplies | 25% |
| GTCC Disposal | 25% |
| Other - includes: Operations and Maintenance Expense, Heavy Equipment and Tooling, and Construction | 15% |
| Energy | 15% |
| Characterization, Licensing and Termination Surveys | 30% |
| Taxes, Fees, and Insurance | 10% |
| Spent Fuel Transfer Costs | 15% |
| ISFSI Decommissioning | 25% |
| Low-Level Radioactive Waste Processing | 15% |

### 3.2.2. Financial Risk

This cost study does not include any specific costs for financial risk since there is insufficient historical data from which to project future liabilities. Consequently, the areas of uncertainty or risk are revisited periodically and addressed through repeated revisions or updates of the base estimates.

### 3.2.3. Work Difficulty Factors

Work difficulty factor (WDF) adjustments have been applied to account for the inefficiencies in working in a power plant environment. WDFs were assigned to each unique set of unit factors, commensurate with the inefficiencies associated with working in confined and/or hazardous environments. The study applies WDFs to account for use of radiological dose minimization practices (e.g., radiological protection instruction, mock-up training, and use of respiratory protection and protective clothing). Changes to worker exposure limits may also impact the decommissioning cost and project schedule.

The factors and their associated range of values were developed in conjunction with the process described in AIF/NESP-036 (Reference 7.3).

### 3.2.4. Scheduling Program Durations

The WDF adjusted unit factors are applied against the inventory of materials to be removed in the radiologically controlled areas. The resulting work hours are used to develop the decommissioning program schedule. The scheduling of conventional removal and dismantling activities are based upon productivity information from RSMeans (Reference 7.5). Dismantling of the fuel handing systems and decontamination of the spent fuel pools is dependent upon the timing of the transfer of the spent fuel assemblies to the ISFSI.

The program schedule is used to determine the period-dependent costs for program management, administration, field engineering, equipment rental, contracted services, etc. The study relies upon regional or site-specific salary and wage rates for the personnel associated with the intended program.

# 4. ASSUMPTIONS

The current cost estimate assumes the unit ceases operations in 2027, and that the shutdown is pre-planned (i.e., there is no delay in transitioning the plant and workforce from operations or in obtaining regulatory relief from operating requirements, etc.). This estimate includes additional resources to support the engineering, planning, and licensing efforts. The ISFSI is assumed to remain operational until the DOE transfers the spent fuel offsite. The estimate also includes the dismantling of non-essential structures and restoration of the site.

## 4.1. GENERAL

### 4.1.1. Energy

The physical plant is assumed to be de-energized, except for those facilities associated with spent fuel storage. Minimal energy usage is assumed to support remaining plant staffing. Additional energy is required during active decommissioning.

### 4.1.2. Emergency Planning

Federal Emergency Management Agency (FEMA) and state and local fees associated with emergency planning are assumed to continue through the end of the Zirc fire window following the cessation of operations.

### 4.1.3. Insurance

Costs for continuing coverage (nuclear liability and property insurance) following cessation of plant operations and during decommissioning are included and based upon current operating premiums, and subsequent reductions based on regulatory requirements.

### 4.1.4. Taxes

Property taxes are included for all decommissioning periods. Tax payments decrease during decommissioning until reaching a minimum property tax payment for the site; this level is maintained for the balance of the decommissioning program.

### 4.1.5. NRC Fees

NRC charges are included to support the decommissioning program. The license fee is reduced based on the NRC fees for a reactor in a decommissioning (possession-only status). The charges associated with NRC professional services for inspections and reviews are based on the NRC hourly rate and the anticipated level of participation commensurate with the decommissioning alternative and schedule.

### 4.1.6. Contaminated Soil

The estimate includes an allowance for the remediation of contaminated soil at the site as documented in the 10 CFR 50.57(g) file. This portion of the estimate may be affected by continued plant operations and/or future regulatory actions.

## 4.2. LABOR COSTS

For purposes of this analysis, it is assumed that Constellation will hire a Decommissioning Operations Contractor (DOC) to manage the decommissioning. Constellation will provide site security, radiological health and safety, quality assurance and overall site administration during the decommissioning and demolition phases. Constellation provides the total site scope during

planning, transition periods, and dormancy periods. Contract personnel will provide engineering services under the direction of Constellation.

Average Constellation labor costs are based on industry wide average salaries. Craft labor rates are based on the current Constellation craft labor contract. DOC labor costs were based on industry wide average salaries. All costs include adders for pension and benefits, payroll taxes, corporate overhead, per diems, and profit where applicable. All labor costs are adjusted to account for regional differences between the sites. A profile of the projected staffing level for decommissioning is provided in Figure 4.1

## 4.3. TRANSITION ACTIVITIES

Those systems and components that are not needed for the safe storage and handling of spent fuel will be removed from service and deactivated. Hazardous fluids will be drained and removed from retired plant equipment. Operating waste inventories will be processed by plant staff during the transition period.

Operation and maintenance costs for the spent fuel pool(s) are included within the estimates until the spent fuel has been transferred to the ISFSI.

The perimeter fence and in-plant security barriers will be moved, as appropriate, to conform to the Site Security Plan in force during the various stages of the project.

## 4.4. NON-RADIOACTIVE WASTE

### 4.4.1. Processed Water

It is assumed that all water released will meet the state and federal release limits. These estimates assume that processed water which meets state and federal release limits is disposed of without additional cost.

### 4.4.2. Asbestos Abatement

An allowance for the removal of asbestos has been added to the estimates to account for the removal and disposal costs.

### 4.4.3. Scrap and Salvage

Metallic material generated is processed to the greatest extent possible to reduce the total cost of controlled disposal. Material meeting the regulatory and/or site release criterion, is released as scrap, requiring no further cost consideration.

The existing plant equipment is considered obsolete and suitable for scrap as deadweight quantities only. No credit is taken for salvage value since it would be speculative, and any recovered value would be small in comparison to the overall decommissioning expenses.

## 4.5. RADIOACTIVE WASTE

The objectives of the decommissioning process are the removal of all radioactive material from the site that would restrict its future use and the termination of the NRC license. Most of the materials being transported for controlled burial are categorized as Low Specific Activity (LSA) or Surface Contaminated Object (SCO) materials containing Type A quantities of radioactive material.

The waste material generated in the decontamination and dismantling of the site is primarily generated during Period 4. Material that is considered potentially contaminated is sent to processing facilities in Tennessee for conditioning and disposal. Heavily contaminated components and activated materials are routed for controlled disposal.

The volumes of radioactive waste generated during the various decommissioning activities are calculated based on the container size and are summarized consistent with 10 CFR 61 classifications. Table 4.1 provides the radwaste volumes by class expected to be generated during decommissioning.

### 4.5.1. Low-Level Radioactive Waste Disposal

A significant portion of the waste material may only be potentially contaminated by radioactive materials. This waste can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. The estimates reflect the savings from waste recovery/volume reduction when feasible.

All options and services currently available to Constellation were taken into consideration regarding the disposition of the various waste streams produced by the decommissioning process. Disposal fees are calculated using representative costs. The disposal costs for Class A, B and C waste were based upon a representative Constellation fleet cost. Class A waste is assumed to be disposed of at a facility in Utah. This facility is not licensed to receive Class B and C wastes. Class B and C waste is assumed to be disposed of at a facility in Texas.

The waste volumes are calculated based on the exterior package dimensions for containerized material or a specific calculation for components serving as their own waste containers.

### 4.5.2. Greater Than Class C Radioactive Waste

The dismantling of the components residing closest to the reactor core generally generates radioactive waste considered unsuitable for shallow-land disposal (i.e., low-level waste with concentrations greater than the NRC limits for Class C waste (i.e., GTCC)). A small quantity of material generated during decommissioning will be GTCC waste; GTCC waste is expected to be a small percentage of the total waste volume. GTCC waste is assumed to be placed in spent fuel storage canisters and disposed of in a similar manner to that envisioned for spent fuel disposal.

The federal government has the responsibility for the disposal of this material. However, the federal government has not identified a cost for disposing of GTCC, a schedule for acceptance, nor acceptance criteria for this material. For purposes of this analysis, the GTCC radioactive waste is assumed to be packaged and disposed of in a similar manner as high-level waste and at a cost equivalent to that envisioned for the spent fuel.

GTCC canisters will remain in storage until such time the DOE is ready to accept GTCC waste; it is assumed that the DOE would not accept this waste prior to completing the transfer of spent fuel.

### 4.5.3. Transportation Methods

The transport of all waste material and components will be by a combination of truck and/or multi-wheeled transporter. Transportation costs for material requiring controlled disposal or processing are based upon the mileage to the respective disposal or processing site.

## 4.6. COMPONENT REMOVAL

### 4.6.1. Reactor Vessel and Internal Components

The curie contents of the reactor vessel and internals are derived from those listed in NUREG/CR-3474, "Long-Lived Activation Products in Reactor Materials," (Reference 7.6) and are based on a generic model for the reactor design. Additional short-lived isotopes were derived from NUREG/CR-0130, "Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station," (Reference 7.7) and NUREG/CR-0672, "Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station," (Reference 7.7) and benchmarked to the long-lived values from NUREG/CR-3474 (Reference 7.6).

The reactor pressure vessel and internal components are assumed to be segmented for disposal in shielded, reusable transportation casks. Transportation cask specifications and transportation regulations dictate the segmentation and packaging methodology. Due to the uncertainty in the viability of disposing of the reactor vessel and internals as a self-contained package, segmentation is assumed as a bounding condition.

The disposal cost for the control blades removed from the vessel with the final core load are included within the estimates. Control blades are not Greater than Class C (GTCC) material.

### 4.6.2. System Components

Reactor piping and other NSSS components will be removed. Specialized equipment will be brought in as necessary. With proper closure of all openings, access ways, and penetrations, some larger components may be used as their own shipping and burial containers.

Radioactive piping and components will be removed using methods appropriate with their potential contamination level. Non-contaminated piping and components will be removed using conventional dismantlement and removal processes.

Components will be packaged and readied for transport in accordance with the intended disposition.

### 4.6.3. Retired Components

Any components that have been replaced and where the original components are stored on site at the time of shutdown are included in the cost of decommissioning. Since the components have already been removed from the plant, only packaging, disposal, and transportation costs are included for the components.

## 4.7. SPENT FUEL MANAGEMENT

Since the DOE is ultimately responsible for spent fuel disposal, the cost to dispose of spent fuel is not reflected within the estimates. However, the costs for spent fuel management while the fuel remains onsite are included and identified separately as "Spent Fuel Management."

Constellation assumes, for the purposes of this estimate, that the spent fuel will be packaged into multi-purpose containers (MPCs) over the first 3 to 5 years after shutdown. It is assumed that this period provides the necessary cooling for the spent fuel from the final core to meet the transport and/or storage requirements for decay heat. The estimates include the cost for the labor and equipment to transfer and load each MPC and relocate it to the ISFSI. For estimating purposes, an allowance is used to estimate the cost to transfer the fuel containers from the ISFSI onto the transport vehicle.

Given the status of the DOE spent fuel program, Constellation estimates that 2035 will be the most likely year when the DOE begins spent fuel removal from the industry. Constellation assumed that the DOE's repository will have a maximum annual capacity of receiving 3,000 metric tons of uranium from the industry (Reference 7.9) and that the repository will accept spent fuel in the order in which it was removed (oldest fuel first). Additionally, Constellation assumes that it is able to re-assign its DOE spent fuel allocations between its large fleet of units to minimize on-site storage costs.

Based on the above, the spent fuel is projected to remain onsite until the end of 2044. Any delay in transfer of fuel to DOE or decrease in the rate of acceptance will result in spent fuel remaining at the site longer.

## 4.8. INDEPENDENT SPENT FUEL INSTALLATION

### 4.8.1. Construction, Operation and Maintenance

An ISFSI has been constructed on site to support storage of all spent fuel. Expansion of the ISFSI is modeled to support the transfer of all the fuel in the SFP to the ISFSI. The ISFSI will continue to operate until such time that the transfer of spent fuel to the DOE can be completed. Operation and maintenance costs for the ISFSI are included as "Spent Fuel Management" expenditures in the estimates.

### 4.8.2. ISFSI Decommissioning

The ISFSI site and associated facilities also must have a proposed decommissioning plan. The cost estimate for decommissioning the ISFSI reflects: 1) the cost of an independent contractor performing the decommissioning activities, 2) an adequate contingency factor (see Section 3.2.1), and 3) the cost of meeting the criteria for unrestricted use.

## 4.9. SITE RESTORATION

The cost for the site restoration of non-contaminated structures has been calculated and is separately presented as "Site Restoration" expenditures in this report.

While some structures may be dismantled, and the costs included in the decontamination process, the dismantlement of the remaining site structures are included in the site restoration costs. All structures are assumed to be removed to a nominal depth of three feet below grade and the voids backfilled with clean debris then topped with soil. Bulk excavation of soil and material in the immediate vicinity of the reactor building is included to remove various duct banks, catch basins, and underground utilities that may exist. The site will then be graded to conform to the adjacent landscape and vegetation is established to inhibit erosion.

Site utility and service piping are abandoned in place and manholes are backfilled. Asphalt surfaces and facility roads, except for the site access road, will be broken up and the material used as backfill on site.

The existing electrical switchyard is assumed to remain functional in support of the regional electrical distribution system.

## 4.10. SITE CONDITIONS FOLLOWING DECOMMISSIONING

Once the NRC determines that site radiological remediation has been performed in accordance with the LTP and the final radiation survey demonstrates that the facility is suitable for release, the NRC will terminate the facility license(s) (or amend the license(s) if an ISFSI is still present). Building codes and environmental regulations will dictate the remaining actions in the decommissioning process.

**Figure 4-1: Total Labor Hours**

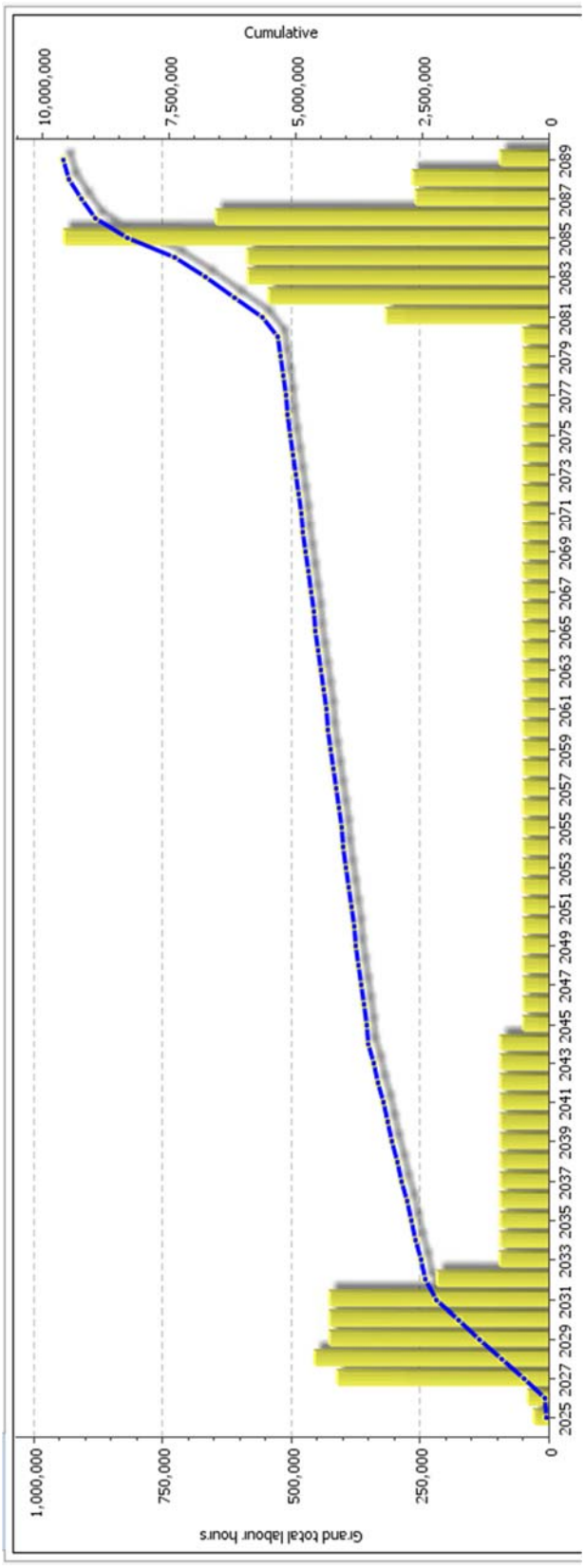


**Table 4-1: Burial Volumes by Waste Category**

| Class / Type | Volume (cf) | Mass (lb) |
|---|---|---|
| **A / Bulk** | 73,724 | 3,555,299 |
| **A / Containerized** | 228,252 | 11,587,125 |
| **A / DAW** | 34,449 | 688,975 |
| **A / Lead** | 353 | 250,000 |
| **A/ Oil** | 2,005 | 125,175 |
| **A / Processed** | 520,935 | 21,570,635 |
| **B** | 2,224 | 342,699 |
| **B / Resin** | 2,906 | 191,807 |
| **C** | 840 | 129,346 |
| **GTCC** | 2,534 | 518,021 |
| | | |
| **Total / Disposal** | 868,222 | 38,959,081 |

# 5. SCHEDULE ESTIMATE

## 5.1. SCHEDULE ASSUMPTIONS

The schedules for the decommissioning scenarios follow the sequence presented in the AIF/NESP-036 study, with minor changes to reflect recent experience and site-specific constraints. In addition, the scheduling has been revised to reflect spent fuel management plans.

The work activity durations are based on adjusted actual person-hour estimates. Durations are established between several milestones in each decommissioning period; these durations are used to establish a critical path for the entire project. In turn, the critical path duration for each period is used as the basis for determining the period-dependent costs. A second critical path is also used for the spent fuel cooling period, which determines the release of the spent fuel building for final decontamination. The project schedule is included in Table 5-1.

**Table 5-1: Decommissioning Timeline**

| Plant Status / Decommissioning Activities | Start | End | Approximate Duration *(years)* |
|---|---|---|---|
| **Pre-Shutdown** | | | |
| Pre-Shutdown Planning | Apr 2025 | Apr 2027 | 2.0 |
| | | | |
| **Preparations for Dormancy** | | | |
| Plant Shutdown / Defueling Outage | Apr 2027 | Apr 2027 | 0.1 |
| System Abandonments and Fuel Transfer to ISFSI | May 2027 | Apr 2032 | 5.0 |
| Final System Abandonments | May 2032 | Jan 2033 | 0.7 |
| | | | |
| **Dormancy** | | | |
| Dormancy w/ Dry Fuel Storage | Feb 2033 | Mar 2043 | 10.2 |
| Fuel Shipping | Apr 2043 | Dec 2044 | 1.7 |
| Dormancy w/ No Fuel | Jan 2045 | Mar 2081 | 36.2 |
| | | | |
| **Decommissioning Preparations** | Mar 2081 | Mar 2082 | 1.0 |
| | | | |
| **Decommissioning Operations** | | | |
| Large Component Removal | Mar 2082 | Jan 2085 | 2.8 |
| Plant Systems Removal and Building Decontamination | Jan 2085 | Jul 2086 | 1.5 |
| License Termination | Jul 2086 | Apr 2087 | 0.8 |
| | | | |
| **Total from Shutdown to Completion of License Termination** | | | **60** |
| | | | |
| **Site Restoration** | Apr 2087 | Apr 2089 | 2.0 |

## 6. COST ESTIMATE

The estimate presented in this document reflects the total cost to decontaminate the nuclear unit, manage the spent fuel until the DOE transfers it to a federal facility, dismantle the plant, and restore the site for alternative use. Costs are not inflated, escalated, or discounted over the period of expenditure (or projected lifetime of the plant).

Table 6.1 summarizes the estimated costs for the SAFSTOR scenario reflecting the various cost elements. Table 6.2 provides yearly expenditures broken down by cost contributor. The detailed cost estimate is provided in Table 6.3.

**Table 6-1: SAFSTOR Alternative for Clinton**

*(thousands, June 2021 dollars)*

| Cost Element | Total |
|---|---|
| Decontamination | 31,206 |
| Removal | 202,487 |
| Packaging | 26,663 |
| Transportation | 11,757 |
| Waste Disposal | 89,715 |
| Waste Processing | 16,069 |
| Program Management[1] | 479,779 |
| Security | 212,402 |
| Spent Fuel Storage | 141,746 |
| Insurance and Regulatory Fees | 61,976 |
| Energy | 25,726 |
| Characterization and Licensing Surveys | 9,453 |
| Property Taxes | 120,591 |
| Miscellaneous Equipment and Supplies | 59,057 |
| **Total**[2] | 1,488,626 |

| Cost Element | Total |
|---|---|
| Radiological Decommissioning | 1,159,064 |
| Spent Fuel Management | 209,683 |
| Site Restoration | 98,528 |
| ISFSI Radiological Decommissioning | 9,912 |
| Radiological Decommissioning Planning | 11,440 |
| **Total**[2] | 1,488,626 |

1 Includes engineering costs.

2 Columns may not add up due to rounding.

## Table 6-1: Total Annual Expenditures

*(thousands, June 2021 dollars)*

| Year | Radiological Decommissioning | Spent Fuel Management | Site Restoration | ISFSI Radiological Decommissioning | Radiological Decommissioning Planning | Total |
|---|---|---|---|---|---|---|
| 2025 | 0 | 0 | 0 | 0 | 3,942 | 3,942 |
| 2026 | 0 | 0 | 0 | 0 | 5,533 | 5,533 |
| 2027 | 56,873 | 75,237 | 64 | 0 | 1,966 | 134,140 |
| 2028 | 60,477 | 22,005 | 32 | 0 | 0 | 82,514 |
| 2029 | 52,141 | 3,920 | 19 | 0 | 0 | 56,080 |
| 2030 | 48,325 | 15,354 | 19 | 0 | 0 | 63,698 |
| 2031 | 43,508 | 20,952 | 19 | 0 | 0 | 64,478 |
| 2032 | 24,130 | 9,575 | 78 | 0 | 0 | 33,783 |
| 2033 | 7,328 | 3,920 | 9 | 0 | 0 | 11,256 |
| 2034 | 6,607 | 3,920 | 0 | 0 | 0 | 10,527 |
| 2035 | 6,607 | 3,920 | 0 | 0 | 0 | 10,527 |
| 2036 | 6,625 | 3,931 | 0 | 0 | 0 | 10,556 |
| 2037 | 6,607 | 3,920 | 0 | 0 | 0 | 10,527 |
| 2038 | 6,607 | 3,920 | 0 | 0 | 0 | 10,527 |
| 2039 | 6,607 | 3,920 | 0 | 0 | 0 | 10,527 |
| 2040 | 6,625 | 3,931 | 0 | 0 | 0 | 10,556 |
| 2041 | 6,607 | 3,920 | 0 | 0 | 0 | 10,527 |
| 2042 | 6,607 | 3,920 | 0 | 0 | 0 | 10,527 |
| 2043 | 6,133 | 10,600 | 0 | 0 | 0 | 16,733 |
| 2044 | 5,994 | 12,820 | 0 | 0 | 0 | 18,814 |
| 2045 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2046 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2047 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2048 | 7,174 | 0 | 0 | 0 | 0 | 7,174 |
| 2049 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2050 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2051 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2052 | 7,174 | 0 | 0 | 0 | 0 | 7,174 |
| 2053 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2054 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2055 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2056 | 7,174 | 0 | 0 | 0 | 0 | 7,174 |
| 2057 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2058 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2059 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |

## Table 6-2: Total Annual Expenditures (cont)

*(thousands, June 2021 dollars)*

| Year | Radiological Decommissioning | Spent Fuel Management | Site Restoration | ISFSI Radiological Decommissioning | Radiological Decommissioning Planning | Total |
|---|---|---|---|---|---|---|
| 2060 | 7,174 | 0 | 0 | 0 | 0 | 7,174 |
| 2061 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2062 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2063 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2064 | 7,174 | 0 | 0 | 0 | 0 | 7,174 |
| 2065 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2066 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2067 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2068 | 7,174 | 0 | 0 | 0 | 0 | 7,174 |
| 2069 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2070 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2071 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2072 | 7,174 | 0 | 0 | 0 | 0 | 7,174 |
| 2073 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2074 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2075 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2076 | 7,174 | 0 | 0 | 0 | 0 | 7,174 |
| 2077 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2078 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2079 | 7,154 | 0 | 0 | 0 | 0 | 7,154 |
| 2080 | 7,174 | 0 | 0 | 0 | 0 | 7,174 |
| 2081 | 37,834 | 0 | 64 | 0 | 0 | 37,898 |
| 2082 | 94,852 | 0 | 505 | 0 | 0 | 95,356 |
| 2083 | 106,856 | 0 | 607 | 0 | 0 | 107,463 |
| 2084 | 107,149 | 0 | 609 | 0 | 0 | 107,757 |
| 2085 | 110,714 | 0 | 2,979 | 2,708 | 0 | 116,402 |
| 2086 | 71,233 | 0 | 1,663 | 7,204 | 0 | 80,099 |
| 2087 | 8,281 | 0 | 31,741 | 0 | 0 | 40,022 |
| 2088 | 0 | 0 | 45,021 | 0 | 0 | 45,021 |
| 2089 | 0 | 0 | 15,100 | 0 | 0 | 15,100 |
| | | | | | | |
| **Total**[1] | 1,159,064 | 209,683 | 98,528 | 9,912 | 11,440 | 1,488,626 |

[1] Columns may not add up due to rounding.

# Table 6-3: Total Cost by WBS

*(thousands, June 2021 dollars)*

| | | Decontamination | Removal | Packaging | Transportation | Waste Disposal | Waste Processing | Program Management | Security | Spent Fuel Storage | Insurance and Regulatory Fees | Energy | Characterization and Licensing Surveys | Property Taxes | Miscellaneous Equipment and Supplies | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 - Planning & Preparation Costs | 01.0101 - Utility Staff | 0 | 0 | 0 | 0 | 0 | 0 | 9,754 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,754 |
| | 01.0801 - NRC Fees | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,439 | 0 | 0 | 0 | 0 | 1,439 |
| | 01.3201 - Contracted Engineering Analyses | 0 | 0 | 0 | 0 | 0 | 0 | 247 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 247 |
| 02 - Plant Deactivation Costs | 02.0101 - Utility Staff | 0 | 0 | 0 | 0 | 0 | 0 | 116,762 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 116,762 |
| | 02.0102 - Security Staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 61,605 | 0 | 0 | 0 | 0 | 0 | 0 | 61,605 |
| | 02.0201 - Structure Decontamination | 15,498 | 384 | 3 | 9 | 107 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16,001 |
| | 02.0301 - Insurance | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,331 | 0 | 0 | 0 | 0 | 4,331 |
| | 02.0501 - Heavy Equipment | 0 | 3,497 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,497 |
| | 02.0503 - Health Physics Supplies | 0 | 316 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 316 |
| | 02.0504 - Maintenance Supplies | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,548 | 3,548 |
| | 02.0508 - Spent Fuel Pool O&M Supplies | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,559 | 5,559 |
| | 02.0601 - Plant Energy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,165 | 0 | 0 | 0 | 12,165 |
| | 02.0702 - Hazardous Liquid Remediation | 0 | 0 | 74 | 75 | 251 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 400 |
| | 02.0801 - NRC Fees | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,390 | 0 | 0 | 0 | 0 | 3,390 |
| | 02.1001 - Emergency Planning Fees | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,269 | 0 | 0 | 0 | 0 | 2,269 |
| | 02.1101 - Modifications | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7,011 | 7,011 |
| | 02.1801 - Process Decommissioning Water Waste | 0 | 0 | 28 | 351 | 3,724 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 3,026 | 7,136 |
| | 02.1901 - Site Upkeep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,906 | 1,906 |
| | 02.2301 - Disposal of Dry Active Waste | 0 | 0 | 2 | 4 | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62 |
| | 02.3701 - Severance | 0 | 0 | 0 | 0 | 0 | 0 | 13,157 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13,157 |
| 03 - Safe Storage Operations Costs | 03.0101 - Utility Staff | 0 | 0 | 0 | 0 | 0 | 0 | 109,342 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 109,342 |
| | 03.0102 - Security Staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63,224 | 0 | 0 | 0 | 0 | 0 | 0 | 63,224 |
| | 03.0301 - Insurance | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28,926 | 0 | 0 | 0 | 0 | 28,926 |
| | 03.0503 - Health Physics Supplies | 0 | 2,643 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,643 |
| | 03.0504 - Maintenance Supplies | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,097 | 6,097 |
| | 03.0601 - Plant Energy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,981 | 0 | 0 | 0 | 3,981 |
| | 03.0801 - NRC Fees | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14,329 | 0 | 0 | 0 | 0 | 14,329 |
| | 03.1801 - Process Decommissioning Water Waste | 0 | 0 | 14 | 179 | 1,903 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,221 | 4,317 |
| | 03.1901 - Site Upkeep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21,067 | 21,067 |
| | 03.2301 - Disposal of Dry Active Waste | 0 | 0 | 14 | 38 | 464 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 516 |
| 04 - Dismantlement Costs | 04.0101 - Utility Staff | 0 | 0 | 0 | 0 | 0 | 0 | 42,028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42,028 |
| | 04.0102 - Security Staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25,009 | 0 | 0 | 0 | 0 | 0 | 0 | 25,009 |
| | 04.0103 - DOC Staff | 0 | 0 | 0 | 0 | 0 | 0 | 178,924 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 178,924 |
| | 04.0201 - Structure Removal | 14,165 | 42,171 | 280 | 994 | 3,803 | 458 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 61,872 |
| | 04.0202 - System Removal | 109 | 73,188 | 1,988 | 2,434 | 6,067 | 13,789 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 97,574 |
| | 04.0301 - Insurance | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,221 | 0 | 0 | 0 | 0 | 3,221 |
| | 04.0401 - Reactor Pressure Vessel | 0 | 9,543 | 5,844 | 1,595 | 7,059 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24,041 |
| | 04.0402 - Reactor Pressure Vessel Internals | 0 | 9,265 | 16,323 | 3,047 | 41,776 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 70,412 |
| | 04.0403 - GTCC Disposal | 0 | 0 | 0 | 0 | 15,580 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15,580 |
| | 04.0501 - Heavy Equipment | 0 | 22,781 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22,781 |
| | 04.0503 - Health Physics Supplies | 0 | 4,805 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,805 |
| | 04.0504 - Maintenance Supplies | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 976 | 976 |
| | 04.0507 - Plant Preparation and Temporary Services | 0 | 4,980 | 3 | 8 | 96 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,086 |
| | 04.0601 - Plant Energy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,561 | 0 | 0 | 0 | 8,561 |
| | 04.0702 - Hazardous Liquid Remediation | 0 | 0 | 25 | 25 | 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 133 |
| | 04.0703 - Lead Remediation | 0 | 0 | 14 | 77 | 0 | 109 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 200 |
| | 04.0801 - NRC Fees | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,158 | 0 | 0 | 0 | 0 | 3,158 |
| | 04.0901 - Asbestos | 0 | 3,125 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,125 |
| | 04.1303 - Condenser | 0 | 359 | 559 | 407 | 539 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,865 |
| | 04.1304 - Turbine Generator | 0 | 355 | 371 | 542 | 1,186 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,454 |
| | 04.1304R - Retired Turbine Generator | 0 | 0 | 219 | 237 | 712 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,168 |
| | 04.1306 - Recirc Pumps/Reactor Coolant Pumps | 0 | 355 | 306 | 273 | 310 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,245 |
| | 04.1401 - Site Excavation | 0 | 2,578 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,578 |
| | 04.1701 - Scaffolding | 0 | 9,564 | 82 | 26 | 135 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,808 |
| | 04.1801 - Process Decommissioning Water Waste | 0 | 0 | 22 | 279 | 2,956 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,201 | 5,458 |
| | 04.1901 - Site Upkeep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,886 | 2,886 |

## Table 6-3: Total Cost by WBS (cont.)

*(thousands, June 2021 dollars)*

| | | Decontamination | Removal | Packaging | Transportation | Waste Disposal | Waste Processing | Program Management | Security | Spent Fuel Storage | Insurance and Regulatory Fees | Energy | Characterization and Licensing Surveys | Property Taxes | Miscellaneous Equipment and Supplies | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 04.2101 - Spent Fuel Rack Removal | 1,435 | 1,197 | 213 | 439 | 1,290 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,574 |
| | 04.2301 - Disposal of Dry Active Waste | 0 | 0 | 13 | 35 | 436 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 484 |
| | 04.2601 - DOC Relocation | 0 | 0 | 0 | 0 | 0 | 0 | 732 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 732 |
| | 04.2700 - Misc Decommissioning Waste | 0 | 0 | 53 | 91 | 55 | 665 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 864 |
| | 04.2801 - Cofferdams | 0 | 2,266 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,266 |
| | 04.2901 - Site Grading and Landscaping | 0 | 3,714 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,714 |
| | 04.3103 - Remove Rubble / Backfill Site | 0 | 2,695 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,695 |
| | 04.3300 - Radiation Surveys | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,340 | 0 | 0 | 9,340 |
| | 04.3701 - Severance | 0 | 0 | 0 | 0 | 0 | 0 | 3,074 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,074 |
| 05 - ISFSI Costs | 05.0101 - Utility Staff | 0 | 0 | 0 | 0 | 0 | 0 | 4,159 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,159 |
| | 05.0102 - Security Staff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62,564 | 0 | 0 | 0 | 0 | 0 | 0 | 62,564 |
| | 05.0301 - Insurance | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 507 | 0 | 0 | 0 | 0 | 507 |
| | 05.0501 - Heavy Equipment | 0 | 441 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 441 |
| | 05.0504 - Maintenance Supplies | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51 | 51 |
| | 05.0601 - Plant Energy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,019 | 0 | 0 | 0 | 1,019 |
| | 05.0801 - NRC Fees | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 396 | 0 | 0 | 0 | 0 | 396 |
| | 05.1201 - Fuel from Pool to Pad | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 124,789 | 0 | 0 | 0 | 0 | 0 | 124,789 |
| | 05.1202 - Fuel from Pad to DOE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14,463 | 0 | 0 | 0 | 0 | 0 | 14,463 |
| | 05.1601 - ISFSI License Termination Planning | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 137 | 0 | 0 | 0 | 0 | 0 | 137 |
| | 05.1602 - ISFSI License Termination Radiological D&D | 0 | 444 | 213 | 591 | 1,128 | 1,047 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,422 |
| | 05.1603 - ISFSI License Termination Surveys | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,357 | 0 | 0 | 0 | 0 | 0 | 2,357 |
| | 05.1604 - ISFSI Site Restoration | 0 | 1,820 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,820 |
| | 05.1901 - Site Upkeep | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,508 | 2,508 |
| | 05.3202 - Contracted Engineering Analyses - ISFSI | 0 | 0 | 0 | 0 | 0 | 0 | 493 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 493 |
| | 05.3300 - Radiation Surveys | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 112 | 0 | 0 | 112 |
| | 05.3701 - Severance | 0 | 0 | 0 | 0 | 0 | 0 | 1,107 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,107 |
| 06 - Property Tax Costs | 06.0302 - Property Taxes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120,591 | 0 | 120,591 |
| Grand total | - | 31,206 | 202,487 | 26,663 | 11,757 | 89,715 | 16,069 | 479,779 | 212,402 | 141,746 | 61,976 | 25,726 | 9,453 | 120,591 | 59,057 | 1,488,626 |

## 7. REFERENCES

7.1. Regulatory Guide 1.184, "Decommissioning of Nuclear Power Reactors," Revision 1, Nuclear Regulatory Commission, October 2013

7.2. Regulatory Guide 1.202, "Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Reactors," Nuclear Regulatory Commission, February 2005

7.3. "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986, T.S. LaGuardia et al.

7.4. "Decommissioning Handbook," U.S. Department of Energy, DOE/EV/10128-1, November 1980, W.J. Manion and T.S. LaGuardia

7.5. Construction Cost Information, RSMeansonline.com, Gordian Company

7.6. NUREG/CR-3474, "Long-Lived Activation Products in Reactor Materials," Pacific Northwest Laboratory for the Nuclear Regulatory Commission, August 1984, J.C. Evans et al.

7.7. NUREG/CR-0130 and addenda, "Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station," Pacific Northwest Laboratory for the Nuclear Regulatory Commission, June 1978, R.I. Smith, G.J. Konzek, W.E. Kennedy, Jr.

7.8. NUREG/CR-0672 and addenda, "Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station," Pacific Northwest Laboratory for the Nuclear Regulatory Commission, June 1980, H.D. Oak, et al.

7.9. Civilian Radioactive Waste Management System Requirements Document, DOE/RW-0406, Revision 8, September 2007

**Attachment 2**

**Spent Fuel Management Plan for Clinton Power Station**

## 1.0 Background

The Clinton Power Station, Unit 1, (CPS) Facility Operating License (FOL) expires on April 17, 2027. Constellation Energy Generation, LLC (CEG) has not made a final determination of the decommissioning approach for CPS. For purposes of this Spent Fuel Management Plan (SFMP), the SAFSTOR option has been selected. CEG reserves the right to choose an alternative decommissioning option at the actual time of decommissioning in accordance with its business needs, recognizing that it needs to assure the chosen option meets NRC requirements for decommissioning funding.

In order to estimate the costs associated with maintenance of the CPS site in SAFSTOR and the eventual decommissioning of the site, at the time of the estimate, CEG assumed 2035 as the first year that the U.S. Department of Energy (DOE) will begin removing spent nuclear fuel from nuclear power reactor sites. In accordance with the Nuclear Waste Policy Act (Reference 5.2), the Federal government has the responsibility to remove all spent fuel from CPS and other commercial nuclear power reactor sites. However, the DOE spent fuel and high-level waste management program is currently stalled. Given the status of the DOE program, CEG considered information made publicly available by DOE, the Government Accountability Office (GAO), the Blue Ribbon Commission on America's Nuclear Future, and the political environment surrounding this issue, and concluded that 2035 was the most likely timeframe for DOE to initiate removal of commercial nuclear fuel from reactor sites.

## 2.0 Spent Fuel Management Strategy

The NRC requires (as discussed in 10 CFR 50.54(bb)) that licensees establish a program "to manage and provide funding for the management of all irradiated fuel at the reactor following permanent cessation of operation of the reactor until title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its ultimate disposal in a repository." Pending transfer of the fuel to the DOE [Secretary of Energy], CEG will store fuel on an interim basis in the spent fuel pool and/or the Independent Spent Fuel Storage Installation (ISFSI) located at the CPS site.

A licensed ISFSI is currently operational at CPS. The ISFSI facility will be expanded to accommodate the inventory of spent fuel in the spent fuel pool following the final reactor defueling. After the required cooling time, the spent fuel will be loaded in fuel storage canisters and moved to the ISFSI. Once the spent fuel pool is emptied of fuel, the facility will be placed in a SAFSTOR condition. The ISFSI will continue to operate until the transfer of spent fuel to the DOE is complete.

Assuming the DOE's generator allocation/receipt schedules are based upon the oldest fuel receiving the highest priority and that the DOE begins removing spent fuel from commercial facilities in 2035 with an annual capacity of 3,000 metric tons of uranium, spent fuel is projected to remain at the CPS site for approximately 17 years after the termination of operation (spent fuel is projected to be removed from the CPS site by the end of 2044). Any delay in transfer of fuel to DOE or decrease in the rate of acceptance will correspondingly prolong the transfer process and result in spent fuel remaining at the site longer than anticipated.

Operation and maintenance costs for the storage facilities (ISFSI and spent fuel pool) are reflected in the CPS Decommissioning Cost Estimate (DCE) (Reference 5.1). The estimate includes the costs for staffing the facilities, maintenance of necessary operational requirements as well as security, insurance, and licensing fees. The estimate includes the costs to purchase, load, and transfer the fuel storage canisters to the ISFSI and to decommission the ISFSI. A discussion of site-specific considerations for the management of spent fuel at CPS is included in the DCE report.

When CPS terminates operations in 2027, CPS will continue to comply with existing NRC licensing requirements, including the operation and maintenance of the systems and structures needed to support continued operation of the CPS spent fuel pool and ISFSI, as necessary, under the decommissioning scenario ultimately selected. In addition, CPS will also comply with applicable license termination requirements in accordance with 10 CFR 50.82, "Termination of license," with respect to plant shutdown and post-shutdown activities, including seeking NRC approvals as appropriate for the continued storage of irradiated fuel until transfer of the fuel to the DOE is complete.

## 3.0 Cost Estimate and Funding for Spent Fuel Management

Total costs for spent fuel management under the SAFSTOR scenario will be approximately $209.7 million (2021 dollars). Further breakdown is included in the DCE (Reference 5.1).

As of December 31, 2021, the CPS decommissioning trust fund balance was $719.0 million. At this time, there are no annual contributions to the fund, and none are anticipated through the decommissioning period. To the extent that the trust fund balance exceeds costs required for radiological decommissioning, trust fund monies (subject to receipt of NRC approval of an exemption as discussed in Section 4), in conjunction with CEG operating revenues, will be used to pay for spent fuel management costs.

An additional potential source of funding for CPS spent fuel management costs is the Settlement Agreement between CEG and the DOE, under which the United States Government has agreed to reimburse CEG for costs incurred attributable to DOE’s failure to meet its contractual obligations for the transfer of spent fuel from CPS and other CEG nuclear plants (Reference 5.3).

## 4.0 NRC Approvals

This SFMP contemplates potential withdrawals from the decommissioning trust for spent fuel management purposes. Prior to any such withdrawals, in accordance with 10 CFR 50.12, "Specific exemptions," CEG will make appropriate submittals seeking an exemption from the requirements of 10 CFR 50.82(a)(8)(i)(A) in order to use the decommissioning trust funds for spent fuel management expenses. CEG will monitor the funding level of the decommissioning fund to ensure that spent fuel management withdrawals will not inhibit the ability of CEG to complete radiological decommissioning.

## 5.0 References

5.1 DECOM-2021-DCE-CPS, Revision 0,"2021 Decommissioning Cost Analysis Report Clinton Power Stations," March 2022

5.2 United States of America Public Law 97-425, "Nuclear Waste Policy Act of 1982," dated January 7, 1983

5.3 Settlement Agreement between the U.S. Department of Energy and Exelon Generation Company, LLC (including Commonwealth Edison Company and AmerGen Energy Company), signed and executed August 5, 2004, as amended by the First Addendum to the Settlement Agreement signed May 4, 2009, as amended by the Second Addendum to the Settlement Agreement signed August 18, 2019

## Attachment 3

## Decommissioning Cash Flow Analysis for Clinton Power Station
**(thousands of 2022 dollars)**

| Year | Radiological Decommissioning Cost | ISFSI Decommissioning Cost | Total Cost[(a)] | BOY Trust Fund Value | BOY Trust Fund Less Cost | Trust Fund Earnings[(b)] | EOY Trust Fund Value[(a)] |
|---|---|---|---|---|---|---|---|
| 2025[(c)(d)] | 3,994 | 0 | 3,994 | 763,004 | 759,011 | 15,180 | 774,191 |
| 2026[(c)] | 5,606 | 0 | 5,606 | 774,191 | 768,585 | 15,372 | 783,957 |
| 2027 | 59,619 | 0 | 59,619 | 783,957 | 724,338 | 14,487 | 738,824 |
| 2028 | 61,279 | 0 | 61,279 | 738,824 | 677,546 | 13,551 | 691,097 |
| 2029 | 52,832 | 0 | 52,832 | 691,097 | 638,265 | 12,765 | 651,030 |
| 2030 | 48,965 | 0 | 48,965 | 651,030 | 602,065 | 12,041 | 614,106 |
| 2031 | 44,084 | 0 | 44,084 | 614,106 | 570,022 | 11,400 | 581,423 |
| 2032 | 24,450 | 0 | 24,450 | 581,423 | 556,973 | 11,139 | 568,112 |
| 2033 | 7,425 | 0 | 7,425 | 568,112 | 560,687 | 11,214 | 571,901 |
| 2034 | 6,695 | 0 | 6,695 | 571,901 | 565,206 | 11,304 | 576,510 |
| 2035 | 6,695 | 0 | 6,695 | 576,510 | 569,815 | 11,396 | 581,212 |
| 2036 | 6,713 | 0 | 6,713 | 581,212 | 574,498 | 11,490 | 585,988 |
| 2037 | 6,695 | 0 | 6,695 | 585,988 | 579,293 | 11,586 | 590,879 |
| 2038 | 6,695 | 0 | 6,695 | 590,879 | 584,184 | 11,684 | 595,868 |
| 2039 | 6,695 | 0 | 6,695 | 595,868 | 589,173 | 11,783 | 600,956 |
| 2040 | 6,713 | 0 | 6,713 | 600,956 | 594,243 | 11,885 | 606,128 |
| 2041 | 6,695 | 0 | 6,695 | 606,128 | 599,433 | 11,989 | 611,422 |
| 2042 | 6,695 | 0 | 6,695 | 611,422 | 604,727 | 12,095 | 616,821 |
| 2043 | 6,214 | 0 | 6,214 | 616,821 | 610,607 | 12,212 | 622,819 |
| 2044 | 6,073 | 0 | 6,073 | 622,819 | 616,746 | 12,335 | 629,081 |
| 2045 | 7,249 | 0 | 7,249 | 629,081 | 621,832 | 12,437 | 634,269 |
| 2046 | 7,249 | 0 | 7,249 | 634,269 | 627,019 | 12,540 | 639,560 |
| 2047 | 7,249 | 0 | 7,249 | 639,560 | 632,310 | 12,646 | 644,957 |
| 2048 | 7,269 | 0 | 7,269 | 644,957 | 637,688 | 12,754 | 650,441 |
| 2049 | 7,249 | 0 | 7,249 | 650,441 | 643,192 | 12,864 | 656,056 |
| 2050 | 7,249 | 0 | 7,249 | 656,056 | 648,807 | 12,976 | 661,783 |
| 2051 | 7,249 | 0 | 7,249 | 661,783 | 654,534 | 13,091 | 667,624 |
| 2052 | 7,269 | 0 | 7,269 | 667,624 | 660,355 | 13,207 | 673,562 |
| 2053 | 7,249 | 0 | 7,249 | 673,562 | 666,313 | 13,326 | 679,639 |
| 2054 | 7,249 | 0 | 7,249 | 679,639 | 672,390 | 13,448 | 685,838 |
| 2055 | 7,249 | 0 | 7,249 | 685,838 | 678,589 | 13,572 | 692,161 |
| 2056 | 7,269 | 0 | 7,269 | 692,161 | 684,892 | 13,698 | 698,589 |
| 2057 | 7,249 | 0 | 7,249 | 698,589 | 691,340 | 13,827 | 705,167 |
| 2058 | 7,249 | 0 | 7,249 | 705,167 | 697,918 | 13,958 | 711,876 |
| 2059 | 7,249 | 0 | 7,249 | 711,876 | 704,627 | 14,093 | 718,719 |
| 2060 | 7,269 | 0 | 7,269 | 718,719 | 711,450 | 14,229 | 725,679 |

## Attachment 3

## Decommissioning Cash Flow Analysis for Clinton Power Station
**(thousands of 2022 dollars)**

| Year | Radiological Decommissioning Cost | ISFSI Decommissioning Cost | Total Cost[a] | BOY Trust Fund Value | BOY Trust Fund Less Cost | Trust Fund Earnings[b] | EOY Trust Fund Value[a] |
|---|---|---|---|---|---|---|---|
| 2061 | 7,249 | 0 | 7,249 | 725,679 | 718,430 | 14,369 | 732,799 |
| 2062 | 7,249 | 0 | 7,249 | 732,799 | 725,550 | 14,511 | 740,061 |
| 2063 | 7,249 | 0 | 7,249 | 740,061 | 732,811 | 14,656 | 747,468 |
| 2064 | 7,269 | 0 | 7,269 | 747,468 | 740,198 | 14,804 | 755,002 |
| 2065 | 7,249 | 0 | 7,249 | 755,002 | 747,753 | 14,955 | 762,708 |
| 2066 | 7,249 | 0 | 7,249 | 762,708 | 755,459 | 15,109 | 770,568 |
| 2067 | 7,249 | 0 | 7,249 | 770,568 | 763,319 | 15,266 | 778,585 |
| 2068 | 7,269 | 0 | 7,269 | 778,585 | 771,316 | 15,426 | 786,743 |
| 2069 | 7,249 | 0 | 7,249 | 786,743 | 779,493 | 15,590 | 795,083 |
| 2070 | 7,249 | 0 | 7,249 | 795,083 | 787,834 | 15,757 | 803,591 |
| 2071 | 7,249 | 0 | 7,249 | 803,591 | 796,342 | 15,927 | 812,268 |
| 2072 | 7,269 | 0 | 7,269 | 812,268 | 804,999 | 16,100 | 821,099 |
| 2073 | 7,249 | 0 | 7,249 | 821,099 | 813,850 | 16,277 | 830,127 |
| 2074 | 7,249 | 0 | 7,249 | 830,127 | 822,878 | 16,458 | 839,336 |
| 2075 | 7,249 | 0 | 7,249 | 839,336 | 832,086 | 16,642 | 848,728 |
| 2076 | 7,269 | 0 | 7,269 | 848,728 | 841,459 | 16,829 | 858,288 |
| 2077 | 7,249 | 0 | 7,249 | 858,288 | 851,039 | 17,021 | 868,060 |
| 2078 | 7,249 | 0 | 7,249 | 868,060 | 860,810 | 17,216 | 878,027 |
| 2079 | 7,249 | 0 | 7,249 | 878,027 | 870,777 | 17,416 | 888,193 |
| 2080 | 7,269 | 0 | 7,269 | 888,193 | 880,924 | 17,618 | 898,542 |
| 2081 | 38,335 | 0 | 38,335 | 898,542 | 860,207 | 17,204 | 877,412 |
| 2082 | 96,109 | 0 | 96,109 | 877,412 | 781,303 | 15,626 | 796,929 |
| 2083 | 108,272 | 0 | 108,272 | 796,929 | 688,657 | 13,773 | 702,430 |
| 2084 | 108,569 | 0 | 108,569 | 702,430 | 593,861 | 11,877 | 605,739 |
| 2085 | 112,182 | 2,744 | 114,925 | 605,739 | 490,813 | 9,816 | 500,629 |
| 2086 | 72,177 | 7,299 | 79,476 | 500,629 | 421,153 | 8,423 | 429,576 |
| 2087 | 8,391 | 0 | 8,391 | 429,576 | 421,186 | 8,424 | 429,609 |
| Totals[a] | 1,186,016 | 10,043 | 1,196,059 | | | | |

[a] Cash flows may not add due to rounding

[b] A 2% real rate of return is used as allowed by 10 CFR 50.75(e)(1)(i)

[c] 2025 and 2026 costs are for decommissioning planning

[d] The 2025 BOY Trust Fund Value is the value of the decommissioning trust fund prior to the 2025 decommissioning planning expenses