Ameren MISSOURI

Callaway Plant

March 30, 2023

ULNRC-06798

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

10 CFR 50.75(f)(1)
10 CFR 72.30

Ladies and Gentlemen:

DOCKET NUMBERS 50-483 AND 72-1045
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
RENEWED FACILITY OPERATING LICENSE NPF-30
STATUS OF PLANT DECOMMISSIONING FUNDING
AND ISFSI DECOMMISSIONING FUNDING PLAN

In accordance with the requirements of 10 CFR 50.75(f)(1), which requires reporting of the status of reactor decommissioning funding, and of 10 CFR 72.30 on financial assurance and recordkeeping for Independent Spent Fuel Storage Installation (ISFSI) decommissioning, Union Electric Company (Ameren Missouri) hereby submits its Callaway Plant Decommissioning Funding Status Report and ISFSI Decommissioning Funding Plan for the ISFSI located at the Callaway Plant site. These reports are provided as enclosures to this letter.

10 CFR 72.30 requires ISFSI decommissioning funding plan updates to be submitted "at intervals not to exceed 3 years," while the status of the decommissioning funding plan for reactors is required to be reported on a 2-year interval per 10 CFR 50.75(f)(1). As noted in Ameren Missouri's decommissioning funding letter submitted on March 30, 2021 (ULNRC-06644), Ameren Missouri is submitting all reports required per 10 CFR 50.57(f)(1) and 10 CFR 72.30 via one submittal at two-year intervals.

This letter does not contain any new commitments. If you have any questions on this report, please contact Mr. Tom Elwood at (314) 225-1905.

Sincerely,

Todd A. Witt
Manager, Regulatory Affairs

Enclosure 1	NRC Plant Decommissioning Funding Status Report - 2023
Enclosure 2	Callaway Energy Center 10 CFR 72.30 ISFSI Decommissioning Funding Plan - March 2021
Enclosure 3	Minimum Decommissioning Cost per 10 CFR 50.75 Formula Process
Enclosure 4	Decommissioning Cost Analysis for the Callaway Energy Center - October 2020
Enclosure 5	Statement of Net Assets Available for Benefits – 31 December 2022
Enclosure 6	Application for Acceptance of Decommissioning Cost Estimates for Callaway Energy Center, Including Independent Spent Fuel Storage Installation, and Approval of Funding Level for Nuclear Decommissioning Trust Fund – November 5, 2020
Enclosure 7	Callaway Energy Center Tax-Qualified Nuclear Decommissioning Trust Fund Projection
Enclosure 8	Non-Unanimous Stipulation Agreement – February 9, 2021
Enclosure 9	Order Approving Stipulation and Agreement – February 24, 2021 (effective March 26, 2021)

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NRC Plant Decommissioning Funding Status Report - 2023

10 CFR 50.75(f)(1) requires each power reactor licensee to report to the NRC on a calendar year basis, beginning on March 31, 1999, and every 2 years thereafter, on the status of its decommissioning funding for each reactor or share of reactor it owns. Union Electric Company d/b/a Ameren Missouri ("Ameren Missouri") hereby reports the decommissioning funding status for its Callaway Energy Center ("Plant").

The scope of this Enclosure pertains only to the decommissioning funding status of the Callaway Energy Center, i.e., the Plant. The decommissioning funding plan for the independent spent fuel storage installation (ISFSI) is included for reference as Enclosure 2 of this letter and was submitted on March 30, 2021 to the NRC via Reference 4 (listed on page 8 of this letter).

Ameren Missouri is required to file updates regarding decommissioning cost estimates and funding adequacy projections on a triennial basis with the Missouri Public Service Commission (MPSC) as discussed more fully in Section 2 below. The scope of these triennial filings includes both the Plant and the ISFSI. Ameren Missouri obtains separate, updated site-specific decommissioning cost estimates and prepares separate, updated, funding adequacy analyses for the Plant and for the ISFSI for the MPSC triennial filings. When making these filings, Ameren Missouri has requested that the MPSC address the Plant and ISFSI separately in their orders issued pursuant to the filings. The decommissioning trust fund established by Ameren Missouri has separate, segregated sub-accounts for Plant and ISFSI decommissioning funding.

The site-specific decommissioning study referenced in this decommissioning funding status report is provided for information only. This site-specific study was part of the documentation presented to the MPSC in the Company's 2020 MPSC triennial update filing.

1. Amount of Decommissioning Funds Estimated to be Required Pursuant to 10 CFR 50.75(b) and (c)

For the purposes of this 2023 NRC biennial plant decommissioning funding status report, Ameren Missouri is using the "three-factor formula" specified in 10 CFR 50.75(b) and (c)[1] for determining decommissioning funding adequacy.

The minimum decommissioning cost estimate, pursuant to the 10 CFR 50.75(b) and (c) methodology, is $580,597,000, in terms of December 2022 dollars.

The detailed calculations from which the above estimate is derived are contained in Enclosure 3.

Ameren Missouri also has site-specific decommissioning cost estimates for decommissioning of the Callaway Energy Center prepared by TLG Services, Inc. of Bridgewater, Connecticut. The specific studies are conducted to comply with Missouri Law:

20 CSR 4240-20.070 Decommissioning Trust Funds

(4) Every three (3) years, utilities with decommissioning trust funds shall perform and file with the commission cost studies detailing the utilities' latest cost estimates for decommissioning their nuclear generating unit(s) along with the funding levels necessary to defray these decommissioning costs. These studies shall be filed along with appropriate tariff(s) effectuating the change in rates necessary to accomplish the funding required. In addition, the commission, at any time for just cause, may require a utility to file an updated decommissioning cost study, funding requirement, and associated tariff(s).

The current site-specific analysis approved by the MPSC was completed in October 2020. It calculated a Plant decommissioning cost estimate of $1,036,260,000 in terms of 2020 dollars.[2] Ameren Missouri considers this site-specific Plant decommissioning cost estimate of $1,036,260,000 as the estimate for which funding adequacy must be assured for MPSC funding adequacy purposes. Due to its site-specific nature, it is a more accurate estimate of projected decommissioning costs.

For Plant decommissioning in the 2020 study, approximately 82.5% ($855,393,000) of the $1,036,260,000 site-specific cost estimate is associated with physical decontamination and dismantling of radioactive systems and structures such that the license can be terminated. Management and transfer of spent fuel accounts for 6.7% ($69,200,000) of the site specific cost estimate. The remaining 10.8% ($111,667,000) is for demolition of designated non-radioactive structures and limited site restoration.

These studies are considered snap shots of the decommissioning cost and are used to determine if any changes are required in the contributions to the decommissioning fund. Due to the complexity of the study, the use of any cost escalation factors would introduce considerable uncertainty into the escalated cost. Since this study is conducted every three years, Ameren does not escalate the study cost estimates for the years between study periods.

An informational only copy of the October 2020 Site-Specific Decommissioning Cost Analysis for the Callaway Energy Center is provided in Enclosure 4.

2. Amount of Decommissioning Funds Accumulated to the End of the Calendar Year Preceding the Date of this Report

Separate subaccounts have been established and are maintained for Plant and ISFSI decommissioning. The total amount accumulated in the Plant decommissioning fund as of December 31, 2022 is $875,356,047.61. This is an "after tax liquidation value" which reflects the final funds that would be received upon liquidation of the fund's assets and the payment of income taxes on realized capital gains. This is calculated as follows:

		Missouri Jurisdictional Subaccount	FERC Jurisdictional Subaccount	TOTAL Overall Fund
	Total Net Assets:	$ 931,189,312.87	$ 23,346,858.32	$954,536,171.19
Less:	Book Value:	542,233,374.28	16,402,179.02	558,635,553.30
Equals:	Unrealized Gain:	$ 388,955,938.59	$ 6,944,679.30	$ 395,900,617.89
	Income Tax on Unrealized Gain @ 20% Rate:	$ 77,791,187.72	$ 1,388,935.86	$ 79,180,123.58
	After-Tax Liquidation Value:	$ 853,398,125.15	$ 21,957,922.46	$ 875,356,047.61

Copies of the trustee's "Statement of Net Assets Available for Benefits" as of December 31, 2022 confirming the foregoing valuation amounts are provided in Enclosure 5.

This decommissioning fund balance indicated above is a total amount intended to cover the full green fielding of the site. The funds in the trust fund are not segregated into sub-accounts for radiological decommissioning versus non-radiological decommissioning.

Based on the estimated Plant decommissioning costs contained in the 2020 site specific decommissioning cost estimate, allocation percentages for License Termination, Spent Fuel Management and Site Restoration can be calculated. By applying these percentages to the after-tax liquidation value of the jurisdictional subaccounts, the dollar amounts of the overall jurisdictional subaccounts allocated for the decommissioning cost categories can be derived:

License Termination:	82.5%	of	$ 875,356,048	=	$ 722,168,740
Spent Fuel Management:	6.7%	of	$ 875,356,048	=	$ 58,648,855
Site Restoration:	10.8%	of	$ 875,356,048	=	$ 94,538,453

Missouri's definition of decommissioning encompasses both the radiological and non-radiological structures, systems and components of the plant, as stated in the following section from the Missouri Code of State Regulations:

20 CSR 4240-20.070 Decommissioning Trust Funds

(1) As used in this rule, decommissioning means those activities undertaken in connection with a nuclear generating unit's retirement from service to ensure that the final removal, disposal, entombment, or other disposition of the unit and of any radioactive components and materials associated with the unit, are accomplished in compliance with all applicable laws, and to ensure that the final disposition does not pose any undue threat to the public health and safety. Decommissioning includes the removal and disposal of the

structures, systems, and components of a nuclear generating unit at the time of decommissioning.

Missouri law requires triennial updates of the decommissioning cost estimate and of funding adequacy. Missouri law also provides for the changing of rates charged to ratepayers to recover any changes in funding levels necessitated by the triennial update analyses. For these reasons, Ameren Missouri considers the amount in the fund to be fully adequate to cover radiological decommissioning with an excess that could be applied to non-radiological decommissioning. The triennial update process required by Missouri statutes is considered adequate to ensure that any funding shortfalls will be addressed and corrected in a timely manner. The applicable sections from the Missouri Code of State Regulations are as follows:

20 CSR 4240-20.070 Decommissioning Trust Funds

(4) Every three (3) years, utilities with decommissioning trust funds shall perform and file with the commission cost studies detailing the utilities' latest cost estimates for decommissioning their nuclear generating unit(s) along with the funding levels necessary to defray these decommissioning costs. These studies shall be filed along with appropriate tariff(s) effectuating the change in rates necessary to accomplish the funding required. In addition, the commission, at any time for just cause, may require a utility to file an updated decommissioning cost study, funding requirement and associated tariff(s).

and

(9) Upon the filing of the appropriate tariff(s) as set forth in this rule, the commission shall establish a schedule of proceedings which shall be limited in scope to the following issues:

(A) The extent of any change in the level or annual accrual of funding necessary for the utility's decommissioning trust fund; and

(B) The changes in rates which would reflect any change in the funding level or accrual rate.

In past triennial filings, the MPSC has accepted the site-specific decommissioning cost estimates and the funding adequacy analyses based on full green fielding of the site, as would be indicated under Missouri's legal definition of decommissioning. There is no basis for assuming any change in this practice in the future.

Consequently, it can be considered that the trust fund balance indicated is a total balance, not segregated on the basis of radiological versus non-radiological funding. As the Missouri mechanism for assuring funding adequacy and for recovering decommissioning expenses from ratepayers includes the non-radiological decommissioning expenses as well as the radiological expenses, it is not necessary to segregate the decommissioning fund balances. Any shortfalls in funding for full green fielding are expected to be recovered from ratepayers as part of the triennial funding adequacy updating process.

3. **Schedule of the Annual Amounts Remaining to be Collected:**

As of January 1, 2023, the schedule of the total Plant annual decommissioning expense amounts remaining to be collected from ratepayers is $6,242,226 per year for years 2023 through year 2043 and $4,989,505 for year 2044.

As the operating license expires October 18, 2044 and decommissioning expense collections from ratepayers are assumed to cease upon the cessation of plant operations, 2044 is a "partial year" for collection and funding purposes, with the annual amount being pro-rated for three calendar quarters plus eighteen days:

(75% x $6,242,226) + [(18/365) x $6,242,226] = $4,989,505

The funding adequacy analysis performed by Ameren Missouri and approved by the MPSC is based on cash flows deposited into the decommissioning trust fund. Quarterly deposits into the fund are made on the 25th of the month following each quarter-end. Therefore, each year's cash contributions to the decommissioning fund will reflect the expense collected from ratepayers from Q4 of the preceding year plus that for Q1, Q2 and Q3 of the current year.

For that reason, when looking at the funding adequacy analysis performed for the Plant, the "Annual Cash Inflow from Contributions to Fund" value for the year 2023 will indicate $6,242,226 which includes the 2022 Q4 contribution plus the Q1, 2 and 3 contributions for 2023.

In addition, the "Annual Cash Inflow from Contributions to Fund" value for the year 2044 will indicate $6,550,061.50. That represents the $1,560,556.50 expense collected from ratepayers for Q4 of 2043 plus the prorated $4,989,505 for the period from January 1, 2044 through October 18, 2044 (calculated above).

4. **Actions by Regulatory Rate Setting Authorities, Assumptions Used Regarding Rates of Escalation in Decommissioning Costs, Rates of Earnings on Decommissioning Funds, and Rates of Other Factors Used in Funding Projections:**

In accordance with the previously cited 20 CSR 4240-20.070 requirement, Ameren Missouri filed its latest updated decommissioning cost estimate and funding adequacy analysis with the MPSC on November 5, 2020.

In accordance with the previously cited 20 CSR 4240-20.070 requirement, on November 5, 2020, Ameren Missouri filed its "Application for Acceptance of Decommissioning Cost Estimates for Callaway Energy Center, Including Independent Spent Fuel Storage Installation, and Approval of Funding Level for Nuclear Decommissioning Trust Fund" with the MPSC (File No. EO-2021-0050). Attachment 3 to this application contained the updated site-specific decommissioning cost estimate prepared by TLG Services, Inc. titled "Decommissioning Cost Analysis for the Callaway Energy Center" and dated October 2020. Attachment 4 to the application contained Ameren Missouri's analysis of the required

funding level for the decommissioning trust fund, including all of the financial and economic assumptions on which the funding analysis was based. A copy of the "Application for Acceptance of Decommissioning Cost Estimates for Callaway Energy Center, Including Independent Spent Fuel Storage Installation, and Approval of Funding Level for Nuclear Decommissioning Trust Fund" is provided in Enclosure 6. As noted earlier, a copy of the "Decommissioning Cost Analysis for the Callaway Energy Center," dated October 2020 is provided in Enclosure 4. A copy of the funding adequacy analysis (Attachment 4 to the application) is provided in Enclosure 7.

On February 9, 2021, Ameren Missouri and the MPSC Staff entered into a "Non-Unanimous Stipulation and Agreement" that received Ameren Missouri's application and funding level analyses into evidence and requested the MPSC to approve the funding level requested by Ameren Missouri in the application, as well as the return assumptions and other financial and economic assumptions used in the funding level analysis. A copy of the "Non-Unanimous Stipulation and Agreement" is provided in Enclosure 8.

On February 24, 2021, the MPSC issued an "Order Approving Stipulation and Agreement" (effective March 26, 2021) that approved the foregoing "Non-Unanimous Stipulation and Agreement" as well as continuing the contribution to the decommissioning trust fund at the current level of $6,758,605 annually (with $6,242,226 allocated to Plant decommissioning and $516,379 allocated to ISFSI decommissioning) and affirming that Missouri is 100% responsible for the decommissioning liability. The MPSC Order also approved the rates of return and other financial and economic assumptions described in the "Non-Unanimous Stipulation and Agreement" and used in the funding level analysis.

In the Order, the MPSC approved the following actuarial assumptions used by Ameren Missouri in its Plant decommissioning funding adequacy analysis filed with the application and referenced in the "Non-Unanimous Stipulation and Agreement":

- The after-tax value of Missouri jurisdictional sub-account of the Plant Tax-Qualified Nuclear Decommissioning Trust Fund as of September 30, 2020 was $814,003,088.
- The proposed expense and contribution amount and allocation between Plant and ISFSI is to be effective beginning with calendar year 2021.
- The Plant decommissioning cost estimate is $1,036,260,000 in terms of 2020 dollars.
- Plant operating license expiration date is October 18, 2044.
- The Missouri jurisdictional allocator is 100%.
- The federal income tax rate is 20%.
- The state income tax rate is 0%.
- The composite federal & state income tax rate is 20%.
- An asset allocation of 65% equities and 35% bonds is assumed to exist through 2043, at which time all equity investments will be divested.
- Investment management and trust fees are estimated at 15 basis points annually.
- An inflation rate of 2.150% is assumed for general ("CPI") inflation.
- The pre-tax and expense nominal return on bonds is assumed to be 3.200%.
- The pre-tax and expense real return on bonds is assumed to be 1.050%.

- The pre-tax and expense nominal return on equities is assumed to be 8.500%.
- The pre-tax and expense real return on equities is assumed to be 6.350%.
- The pre-tax and expense nominal weighted-average return is assumed to be 6.645% through the 2043 date of divestiture of equity investments.
- The pre-tax and expense real weighted-average return is assumed to be 4.495% through the 2043 date of divestiture of equity investments.
- The pre-tax and expense real weighted-average return is assumed to be 1.050% following the 2043 date of divestiture of equity investments.

Based on the foregoing assumptions, the anticipated annual Plant decommissioning contributions would be adequate up to an annual decommissioning inflation rate of 4.1916%. The annualized rate of return on the Plant decommissioning fund (pre-tax and fee) required at the above level of inflation is 6.087%.

A copy of the MPSC "Order Approving Stipulation and Agreement" is provided in Enclosure 9.

As of the March 30, 2023 date of this report, the MPSC Order in this Case EO-2021-0050 continues to be the effective ruling establishing state regulatory authority approved return and funding assumptions.

5. Any Contracts Upon Which the Licensee is Relying on Pursuant to 10 CFR 50.75(E)(L)(V):

None

6. Any Modifications Occurring to a Licensee's Current Method of Providing Financial Assurance Since the Last Submitted Report:

None.

The Company has used the "External Sinking Fund" method since 1985.

7. Any Material Changes to Trust Agreements:

There have been no material changes to the qualified trust agreement since the last report.

The non-qualified trust that was required by Illinois has been eliminated, as Ameren Missouri no longer has customers in Illinois. This non-qualified trust was never funded. [3]

8. References

1. ULNRC-06201, "Status of Decommissioning Funding," dated March 30, 2015

2. ULNRC-06349, " Status of Decommissioning Funding," dated March 30, 2017

3. ULNRC-06494, " Status of Decommissioning Funding," dated March 22, 2019

4. ULNRC-06644, " Status of Decommissioning Funding," dated March 30, 2021

[1] The NRC formulas in section 10 CFR 50.75(c) include only those decommissioning costs incurred by licensees to remove a facility or site safely from service and reduce residual radioactivity to levels that permit: (1) release of the property for unrestricted use and termination of the license; or (2) release of the property under restricted conditions and termination of the license. The cost of dismantling or demolishing non-radiological systems and structures and the costs of managing and storing spent fuel on site until transfer to DOE are not included in the 10 CFR 50.75(c) cost formulas.

[2] This estimate is applicable to the 60-year operating life, DECON decommissioning alternative scenario with low-level radioactive waste processing, and is presented in Appendix C of the August, 2017 site specific decommissioning cost estimate. This is the option Ameren Missouri intends to utilize for plant decommissioning.

[3] On February 10, 2005, the MPSC approved Ameren Missouri's proposed transfer of its Illinois electric and gas properties to an Illinois affiliate, Ameren Illinois. The closing date for the property transfer was May 2, 2005. In accordance with the MPSC Order, the tax-qualified decommissioning trust's Illinois jurisdictional sub-account was eliminated following the closing. Ninety-eight percent of the assets in the existing Illinois subaccount as of the closing date were reallocated to the Missouri sub-account and the remaining two percent were reallocated to the Wholesale sub-account. As a result of the transfer, Ameren Missouri no longer has any Illinois ratepayers and will no longer collect decommissioning contributions in Illinois for its Callaway Plant, which is located in Missouri. The decommissioning liability previously borne by the Illinois ratepayers was transferred to Ameren Missouri and Wholesale customers. Decommissioning expenses collected from Missouri jurisdictional ratepayers was increased by $272,194 annually in accordance with the MPSC Order to account for the increased decommissioning liability borne by the Missouri ratepayers following the property transfer.

Callaway Energy Center 10 CFR 72.30 ISFSI Decommissioning Funding Plan - March 2021

Callaway Energy Center
10 CFR 72.30
ISFSI Decommissioning Funding Plan

Prepared by

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March 25, 2021

Table of Contents

Background and Introduction

The Nuclear Regulatory Commission (NRC) issued its final rule on Decommissioning Planning on June 17, 2011, [1] with the rule becoming effective on December 17, 2012. Subpart 72.30, "Financial assurance and recordkeeping for decommissioning," requires that each holder of, or applicant for, a license under this part must submit for NRC review and approval a decommissioning funding plan that contains information on how reasonable assurance will be provided that funds will be available to decommission the Independent Spent Fuel Storage Installation (ISFSI).

In accordance with the rule, a detailed cost estimate is provided herein for decommissioning the ISFSI at Callaway Energy Center (Callaway) in an amount reflecting:

1. The work is performed by an independent contractor,
2. An adequate contingency factor, and
3. Release of the facility and dry storage systems for unrestricted use, as specified in 10 CFR Part 20.1402

The following are also provided herein:

1. Identification of the key assumptions contained in the cost estimate, and
2. The volume of onsite subsurface material containing residual radioactivity, if any, that will require remediation to meet the criteria for license termination.

Spent Fuel Management Strategy

The operating license for Callaway, renewed on March 6, 2015, is set to expire on October 18, 2044. Approximately 3,782 spent fuel assemblies are currently projected to be generated over the life of the plant. Because of the breach by the Department of Energy (DOE) of its contract to remove fuel from the site, an ISFSI has been constructed with spent fuel planned to be transferred to the dry storage

1 U.S. Code of Federal Regulations, Title 10, Parts 20, 30, 40, 50, 70 and 72 "Decommissioning Planning," Nuclear Regulatory Commission, Federal Register Volume 76, Number 117 (p 35512 et seq.), June 17, 2011.

modules located at the ISFSI, to support continued plant operations. The ISFSI is operated under a Part 50 General License (in accordance with 10 CFR 72, Subpart K[2]).

Completion of the ISFSI decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site. 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 in which it was discharged from the reactor.[3]

In January 2013, the DOE issued a report, "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," in response to the recommendations made by the Blue Ribbon Commission on America's Nuclear Future and as "a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel..."[4] The report stated, "[W]ith the appropriate authorizations from Congress, the Administration currently plans to implement a program over the next 10 years that: …[A]dvances toward the siting and licensing of a larger interim storage facility to be available by 2025 that will have sufficient capacity to provide flexibility in the waste management system and allows for acceptance of enough used nuclear fuel to reduce expected government liabilities; …"

Based upon DOE's latest strategy, Ameren Missouri believes that one or more monitored interim storage facilities could be put into place within a reasonable time. Ameren Missouri's current spent fuel management plan for the Callaway spent fuel is based in general upon the spent fuel being fully removed from the Callaway site by 2050. The estimates described in this analysis were developed based on this assumption that DOE would remove spent fuel from the site by 2050, thus allowing decommissioning of the ISFSI to proceed.

Ameren Missouri's position is that the DOE has a contractual obligation to accept the spent fuel earlier than the projections set out above consistent with its contract commitments. No assumption made in this study should be interpreted to be inconsistent with this position.

2 U.S. Code of Federal Regulations, Title 10, Part 72, Subpart K, "General License for Storage of Spent Fuel at Power Reactor Sites."

3 U.S. Code of Federal Regulations, Title 10, Part 961.11, Article IV – Responsibilities of the Parties, B. DOE Responsibilities, 5.(a) … DOE shall issue an annual acceptance priority ranking for receipt of SNF and/or HLW at the DOE repository. This priority ranking shall be based on the age of SNF and/or HLW as calculated from the date of discharge of such materials from the civilian nuclear power reactor. The oldest fuel or waste will have the highest priority for acceptance, except as …"

4 "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," U.S. DOE, January 11, 2013.

ISFSI Decommissioning Strategy

At the conclusion of the spent fuel transfer process the ISFSI will be promptly decommissioned (similar to the power reactor DECON alternative).

For purposes of providing an estimate for a funding plan, financial assurance is expected to be provided on the basis of a prompt ISFSI decommissioning scenario. In this estimate the ISFSI decommissioning is considered an independent project, regardless of the decommissioning alternative identified for the nuclear power plant.

ISFSI Description

The Callaway ISFSI is based upon Holtec International's (Holtec) HI-STORM UMAX underground system for the dry storage of used nuclear fuel. In this system, spent fuel is stored in a multi-purpose container (MPC) and placed within an underground vertical ventilated module (VVM). The ISFSI pad is designed for 48 VVMs, although all the cells may not be needed, depending upon DOE performance.

In addition to the spent fuel stored at the ISFSI, there is projected to be five additional modules used for Greater-than-Class-C (GTCC) waste storage. The multi-purpose containers used for this GTCC waste canister are also expected to be transferred to the DOE at the same time as the spent fuel transfer.

The key constituent of a HI-STORM UMAX VVM is the Cavity Enclosure Container (CEC). The CEC is a closed bottom, open top, thick-walled cylindrical vessel that has no penetrations or openings. The closure lid completes the physical embodiment of the HI-STORM UMAX VVM once the loaded MPC is placed inside the CEC. The closure lid is a steel structure filled with plain concrete and is designed to protect the VVM from the impact of design basis missiles as well as to provide an inlet and outlet for air flow.

The wall thickness of the welded steel CEC is approximately ¾ inches. The CEC rests on a foundation pad with a thickness of 2 feet 9 inches, approximately 16 feet 11 inches below the grade-level ISFSI pad.

A divider shell divides the CEC into an inlet flow downcomer and an outlet flow passage. It is a vertical cylindrical shell concentrically situated in the CEC and is not attached to the CEC, which allows its convenient removal for decommissioning.

All exposed surfaces of the CEC are made from ferritic steels that are painted and protected from corrosion. The inside surface of the CECs and the divider shells is protected by paint. In addition, one side of the divider shell is further protected by insulation.

The VVMs are surrounded by controlled low-strength material (CLSM), a self-compacted, cementitious material.

A reinforced concrete slab (ISFSI pad) surrounds the upper portion of the CEC and extends to the underside of the CEC Flange. The ISFSI pad provides robust support for a loaded transporter and enables rainwater to flow away from the storage array. The concrete ISFSI pad is approximately 2 feet 6 inches thick.

Ameren Missouri's current spent fuel management plan for the Callaway spent fuel would result in all 48 MPCs being placed at the ISFSI by the year 2044, excluding GTCC.

The storage modules used for the GTCC canisters (estimated quantity of 5) are not expected to have any interior contamination or residual activation and can be reused or disposed of by conventional means after a final status survey.

Table 1 provides the significant quantities and physical dimensions used as the basis in developing the ISFSI decommissioning estimate.

Key Assumptions / Estimating Approach

The decommissioning estimate is based on the configuration of the ISFSI expected after all spent fuel and GTCC material has been removed from the site. The configuration of the ISFSI is based on the station operating until the end of its current license (2044) and the DOE's spent fuel acceptance assumptions, as previously described.

The dry storage vendor, Holtec, does not expect the VVMs to have any interior or exterior radioactive surface contamination.[5] It is expected that this assumption would be confirmed as a result of good radiological practice of surveying potentially impacted areas after each spent fuel transfer campaign. Any neutron activation of the steel and concrete is expected to be extremely small.[6] This assumption is adopted for this analysis.

5 Final Safety Analysis Report for the HI-STORM UMAX Canister Storage System, FSAR Report No. HI-2115090, Rev. 1, at page 2-120.
6 Ibid.

The decommissioning estimate is based on the conservative premise that a small percentage of the VVMs would contain very low levels of neutron-induced residual radioactivity that would necessitate remediation at the time of decommissioning. As an allowance, 6 of the 48 MPCs are assumed to be affected, i.e., contain residual radioactivity. The allowance quantity is based upon the number of MPCs required for the final core off-load (i.e., 193 offloaded assemblies/unit, 37 assemblies per MPC) which results in a total of 6 VVMs that contain residual radioactivity. It is assumed that these are the final VVMs offloaded; consequently, they have the least time for radioactive decay of the neutron activation products.

It is not expected that there will be any residual contamination left on the concrete ISFSI pad. It is expected that this assumption would be confirmed as a result of good radiological practice of surveying potentially impacted areas after each spent fuel transfer campaign. Therefore, it is assumed for this analysis that the ISFSI pad will not be contaminated. As such, only verification surveys are included for the pad in the decommissioning estimate.

The ISFSI storage modules were constructed in the original Callaway unit 2 excavation, after the non-usable sediment was removed and replaced with clean fill. The clean fill was obtained from a borrow pit and suppliers located outside of the Owner Control Area and not radiologically affected by plant Operations. It is assumed that there is no subsurface soil in the proximity of the ISFSI containing residual radioactivity that will require remediation to meet the criteria for license termination.

Costs are reported in 2020 dollars and based upon the triennial decommissioning analysis prepared for Callaway in October, 2020.[7]

Decommissioning is assumed to be performed by an independent contractor. As such, essentially all labor, equipment, and material costs are based on national averages, i.e., costs from national publications such as R.S. Means' Building Construction Cost Data (adjusted for regional variations), and laboratory service costs are based on vendor price lists. Ameren Missouri, as licensee, will oversee the site activities. The estimate includes Ameren Missouri's labor and overhead costs.

Low-level radioactive waste packaging, transport and disposal costs are based on rates consistent with the most recently developed decommissioning cost estimate.

Contingency has been added at an overall rate of 25% to the license termination tasks. This is consistent with the contingency evaluation criteria referenced by the NRC in NUREG-1757.[8]

7 "Decommissioning Cost Analysis for the Callaway Energy Center," TLG Services, Inc. Document A22-1782-001, Rev. 0, dated October 2020.

The estimate is limited to costs necessary to terminate the ISFSI's NRC license and meet the §20.1402 criteria for unrestricted use. Disposition of released material and structures is outside the scope of the estimate.

The effects, if any, since the last submittal of the ISFSI decommissioning funding plan of the following events listed in 10 CFR 72.30 (c) (1)- (4) have been specifically considered in the decommissioning cost estimate:

(1) Spills of radioactive material producing additional residual radioactivity in onsite subsurface material: There have been no spills at the ISFSI.

(2) Facility modifications: There have been no facility modifications in the past three years that affect the decommissioning cost estimate.

(3) Changes in authorized possession limits: There are no changes in authorized possession limits that affect the decommissioning cost estimate.

(4) Actual remediation costs that exceed the previous cost estimate: No actual remediation costs have been incurred, so no actual remediation costs exceed the previous cost estimate.

Cost Estimate

The estimated cost to decommission the ISFSI and release the facility for unrestricted use is provided in Table 2. The cost has been organized into three phases, including:

- An initial planning phase - empty VVMs are characterized and the specifications and work procedures for the decontamination (MPC support structure removal) developed.
- The remediation phase - residual radioactivity is removed. The empty VVMs are used as waste containers, transported to the low-level waste site, and disposed of at low-level waste.
- The final phase - license termination surveys and independent surveys are completed, and an application for license termination submitted.

[8] "Consolidated Decommissioning Guidance - Financial Assurance, Recordkeeping, and Timeliness," U.S. Nuclear Regulatory Commission's Office of Nuclear Material Safety and Safeguards, NUREG-1757, Volume 3, Revision 1, February 2012

In addition to the direct costs associated with a contractor providing the decommissioning services, the estimate also contains costs for the NRC (and NRC contractor to perform the verification survey), Ameren Missouri's oversight staff, site security (industrial), and other site operating costs.

For estimating purposes it should be conservatively assumed that all license termination expenditures will incurred in years 2050, following all spent fuel removal.

Financial Assurance

This section describes the methodology by which Ameren Missouri is providing financial assurance for decommissioning the ISIFI at the end of its useful life.

ISFSI operations at Callaway are required due to the DOE's) failure to remove spent nuclear fuel from the Callaway Energy Center in a timely manner pursuant to a written agreement. The costs for management of the spent fuel are costs for which the DOE is responsible under federal law and the Standard Contract.

It is uncertain as to whether the DOE will actually provide reimbursement for the ISFSI decommissioning costs; and if such reimbursement is provided, when it will occur. Consequently, Ameren Missouri intends to provide financial assurance for the ISFSI decommissioning utilizing the "External Sinking Fund" methodology, as described in the following CFR paragraphs:

10 CFR 72.30(e) states (in part):

> *(e) .... Financial assurance for decommissioning must be provided by one or more of the following methods:*
>
> *(5) In the case of licensees who are issued a power reactor license under part 50 of this chapter or ISFSI licensees who are an electric utility, as defined in part 50 of this chapter, with a specific license issued under this part, the methods of 10 CFR 50.75(b), (e), and (h), as applicable. In the event that funds remaining to be placed into the licensee's ISFSI decommissioning external sinking fund are no longer approved for recovery in rates by a competent rate making authority, the licensee must make changes to provide financial assurance using one or more of the methods stated in paragraphs (1) through (4) of this section.*

As Ameren Missouri has been issued a power reactor license and is an electric utility, it meets the foregoing criteria and consequently is utilizing the "External Sinking Fund" method of providing financial assurance for decommissioning the ISFSI, as defined in 10 CFR 50.75(e)(1)(ii). This is also

the financial assurance method that Ameren Missouri currently uses for the Callaway Energy Center Part 50 license termination.

Separate, segregated sub-accounts have been established within the external sinking fund to segregate the ISFSI decommissioning funding from the plant decommissioning funding.

Missouri regulations, cited below, require the triennial filing of updated decommissioning cost estimates and associated funding levels required for decommissioning funding assurance. Missouri regulations also provide for the changing of rates charged to ratepayers to recover any changes in funding levels necessitated by the triennial decommissioning cost estimate updates.

20 CSR 4240-20.070 Decommissioning Trust Funds

(4) Every three (3) years, utilities with decommissioning trust funds shall perform and file with the commission cost studies detailing the utilities' latest cost estimates for decommissioning their nuclear generating unit(s) along with the funding levels necessary to defray these decommissioning costs. These studies shall be filed along with appropriate tariff(s) effectuating the change in rates necessary to accomplish the funding required. In addition, the commission, at any time for just cause, may require a utility to file an updated decommissioning cost study, funding requirement, and associated tariff(s).

and

(9) Upon the filing of the appropriate tariff(s) as set forth in this rule, the commission shall establish a schedule of proceedings which shall be limited in scope to the following issues:

- *(A) The extent of any change in the level or annual accrual of funding necessary for the utility's decommissioning trust fund; and*
- *(B) The changes in rates which would reflect any change in the funding level or accrual rate.*

To comply with the foregoing Missouri regulations, Ameren Missouri prepares an updated site-specific decommissioning cost estimate for the Callaway Energy Center every three (3) years and files this estimate and an updated funding level analysis with the Missouri Public Service Commission (MPSC). The site-specific estimate includes radiological license termination expenses, non-radiological site restoration expenses and spent fuel management expenses. The funding level analysis is based on this total decommissioning cost estimate amount. Although the external sinking fund described in 10 CFR 50.75 is for radiological decommissioning costs only, to the extent that the fund balance exceeds costs required for Part 50 radiological decommissioning, excess funds would be available for non-radiological site restoration expenses and spent fuel management expenses.

The most recent triennial update filing was made with the MPSC on November 5, 2020.

As part of this November 5, 2020, MPSC filing, Ameren Missouri had a decommissioning cost estimate for the ISFSI prepared by the same firm that prepared the cost estimate for the Callaway Energy Center decommissioning. The estimated cost for radiological decommissioning of the ISFSI and release of the facility for unrestricted use is $9,152,000 (2020$). This estimate projects that license termination of the ISFSI will take place in 2050.

On February 9, 2021, Ameren Missouri and the MPSC Staff entered into a "Non-Unanimous Stipulation and Agreement" regarding the cost estimates for decommissioning of the plant and ISFSI and the associated funding levels of the nuclear decommissioning trust fund. The MPSC approved the "Non-Unanimous Stipulation and Agreement" in an Order issued February 24, 2021.[9] Based on the approved cost estimate and funding plan, Ameren Missouri is making annual contributions of $516,379 to the segregated ISFSI sub-accounts of the external sinking fund. This funding level commenced as of January 1, 2021, and will be effective until the next triennial MPSC update filing, required by September 1, 2023. At that time, funding adequacy will be reevaluated and the contribution level changed accordingly, as necessary.

Ameren Missouri will refund to Missouri ratepayers any DOE reimbursement amounts received for costs of decommissioning the ISFSI whereby Ameren Missouri previously collected those decommissioning costs from Missouri ratepayers as Missouri rate tariffs.

As 10 CFR 72.30 (c) states, in part:

> *(c) At the time of license renewal and at intervals not to exceed 3 years, the decommissioning funding plan must be resubmitted with adjustments as necessary to account for changes in costs and the extent of contamination.*

To comply with this requirement, Ameren Missouri intends to obtain updated site-specific decommissioning cost estimates for the ISFSI concurrently with updated plant decommissioning cost estimates and file both on a triennial basis with the MPSC, along with updated funding level analyses, as required by Missouri regulations. The next filing will be made by September 1, 2023, and then every three (3) years thereafter. Concurrent with these MPSC filings, updated ISFSI cost estimates and funding level analyses will be submitted to the NRC in accordance with 10 CFR 72.30(c).

[9] Copies of the ISFSI decommissioning cost estimate, the "Funding Adequacy Analysis," the "Non-Unanimous Stipulation and Agreement" and the February 24, 2021 MPSC Order are available on request.

Table 1
Significant Quantities and Physical Dimensions

ISFSI Pad

Item	Length (feet)	Width (feet)	Depth (feet)	Residual Radioactivity
ISFSI Pad	157.5	143.5	2.5	No

ISFSI HI-STORM UMAX

Item	Value	Notes (all dimensions are nominal)
Cavity Enclosure Container Inside Height (inches)	181	
Cavity Enclosure Container Inside Diameter (inches)	86	
Quantity (total)	48	Spent Fuel (43) + GTCC (5)
Quantity (with residual radioactivity)	6	Equivalent to the number of VVMs used to store last complete core offload)
Potentially Activated Steel and Concrete (pounds)	847,767	
Misc. Low-Level Radioactive Waste (pounds)	3,289	
Low-Level Radioactive Waste (cubic feet)	13,299	Excluding transfer cask
Low-Level Radioactive Waste (packaged density)	64	Average weight density

Other Potentially Impacted Items

Item	Value	Notes
Number of VVMs used for GTCC storage	5	No residual radioactivity

Table 2
ISFSI Decommissioning Costs[1] and Waste Volumes

	Costs (thousands, 2020 dollars)						Waste Volume	Person-Hours	
	Removal	Packaging	Transport	Disposal	Other	Total	Cubic Feet	Craft	Oversight and Contractor
Decommissioning Contractor									
Planning (characterization, specs and procedures)	-	-	-	-	239	239	-	-	1,024
Remediation (activated metal removal)	591	110	98	3,112	-	3,910	13,299	7,472	-
License Termination (radiological surveys)	-	-	-	-	1,307	1,307	-	9,549	-
Subtotal	**591**	**110**	**98**	**3,112**	**1,546**	**5,457**	**13,299**	**17,021**	**1,024**
Supporting Costs									
NRC and NRC Contractor Fees	-	-	-	-	473	473	-	-	1,153
Insurance	-	-	-	-	144	144	-	-	-
Property Taxes	-	-	-	-	35	35	-	-	-
Plant Energy Budget	-	-	-	-	56	56	-	-	-
Corporate A&G	-	-	-	-	329	329	-	-	-
Security (industrial)	-	-	-	-	420	420	-	-	4,958
Ameren Missouri Oversight	-	-	-	-	408	408	-	-	3,761
Subtotal	-	-	-	-	**1,865**	**1,865**	-	-	**9,872**
Total (w/o contingency)	**591**	**110**	**98**	**3,112**	**3,411**	**7,322**	**13,299**	**17,021**	**10,896**
Total (w/25% contingency)	**738**	**138**	**122**	**3.890**	**4,264**	**9,152**			

Note 1: For funding planning purposes costs can be assumed to be incurred in 2050

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS
($ Millions)

Updated for 2023 Filing

Determine Estimated Decommissioning Costs in 1986 Dollars:

$ 105.00 = 1986$ Cost [From 10 CFR 50.75 (c)(1)(i) For PWR ≥ 3400 MWt]

Calculate Labor Adjustment Factor (Lx):

3.178 = Lx U. S. Department of Labor, Bureau of Labor Statistics;

Employment Cost Index for total compensation, for private industry workers, by bargaining status, census region and division, and metropolitan area status
Midwest Region
Base Lx = 2.080 (December 2005 = 100)
December-2022 ECI = 152.8 (December 2005 = 100)
Lx =[(Base Lx / 100) * ECI]

Calculate Energy Adjustment Factor (Ex):

3.443 = Ex **From NUREG-1307 Revision 19**
Ex = Px (Px Coefficient) + Fx (Fx Coefficient)
0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Determine Px Value
2.451 = Px
U. S. Department of Labor, Bureau of Labor Statistics;
Producer Price Index - Commodities
Series ID: WPU0543
Not Seasonally Adjusted
Fuels and related products and power
Industrial electric power
1982 = 100
January 1986 Value of PPI Series ID WPU0543 = 114.200
December 2022 Value of PPI Series ID WPU0543 = 279.934
Px = December 2022 Value of PPI Series ID WPU0543 / January 1986 Value of PPI Series ID WPU0543

Determine Fx Value
4.813 = Fx
U. S. Department of Labor, Bureau of Labor Statistics;
Producer Price Index - Commodities
Series ID: WPU0573
Not Seasonally Adjusted
Fuels and related products and power
Light fuel oils
1982 = 100
January 1986 Value of PPI Series ID WPU0573 = 82.000
December 2022 Value of PPI Series ID WPU0573 = 394.700
Fx = December 2022 Value of PPI Series ID WPU0573 / January 1986 Value of PPI Series ID WPU0573

Calculate Waste Burial Adjustment Factor (Bx):

13.711 = Bx **From NUREG-1307 Revision 19**
Table 2-1
Bx Values for Generators Located in the Unaffiliated States and those Located in Compact-Affiliated States having no Disposal Facility
PWR

Calculate the Decommissioning Cost Estimate - December 2022$

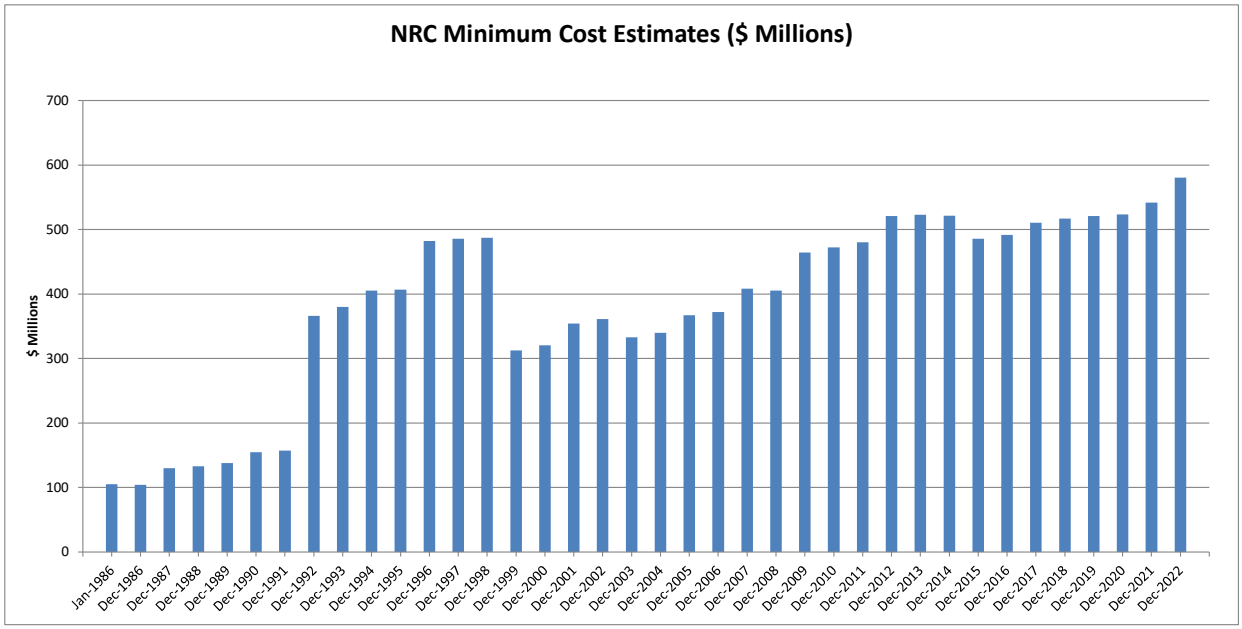
Estimated Cost (Year x) = [1986$ Cost] * [(A*Lx)+(B*Ex)+(C*Bx)]
0.65 = Lx Coefficient (A)
0.13 = Ex Coefficient (B)
0.22 = Bx Coeficcient (C)

$ 580.597 = Estimated December 2022$ Cost

MINIMUM DECOMMISSIONING COST - PER 10CFR50.75 FORMULA PROCESS
($ Millions)

Estimated Cost (Year x) = [1986$ Cost] * [(A*Lx)+(B*Ex)+(C*Bx)]

Year $	1986 Cost	Lx Coefficient (A)	Lx (Use Dec of Year x -1 Value)	Ex Coefficient (B)	Ex (Use Dec of Year x Value)	Bx Coefficient (C)	Bx (Use Year x Values from NUREG-1307)	Total Estimated Decommissioning Cost (December Year xx $)
Jan-1986	$ 105.000	0.65	1.000	0.13	1.000	0.22	1.000	$ 105.000
Dec-1986	$ 105.000	0.65	1.028	0.13	0.804	0.22	1.000	$ 104.241
Dec-1987	$ 105.000	0.65	1.057	0.13	0.854	0.22	2.007	$ 130.161
Dec-1988	$ 105.000	0.65	1.108	0.13	0.820	0.22	2.007	$ 133.150
Dec-1989	$ 105.000	0.65	1.152	0.13	0.929	0.22	2.007	$ 137.697
Dec-1990	$ 105.000	0.65	1.211	0.13	1.061	0.22	2.494	$ 154.756
Dec-1991	$ 105.000	0.65	1.269	0.13	0.954	0.22	2.494	$ 157.227
Dec-1992	$ 105.000	0.65	1.313	0.13	0.948	0.22	11.408	$ 366.065
Dec-1993	$ 105.000	0.65	1.371	0.13	0.903	0.22	11.873	$ 380.135
Dec-1994	$ 105.000	0.65	1.414	0.13	0.927	0.22	12.824	$ 405.364
Dec-1995	$ 105.000	0.65	1.451	0.13	0.959	0.22	12.771	$ 407.120
Dec-1996	$ 105.000	0.65	1.494	0.13	1.038	0.22	15.852	$ 482.307
Dec-1997	$ 105.000	0.65	1.548	0.13	0.956	0.22	15.886	$ 485.671
Dec-1998	$ 105.000	0.65	1.599	0.13	0.842	0.22	15.886	$ 487.586
Dec-1999	$ 105.000	0.65	1.654	0.13	1.016	0.22	8.052	$ 312.780
Dec-2000	$ 105.000	0.65	1.734	0.13	1.189	0.22	8.052	$ 320.549
Dec-2001	$ 105.000	0.65	1.793	0.13	0.985	0.22	9.467	$ 354.540
Dec-2002	$ 105.000	0.65	1.861	0.13	1.142	0.22	9.467	$ 361.316
Dec-2003	$ 105.000	0.65	1.951	0.13	1.216	0.22	7.934	$ 333.013
Dec-2004	$ 105.000	0.65	2.012	0.13	1.428	0.22	7.934	$ 340.066
Dec-2005	$ 105.000	0.65	2.080	0.13	1.811	0.22	8.683	$ 367.233
Dec-2006	$ 105.000	0.65	2.138	0.13	1.879	0.22	8.683	$ 372.126
Dec-2007	$ 105.000	0.65	2.190	0.13	2.280	0.22	9.872	$ 408.621
Dec-2008	$ 105.000	0.65	2.238	0.13	1.791	0.22	9.872	$ 405.211
Dec-2009	$ 105.000	0.65	2.258	0.13	1.956	0.22	12.280	$ 464.508
Dec-2010	$ 105.000	0.65	2.315	0.13	2.253	0.22	12.280	$ 472.385
Dec-2011	$ 105.000	0.65	2.369	0.13	2.580	0.22	12.280	$ 480.542
Dec-2012	$ 105.000	0.65	2.410	0.13	2.639	0.22	13.885	$ 521.269
Dec-2013	$ 105.000	0.65	2.450	0.13	2.570	0.22	13.885	$ 523.015
Dec-2014	$ 105.000	0.65	2.502	0.13	2.208	0.22	13.885	$ 521.620
Dec-2015	$ 105.000	0.65	2.547	0.13	1.762	0.22	12.471	$ 486.003
Dec-2016	$ 105.000	0.65	2.614	0.13	1.860	0.22	12.471	$ 491.882
Dec-2017	$ 105.000	0.65	2.672	0.13	2.295	0.22	12.853	$ 510.614
Dec-2018	$ 105.000	0.65	2.751	0.13	2.359	0.22	12.853	$ 516.873
Dec-2019	$ 105.000	0.65	2.822	0.13	2.305	0.22	12.853	$ 520.969
Dec-2020	$ 105.000	0.65	2.893	0.13	2.255	0.22	12.793	$ 523.724
Dec-2021	$ 105.000	0.65	3.026	0.13	2.933	0.22	12.793	$ 542.061
Dec-2022	$ 105.000	0.65	3.178	0.13	3.443	0.22	13.711	$ 580.597



MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Labor Adjustment Factor (Lx) Derivation

124.6 = Dec - 1985 Index Value - June 1981 = 100
1.409 = Multiplier: Conversion of June 1989 = 100 Index Values to June 1981 = 100 Index Values
1.839 = Multiplier: Conversion of Dec 2005 = 100 Index Values to June 1989 = 100 Index Values

Index Date	Index Value	Index Base Year	Index Value	Index Base Year	Index Value	Index Base Year	Lx At Index date
Mar - 1986	125.9	June 1981 = 100					1.010
Jun - 1986	126.2	June 1981 = 100					1.013
Sep - 1986	127.3	June 1981 = 100					1.022
Dec - 1986	128.1	June 1981 = 100					1.028
Mar - 1987	129.1	June 1981 = 100					1.036
Jun - 1987	130.2	June 1981 = 100					1.045
Sep - 1987	131.2	June 1981 = 100					1.053
Dec - 1987	131.7	June 1981 = 100					1.057
Mar - 1988	134.4	June 1981 = 100					1.079
Jun - 1988	135.5	June 1981 = 100					1.087
Sep - 1988	136.7	June 1981 = 100					1.097
Dec - 1988	138.0	June 1981 = 100					1.108
Mar - 1989	139.3	June 1981 = 100	98.9	June 1989 = 100			1.118
Jun - 1989	140.9	June 1981 = 100	100.0	June 1989 = 100			1.131
Sep - 1989	142.3	June 1981 = 100	101.0	June 1989 = 100			1.142
Dec - 1989	143.6	June 1981 = 100	101.9	June 1989 = 100			1.152
Mar - 1990	145.8		103.5	June 1989 = 100			1.170
Jun - 1990	147.7		104.8	June 1989 = 100			1.185
Sep - 1990	149.8		106.3	June 1989 = 100			1.202
Dec - 1990	150.9		107.1	June 1989 = 100			1.211
Mar - 1991	152.9		108.5	June 1989 = 100			1.227
Jun - 1991	154.6		109.7	June 1989 = 100			1.241
Sep - 1991	156.7		111.2	June 1989 = 100			1.257
Dec - 1991	158.1		112.2	June 1989 = 100			1.269
Mar - 1992	160.3		113.8	June 1989 = 100			1.287
Jun - 1992	161.5		114.6	June 1989 = 100			1.296
Sep - 1992	162.5		115.3	June 1989 = 100			1.304
Dec - 1992	163.6		116.1	June 1989 = 100			1.313
Mar - 1993	166.1		117.9	June 1989 = 100			1.333
Jun - 1993	168.1		119.3	June 1989 = 100			1.349
Sep - 1993	169.2		120.1	June 1989 = 100			1.358
Dec - 1993	170.8		121.2	June 1989 = 100			1.371
Mar - 1994	173.0		122.8	June 1989 = 100			1.389
Jun - 1994	174.2		123.6	June 1989 = 100			1.398
Sep - 1994	175.6		124.6	June 1989 = 100			1.409
Dec - 1994	176.1		125.0	June 1989 = 100			1.414
Mar - 1995	177.3		125.8	June 1989 = 100			1.423
Jun - 1995	178.8		126.9	June 1989 = 100			1.435
Sep - 1995	179.9		127.7	June 1989 = 100			1.444
Dec - 1995	180.8		128.3	June 1989 = 100			1.451
Mar - 1996	182.5		129.5	June 1989 = 100			1.464
Jun - 1996	184.2		130.7	June 1989 = 100			1.478
Sep - 1996	185.0		131.3	June 1989 = 100			1.485
Dec - 1996	186.1		132.1	June 1989 = 100			1.494
Mar - 1997	187.8		133.3	June 1989 = 100			1.507
Jun - 1997	189.8		134.7	June 1989 = 100			1.523
Sep - 1997	191.9		136.2	June 1989 = 100			1.540
Dec - 1997	192.9		136.9	June 1989 = 100			1.548
Mar - 1998	194.9		138.3	June 1989 = 100			1.564
Jun - 1998	196.7		139.6	June 1989 = 100			1.579
Sep - 1998	198.5		140.9	June 1989 = 100			1.593
Dec - 1998	199.2		141.4	June 1989 = 100			1.599
Mar - 1999	199.7		141.7	June 1989 = 100			1.602
Jun - 1999	202.3		143.6	June 1989 = 100			1.624
Sep - 1999	204.3		145.0	June 1989 = 100			1.640
Dec - 1999	206.1		146.3	June 1989 = 100			1.654
Mar - 2000	209.8		148.9	June 1989 = 100			1.684

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Labor Adjustment Factor (Lx) Derivation

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1.409 = Multiplier: Conversion of June 1989 = 100 Index Values to June 1981 = 100 Index Values
1.839 = Multiplier: Conversion of Dec 2005 = 100 Index Values to June 1989 = 100 Index Values

Index Date	Index Value	Index Base Year	Index Value	Index Base Year	Index Value	Index Base Year	Lx At Index date
Jun - 2000	212.3		150.7	June 1989 = 100			1.704
Sep - 2000	214.4		152.2	June 1989 = 100			1.721
Dec - 2000	216.0		153.3	June 1989 = 100			1.734
Mar - 2001	218.1		154.8	June 1989 = 100	84.8	Dec 2005 = 100	1.751
Jun - 2001	219.8		156.0	June 1989 = 100	85.4	Dec 2005 = 100	1.764
Sep - 2001	221.8		157.4	June 1989 = 100	86.1	Dec 2005 = 100	1.780
Dec - 2001	223.5		158.6	June 1989 = 100	86.7	Dec 2005 = 100	1.793
Mar - 2002	227.0		161.1	June 1989 = 100	88.0	Dec 2005 = 100	1.822
Jun - 2002	229.1		162.6	June 1989 = 100	88.7	Dec 2005 = 100	1.839
Sep - 2002	230.4		163.5	June 1989 = 100	89.0	Dec 2005 = 100	1.849
Dec - 2002	231.9		164.6	June 1989 = 100	89.5	Dec 2005 = 100	1.861
Mar - 2003	238.1		169.0	June 1989 = 100	92.1	Dec 2005 = 100	1.911
Jun - 2003	240.1		170.4	June 1989 = 100	92.8	Dec 2005 = 100	1.927
Sep - 2003	241.9		171.7	June 1989 = 100	93.6	Dec 2005 = 100	1.942
Dec - 2003	243.1		172.5	June 1989 = 100	94.0	Dec 2005 = 100	1.951
Mar - 2004	246.2		174.7	June 1989 = 100	95.0	Dec 2005 = 100	1.976
Jun - 2004	248.3		176.2	June 1989 = 100	95.9	Dec 2005 = 100	1.993
Sep - 2004	250.2		177.6	June 1989 = 100	96.6	Dec 2005 = 100	2.008
Dec - 2004	250.7		177.9	June 1989 = 100	96.9	Dec 2005 = 100	2.012
Mar - 2005	253.6		180.0	June 1989 = 100	97.8	Dec 2005 = 100	2.035
Jun - 2005	254.9		180.9	June 1989 = 100	98.4	Dec 2005 = 100	2.046
Sep - 2005	257.8		183.0	June 1989 = 100	99.5	Dec 2005 = 100	2.069
Dec - 2005	259.1		183.9	June 1989 = 100	100.0	Dec 2005 = 100	2.080
Mar - 2006	260.9		185.2		100.7	Dec 2005 = 100	2.094
Jun - 2006	263.5		187.0		101.7	Dec 2005 = 100	2.115
Sep - 2006	265.1		188.1		102.3	Dec 2005 = 100	2.127
Dec - 2006	266.4		189.0		102.8	Dec 2005 = 100	2.138
Mar - 2007	267.7		190.0		103.3	Dec 2005 = 100	2.148
Jun - 2007	270.0		191.6		104.2	Dec 2005 = 100	2.167
Sep - 2007	271.0		192.4		104.6	Dec 2005 = 100	2.175
Dec - 2007	272.8		193.6		105.3	Dec 2005 = 100	2.190
Mar - 2008	274.7		194.9		106.0	Dec 2005 = 100	2.204
Jun - 2008	277.3		196.8		107.0	Dec 2005 = 100	2.225
Sep - 2008	278.3		197.5		107.4	Dec 2005 = 100	2.233
Dec - 2008	278.8		197.9		107.6	Dec 2005 = 100	2.238
Mar - 2009	279.6		198.4		107.9	Dec 2005 = 100	2.244
Jun - 2009	280.1		198.8		108.1	Dec 2005 = 100	2.248
Sep - 2009	280.9		199.3		108.4	Dec 2005 = 100	2.254
Dec - 2009	281.4		199.7		108.6	Dec 2005 = 100	2.258
Mar - 2010	284.8		202.1		109.9	Dec 2005 = 100	2.285
Jun - 2010	286.1		203.0		110.4	Dec 2005 = 100	2.296
Sep - 2010	287.6		204.1		111.0	Dec 2005 = 100	2.308
Dec - 2010	288.4		204.7		111.3	Dec 2005 = 100	2.315
Mar - 2011	290.7		206.3		112.2	Dec 2005 = 100	2.333
Jun - 2011	293.6		208.4		113.3	Dec 2005 = 100	2.356
Sep - 2011	294.4		208.9		113.6	Dec 2005 = 100	2.362
Dec - 2011	295.1		209.5		113.9	Dec 2005 = 100	2.369
Mar - 2012	297.2		210.9		114.7	Dec 2005 = 100	2.385
Jun - 2012	298.8		212.0		115.3	Dec 2005 = 100	2.398
Sep - 2012	299.5		212.6		115.6	Dec 2005 = 100	2.404
Dec - 2012	300.3		213.1		115.9	Dec 2005 = 100	2.410
Mar - 2013	301.6		214.1		116.4	Dec 2005 = 100	2.421
Jun - 2013	303.2		215.2		117.0	Dec 2005 = 100	2.433
Sep - 2013	304.2		215.9		117.4	Dec 2005 = 100	2.441
Dec - 2013	305.2		216.6		117.8	Dec 2005 = 100	2.450
Mar - 2014	306.8		217.7		118.4	Dec 2005 = 100	2.462
Jun - 2014	309.6		219.8		119.5	Dec 2005 = 100	2.485

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Labor Adjustment Factor (Lx) Derivation

124.6 = Dec - 1985 Index Value - June 1981 = 100
1.409 = Multiplier: Conversion of June 1989 = 100 Index Values to June 1981 = 100 Index Values
1.839 = Multiplier: Conversion of Dec 2005 = 100 Index Values to June 1989 = 100 Index Values

Index Date	Index Value	Index Base Year	Index Value	Index Base Year	Index Value	Index Base Year	Lx At Index date
Sep - 2014	310.9		220.7		120.0	Dec 2005 = 100	2.495
Dec - 2014	311.7		221.2		120.3	Dec 2005 = 100	2.502
Mar - 2015	314.0		222.9		121.2	Dec 2005 = 100	2.520
Jun - 2015	314.6		223.3		121.4	Dec 2005 = 100	2.525
Sep - 2015	316.4		224.5		122.1	Dec 2005 = 100	2.539
Dec - 2015	317.4		225.3		122.5	Dec 2005 = 100	2.547
Mar - 2016	319.7		226.9		123.4	Dec 2005 = 100	2.566
Jun - 2016	322.6		229.0		124.5	Dec 2005 = 100	2.589
Sep - 2016	324.7		230.4		125.3	Dec 2005 = 100	2.606
Dec - 2016	325.7		231.2		125.7	Dec 2005 = 100	2.614
Mar - 2017	328.6		233.2		126.8	Dec 2005 = 100	2.637
Jun - 2017	330.1		234.3		127.4	Dec 2005 = 100	2.649
Sep - 2017	331.7		235.4		128.0	Dec 2005 = 100	2.662
Dec - 2017	333.0		236.3		128.5	Dec 2005 = 100	2.672
Mar - 2018	336.3		238.7		129.8	Dec 2005 = 100	2.699
Jun - 2018	338.4		240.2		130.6	Dec 2005 = 100	2.716
Sep - 2018	341.0		242.0		131.6	Dec 2005 = 100	2.737
Dec - 2018	342.8		243.3		132.3	Dec 2005 = 100	2.751
Mar - 2019	345.9		245.5		133.5	Dec 2005 = 100	2.776
Jun - 2019	347.5		246.6		134.1	Dec 2005 = 100	2.789
Sep - 2019	349.8		248.3		135.0	Dec 2005 = 100	2.807
Dec - 2019	351.6		249.6		135.7	Dec 2005 = 100	2.822
Mar - 2020	356.3		252.9		137.5	Dec 2005 = 100	2.859
Jun - 2020	356.5		253.0		137.6	Dec 2005 = 100	2.861
Sep - 2020	358.1		254.1		138.2	Dec 2005 = 100	2.874
Dec - 2020	360.4		255.8		139.1	Dec 2005 = 100	2.893
Mar - 2021	364.6		258.7		140.7	Dec 2005 = 100	2.926
Jun - 2021	367.4		260.8		141.8	Dec 2005 = 100	2.949
Sep - 2021	371.8		263.9		143.5	Dec 2005 = 100	2.984
Dec - 2021	377.0		267.6		145.5	Dec 2005 = 100	3.026
Mar - 2022	383.2		272.0		147.9	Dec 2005 = 100	3.076
Jun - 2022	388.4		275.7		149.9	Dec 2005 = 100	3.117
Sep - 2022	393.3		279.2		151.8	Dec 2005 = 100	3.157
Dec - 2022	395.9		281.0		152.8	Dec 2005 = 100	3.178

Employment Cost Index
Original Data Value

Series Id: CIU2010000000230I
Not seasonally adjusted
Series Title: Total compensation for Private industry workers in Midwest, Index
Ownership: Private industry workers
Component: Total compensation
Occupation: All workers
Industry: All workers
Subcategory: All workers
Area: Midwest census region

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Dec - 1985	112.9		89.400		
Jan - 1986	114.2	1.000	82.000	1.000	1.000
Feb - 1986	115.0	1.007	62.400	0.761	0.904
Mar - 1986	114.4	1.002	51.300	0.626	0.844
Apr - 1986	113.7	0.996	49.800	0.607	0.833
May - 1986	114.1	0.999	47.000	0.573	0.820
Jun - 1986	115.3	1.010	44.700	0.545	0.815
Jul - 1986	116.2	1.018	36.400	0.444	0.777
Aug - 1986	116.3	1.018	40.100	0.489	0.796
Sep - 1986	116.3	1.018	46.300	0.565	0.828
Oct - 1986	113.0	0.989	43.100	0.526	0.795
Nov - 1986	112.7	0.987	43.500	0.530	0.795
Dec - 1986	112.3	0.983	45.600	0.556	0.804
Jan - 1987	110.3	0.966	51.400	0.627	0.823
Feb - 1987	109.8	0.961	53.100	0.648	0.830
Mar - 1987	110.2	0.965	49.700	0.606	0.814
Apr - 1987	109.9	0.962	52.000	0.634	0.825
May - 1987	111.8	0.979	53.300	0.650	0.841
Jun - 1987	113.9	0.997	55.100	0.672	0.861
Jul - 1987	116.2	1.018	56.300	0.687	0.879
Aug - 1987	115.7	1.013	59.400	0.724	0.892
Sep - 1987	115.5	1.011	56.800	0.693	0.878
Oct - 1987	111.0	0.972	59.300	0.723	0.867
Nov - 1987	109.2	0.956	61.200	0.746	0.868
Dec - 1987	109.6	0.960	58.100	0.709	0.854
Jan - 1988	108.8	0.953	54.800	0.668	0.833
Feb - 1988	109.0	0.954	51.500	0.628	0.817
Mar - 1988	109.0	0.954	49.700	0.606	0.808
Apr - 1988	109.1	0.955	53.300	0.650	0.827
May - 1988	108.9	0.954	54.300	0.662	0.831
Jun - 1988	117.2	1.026	50.600	0.617	0.854
Jul - 1988	118.2	1.035	46.900	0.572	0.841
Aug - 1988	118.3	1.036	46.800	0.571	0.841
Sep - 1988	118.5	1.038	45.900	0.560	0.837
Oct - 1988	114.2	1.000	42.300	0.516	0.797
Nov - 1988	109.2	0.956	47.200	0.576	0.796
Dec - 1988	110.5	0.968	50.600	0.617	0.820
Jan - 1989	112.0	0.981	54.900	0.670	0.850
Feb - 1989	112.0	0.981	54.000	0.659	0.845
Mar - 1989	112.3	0.983	57.300	0.699	0.864
Apr - 1989	112.4	0.984	61.500	0.750	0.886
May - 1989	113.6	0.995	57.500	0.701	0.871
Jun - 1989	119.8	1.049	53.300	0.650	0.881
Jul - 1989	122.2	1.070	52.700	0.643	0.891

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Aug - 1989	122.4	1.072	53.500	0.652	0.896
Sep - 1989	122.5	1.073	59.300	0.723	0.926
Oct - 1989	117.2	1.026	64.000	0.780	0.923
Nov - 1989	113.5	0.994	64.400	0.785	0.906
Dec - 1989	114.2	1.000	68.100	0.830	0.929
Jan - 1990	114.9	1.006	85.300	1.040	1.020
Feb - 1990	115.0	1.007	59.400	0.724	0.888
Mar - 1990	115.4	1.011	60.400	0.737	0.895
Apr - 1990	115.1	1.008	61.000	0.744	0.897
May - 1990	117.0	1.025	58.400	0.712	0.893
Jun - 1990	123.9	1.085	53.000	0.646	0.901
Jul - 1990	124.4	1.089	51.600	0.629	0.896
Aug - 1990	124.6	1.091	72.300	0.882	1.003
Sep - 1990	125.0	1.095	87.300	1.065	1.082
Oct - 1990	121.2	1.061	104.800	1.278	1.152
Nov - 1990	120.2	1.053	98.900	1.206	1.117
Dec - 1990	118.9	1.041	89.300	1.089	1.061
Jan - 1991	124.2	1.088	82.900	1.011	1.055
Feb - 1991	124.3	1.088	74.300	0.906	1.012
Mar - 1991	124.3	1.088	61.600	0.751	0.947
Apr - 1991	124.7	1.092	60.000	0.732	0.941
May - 1991	128.2	1.123	59.600	0.727	0.956
Jun - 1991	132.6	1.161	57.600	0.702	0.968
Jul - 1991	134.5	1.178	58.100	0.709	0.981
Aug - 1991	133.8	1.172	62.100	0.757	0.998
Sep - 1991	133.8	1.172	65.400	0.798	1.015
Oct - 1991	128.3	1.123	67.600	0.824	0.998
Nov - 1991	123.1	1.078	71.000	0.866	0.989
Dec - 1991	125.1	1.095	62.200	0.759	0.954
Jan - 1992	125.9	1.102	54.400	0.663	0.918
Feb - 1992	125.3	1.097	57.300	0.699	0.930
Mar - 1992	125.8	1.102	56.000	0.683	0.926
Apr - 1992	124.8	1.093	59.000	0.720	0.936
May - 1992	128.5	1.125	62.100	0.757	0.971
Jun - 1992	134.8	1.180	65.400	0.798	1.020
Jul - 1992	135.6	1.187	64.600	0.788	1.020
Aug - 1992	135.1	1.183	63.300	0.772	1.010
Sep - 1992	135.9	1.190	65.600	0.800	1.026
Oct - 1992	131.2	1.149	68.200	0.832	1.016
Nov - 1992	125.5	1.099	64.200	0.783	0.966
Dec - 1992	126.7	1.109	59.400	0.724	0.948
Jan - 1993	127.1	1.113	59.000	0.720	0.948
Feb - 1993	126.4	1.107	60.400	0.737	0.951
Mar - 1993	126.7	1.109	63.200	0.771	0.967

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Apr - 1993	126.8	1.110	62.400	0.761	0.964
May - 1993	127.5	1.116	62.600	0.763	0.968
Jun - 1993	136.9	1.199	60.800	0.741	1.007
Jul - 1993	137.1	1.201	57.000	0.695	0.988
Aug - 1993	137.2	1.201	54.400	0.663	0.975
Sep - 1993	137.6	1.205	59.300	0.723	1.003
Oct - 1993	131.9	1.155	65.400	0.798	1.005
Nov - 1993	126.3	1.106	61.600	0.751	0.957
Dec - 1993	126.0	1.103	51.400	0.627	0.903
Jan - 1994	126.2	1.105	51.500	0.628	0.905
Feb - 1994	125.9	1.102	57.500	0.701	0.934
Mar - 1994	125.8	1.102	56.200	0.685	0.927
Apr - 1994	125.4	1.098	54.700	0.667	0.917
May - 1994	126.0	1.103	54.700	0.667	0.920
Jun - 1994	133.5	1.169	54.100	0.660	0.955
Jul - 1994	134.5	1.178	56.300	0.687	0.971
Aug - 1994	134.5	1.178	57.500	0.701	0.978
Sep - 1994	134.9	1.181	57.700	0.704	0.981
Oct - 1994	129.1	1.130	57.700	0.704	0.951
Nov - 1994	127.0	1.112	58.800	0.717	0.946
Dec - 1994	127.4	1.116	54.700	0.667	0.927
Jan - 1995	127.6	1.117	54.700	0.667	0.928
Feb - 1995	128.0	1.121	53.300	0.650	0.923
Mar - 1995	128.3	1.123	54.300	0.662	0.930
Apr - 1995	126.4	1.107	57.100	0.696	0.934
May - 1995	130.2	1.140	59.100	0.721	0.964
Jun - 1995	135.3	1.185	55.800	0.680	0.973
Jul - 1995	136.6	1.196	53.500	0.652	0.968
Aug - 1995	136.5	1.195	55.600	0.678	0.978
Sep - 1995	133.7	1.171	58.200	0.710	0.977
Oct - 1995	131.4	1.151	57.800	0.705	0.963
Nov - 1995	127.6	1.117	59.500	0.726	0.953
Dec - 1995	127.7	1.118	60.600	0.739	0.959
Jan - 1996	127.9	1.120	62.600	0.763	0.970
Feb - 1996	127.1	1.113	59.700	0.728	0.951
Mar - 1996	127.8	1.119	63.500	0.774	0.974
Apr - 1996	129.1	1.130	74.700	0.911	1.038
May - 1996	135.0	1.182	72.000	0.878	1.054
Jun - 1996	137.5	1.204	62.800	0.766	1.020
Jul - 1996	136.0	1.191	64.300	0.784	1.020
Aug - 1996	136.2	1.193	66.500	0.811	1.032
Sep - 1996	136.2	1.193	73.400	0.895	1.068
Oct - 1996	131.2	1.149	79.700	0.972	1.075
Nov - 1996	127.1	1.113	76.500	0.933	1.037

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Dec - 1996	127.7	1.118	76.100	0.928	1.038
Jan - 1997	128.3	1.123	73.700	0.899	1.029
Feb - 1997	128.1	1.122	72.300	0.882	1.021
Mar - 1997	128.2	1.123	65.200	0.795	0.985
Apr - 1997	127.3	1.115	65.300	0.796	0.981
May - 1997	129.7	1.136	64.200	0.783	0.988
Jun - 1997	135.1	1.183	60.800	0.741	0.998
Jul - 1997	135.9	1.190	57.800	0.705	0.986
Aug - 1997	134.7	1.180	61.500	0.750	0.999
Sep - 1997	136.0	1.191	60.400	0.737	1.000
Oct - 1997	130.1	1.139	64.800	0.790	0.993
Nov - 1997	127.9	1.120	65.800	0.802	0.987
Dec - 1997	128.3	1.123	59.400	0.724	0.956
Jan - 1998	127.4	1.116	54.100	0.660	0.924
Feb - 1998	127.2	1.114	52.000	0.634	0.912
Mar - 1998	126.7	1.109	48.300	0.589	0.891
Apr - 1998	126.4	1.107	50.200	0.612	0.899
May - 1998	129.2	1.131	50.000	0.610	0.912
Jun - 1998	133.8	1.172	46.300	0.565	0.917
Jul - 1998	134.8	1.180	45.000	0.549	0.915
Aug - 1998	135.2	1.184	44.000	0.537	0.912
Sep - 1998	135.2	1.184	48.300	0.589	0.934
Oct - 1998	130.4	1.142	47.400	0.578	0.905
Nov - 1998	127.6	1.117	46.200	0.563	0.885
Dec - 1998	126.6	1.109	38.800	0.473	0.842
Jan - 1999	126.1	1.104	40.900	0.499	0.850
Feb - 1999	125.5	1.099	38.200	0.466	0.833
Mar - 1999	125.5	1.099	42.800	0.522	0.857
Apr - 1999	125.2	1.096	52.500	0.640	0.905
May - 1999	127.4	1.116	52.600	0.641	0.916
Jun - 1999	131.6	1.152	52.400	0.639	0.937
Jul - 1999	133.9	1.173	58.700	0.716	0.981
Aug - 1999	133.9	1.173	63.000	0.768	1.003
Sep - 1999	134.1	1.174	67.600	0.824	1.027
Oct - 1999	129.5	1.134	65.500	0.799	0.993
Nov - 1999	127.5	1.116	71.300	0.870	1.013
Dec - 1999	126.5	1.108	72.900	0.889	1.016
Jan - 2000	126.8	1.110	75.300	0.918	1.030
Feb - 2000	126.7	1.109	87.900	1.072	1.094
Mar - 2000	126.7	1.109	89.700	1.094	1.103
Apr - 2000	126.8	1.110	83.100	1.013	1.070
May - 2000	128.6	1.126	82.900	1.011	1.078
Jun - 2000	133.6	1.170	86.200	1.051	1.120
Jul - 2000	136.2	1.193	88.700	1.082	1.146

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Aug - 2000	137.4	1.203	91.600	1.117	1.167
Sep - 2000	137.8	1.207	110.100	1.343	1.264
Oct - 2000	134.1	1.174	108.600	1.324	1.237
Nov - 2000	130.9	1.146	108.400	1.322	1.220
Dec - 2000	132.7	1.162	100.600	1.227	1.189
Jan - 2001	136.4	1.194	96.100	1.172	1.185
Feb - 2001	136.4	1.194	91.600	1.117	1.162
Mar - 2001	136.5	1.195	83.100	1.013	1.119
Apr - 2001	135.1	1.183	86.200	1.051	1.128
May - 2001	136.2	1.193	94.200	1.149	1.174
Jun - 2001	148.4	1.299	90.200	1.100	1.216
Jul - 2001	149.5	1.309	81.300	0.991	1.176
Aug - 2001	148.9	1.304	83.200	1.015	1.182
Sep - 2001	148.2	1.298	93.000	1.134	1.229
Oct - 2001	143.8	1.259	76.800	0.937	1.124
Nov - 2001	137.3	1.202	70.500	0.860	1.058
Dec - 2001	136.9	1.199	56.600	0.690	0.985
Jan - 2002	136.3	1.194	58.300	0.711	0.991
Feb - 2002	135.4	1.186	59.600	0.727	0.993
Mar - 2002	135.7	1.188	69.100	0.843	1.043
Apr - 2002	135.4	1.186	76.400	0.932	1.079
May - 2002	137.9	1.208	75.000	0.915	1.085
Jun - 2002	143.6	1.257	71.400	0.871	1.095
Jul - 2002	144.9	1.269	75.500	0.921	1.123
Aug - 2002	145.0	1.270	77.900	0.950	1.135
Sep - 2002	145.8	1.277	89.500	1.091	1.199
Oct - 2002	140.0	1.226	95.100	1.160	1.198
Nov - 2002	139.5	1.222	82.800	1.010	1.133
Dec - 2002	139.6	1.222	84.600	1.032	1.142
Jan - 2003	140.3	1.229	95.700	1.167	1.203
Feb - 2003	140.6	1.231	120.400	1.468	1.331
Mar - 2003	143.3	1.255	128.900	1.572	1.388
Apr - 2003	144.3	1.264	98.300	1.199	1.236
May - 2003	145.1	1.271	85.500	1.043	1.175
Jun - 2003	148.3	1.299	87.200	1.063	1.200
Jul - 2003	151.6	1.327	90.100	1.099	1.231
Aug - 2003	151.3	1.325	94.100	1.148	1.250
Sep - 2003	152.0	1.331	88.200	1.076	1.224
Oct - 2003	147.4	1.291	97.800	1.193	1.250
Nov - 2003	142.7	1.250	93.000	1.134	1.201
Dec - 2003	142.9	1.251	95.800	1.168	1.216
Jan - 2004	143.1	1.253	106.800	1.302	1.274
Feb - 2004	143.1	1.253	100.800	1.229	1.243
Mar - 2004	143.1	1.253	107.800	1.315	1.279

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Apr - 2004	143.1	1.253	115.200	1.405	1.317
May - 2004	144.2	1.263	116.000	1.415	1.327
Jun - 2004	152.4	1.335	111.500	1.360	1.345
Jul - 2004	152.2	1.333	119.300	1.455	1.384
Aug - 2004	154.0	1.349	131.100	1.599	1.454
Sep - 2004	154.0	1.349	136.800	1.668	1.483
Oct - 2004	145.8	1.277	161.700	1.972	1.569
Nov - 2004	144.9	1.269	153.600	1.873	1.523
Dec - 2004	146.2	1.280	133.800	1.632	1.428
Jan - 2005	148.9	1.304	138.500	1.689	1.466
Feb - 2005	148.0	1.296	146.000	1.780	1.499
Mar - 2005	148.1	1.297	169.400	2.066	1.620
Apr - 2005	148.7	1.302	170.900	2.084	1.631
May - 2005	151.1	1.323	165.300	2.016	1.614
Jun - 2005	159.7	1.398	180.600	2.202	1.736
Jul - 2005	162.1	1.419	186.200	2.271	1.777
Aug - 2005	162.5	1.423	194.500	2.372	1.822
Sep - 2005	162.8	1.426	209.900	2.560	1.902
Oct - 2005	159.5	1.397	252.000	3.073	2.101
Nov - 2005	161.1	1.411	199.100	2.428	1.838
Dec - 2005	161.4	1.413	193.600	2.361	1.811
Jan - 2006	167.0	1.462	191.800	2.339	1.831
Feb - 2006	168.6	1.476	190.000	2.317	1.829
Mar - 2006	167.4	1.466	199.200	2.429	1.870
Apr - 2006	169.6	1.485	221.900	2.706	1.998
May - 2006	170.8	1.496	231.400	2.822	2.053
Jun - 2006	181.2	1.587	238.100	2.904	2.140
Jul - 2006	181.9	1.593	231.600	2.824	2.110
Aug - 2006	180.2	1.578	241.400	2.944	2.152
Sep - 2006	181.0	1.585	203.100	2.477	1.960
Oct - 2006	171.2	1.499	198.100	2.416	1.884
Nov - 2006	167.2	1.464	198.200	2.417	1.864
Dec - 2006	167.8	1.469	200.400	2.444	1.879
Jan - 2007	171.9	1.505	180.000	2.195	1.795
Feb - 2007	175.7	1.539	191.500	2.335	1.873
Mar - 2007	172.1	1.507	215.100	2.623	1.976
Apr - 2007	173.1	1.516	231.800	2.827	2.066
May - 2007	179.2	1.569	225.300	2.748	2.064
Jun - 2007	186.7	1.635	222.400	2.712	2.087
Jul - 2007	187.0	1.637	237.800	2.900	2.168
Aug - 2007	187.6	1.643	225.500	2.750	2.108
Sep - 2007	188.4	1.650	238.900	2.913	2.180
Oct - 2007	182.7	1.600	243.300	2.967	2.174
Nov - 2007	180.3	1.579	288.200	3.515	2.392

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Dec - 2007	180.0	1.576	266.700	3.252	2.280
Jan - 2008	181.9	1.593	273.800	3.339	2.326
Feb - 2008	180.0	1.576	280.200	3.417	2.349
Mar - 2008	183.1	1.603	339.600	4.141	2.669
Apr - 2008	185.2	1.622	352.500	4.299	2.746
May - 2008	189.5	1.659	384.900	4.694	2.934
Jun - 2008	191.9	1.680	410.500	5.006	3.077
Jul - 2008	196.1	1.717	423.800	5.168	3.167
Aug - 2008	197.1	1.726	343.900	4.194	2.762
Sep - 2008	195.9	1.715	335.100	4.087	2.711
Oct - 2008	193.0	1.690	279.000	3.402	2.409
Nov - 2008	187.7	1.644	218.200	2.661	2.071
Dec - 2008	188.3	1.649	163.000	1.988	1.791
Jan - 2009	190.3	1.666	159.800	1.949	1.785
Feb - 2009	190.3	1.666	145.600	1.776	1.712
Mar - 2009	187.6	1.643	136.800	1.668	1.653
Apr - 2009	186.9	1.637	159.900	1.950	1.768
May - 2009	190.5	1.668	158.600	1.934	1.780
Jun - 2009	193.3	1.693	183.700	2.240	1.923
Jul - 2009	196.2	1.718	165.200	2.015	1.843
Aug - 2009	194.7	1.705	196.100	2.391	1.993
Sep - 2009	194.9	1.707	186.600	2.276	1.946
Oct - 2009	189.9	1.663	193.300	2.357	1.955
Nov - 2009	186.0	1.629	207.800	2.534	2.009
Dec - 2009	186.0	1.629	197.500	2.409	1.956
Jan - 2010	186.3	1.631	220.700	2.691	2.077
Feb - 2010	186.1	1.630	200.200	2.441	1.971
Mar - 2010	189.0	1.655	217.000	2.646	2.071
Apr - 2010	188.8	1.653	231.500	2.823	2.145
May - 2010	192.0	1.681	226.000	2.756	2.133
Jun - 2010	197.8	1.732	212.400	2.590	2.092
Jul - 2010	199.8	1.750	209.300	2.552	2.087
Aug - 2010	200.8	1.758	221.400	2.700	2.154
Sep - 2010	200.0	1.751	220.000	2.683	2.143
Oct - 2010	194.6	1.704	235.800	2.876	2.196
Nov - 2010	190.9	1.672	245.300	2.991	2.226
Dec - 2010	191.4	1.676	250.000	3.049	2.253
Jan - 2011	193.1	1.691	260.400	3.176	2.314
Feb - 2011	194.4	1.702	278.800	3.400	2.415
Mar - 2011	195.0	1.708	307.500	3.750	2.565
Apr - 2011	194.1	1.700	325.100	3.965	2.651
May - 2011	196.9	1.724	315.100	3.843	2.614
Jun - 2011	205.7	1.801	316.900	3.865	2.668
Jul - 2011	215.3	1.885	311.500	3.799	2.689

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Aug - 2011	216.6	1.897	296.900	3.621	2.621
Sep - 2011	215.8	1.890	306.500	3.738	2.666
Oct - 2011	206.6	1.809	299.600	3.654	2.584
Nov - 2011	204.0	1.786	322.700	3.935	2.689
Dec - 2011	204.4	1.790	301.000	3.671	2.580
Jan - 2012	201.1	1.761	308.800	3.766	2.603
Feb - 2012	200.3	1.754	316.500	3.860	2.638
Mar - 2012	199.8	1.750	330.800	4.034	2.709
Apr - 2012	198.1	1.735	327.100	3.989	2.682
May - 2012	201.5	1.764	315.600	3.849	2.640
Jun - 2012	207.7	1.819	284.600	3.471	2.513
Jul - 2012	221.5	1.940	287.900	3.511	2.600
Aug - 2012	222.1	1.945	313.400	3.822	2.733
Sep - 2012	222.8	1.951	330.400	4.029	2.824
Oct - 2012	214.1	1.875	334.100	4.074	2.799
Nov - 2012	212.3	1.859	311.600	3.800	2.674
Dec - 2012	213.8	1.872	303.300	3.699	2.639
Jan - 2013	199.2	1.744	303.600	3.702	2.567
Feb - 2013	199.4	1.746	327.700	3.996	2.691
Mar - 2013	199.0	1.743	308.700	3.765	2.592
Apr - 2013	198.8	1.741	303.900	3.706	2.566
May - 2013	203.5	1.782	296.400	3.615	2.552
Jun - 2013	211.9	1.856	294.900	3.596	2.587
Jul - 2013	211.4	1.851	300.400	3.663	2.612
Aug - 2013	210.4	1.842	307.400	3.749	2.643
Sep - 2013	210.3	1.842	315.300	3.845	2.683
Oct - 2013	201.2	1.762	306.800	3.741	2.593
Nov - 2013	199.0	1.743	295.300	3.601	2.523
Dec - 2013	200.5	1.756	302.900	3.694	2.570
Jan - 2014	215.1	1.884	297.500	3.628	2.616
Feb - 2014	214.4	1.877	309.100	3.770	2.672
Mar - 2014	214.8	1.881	306.500	3.738	2.661
Apr - 2014	210.8	1.846	306.700	3.740	2.642
May - 2014	215.2	1.884	304.400	3.712	2.652
Jun - 2014	224.0	1.961	296.500	3.616	2.656
Jul - 2014	227.5	1.992	295.300	3.601	2.668
Aug - 2014	227.7	1.994	293.900	3.584	2.662
Sep - 2014	225.1	1.971	291.000	3.549	2.634
Oct - 2014	217.0	1.900	271.400	3.310	2.492
Nov - 2014	210.7	1.845	260.900	3.182	2.406
Dec - 2014	213.9	1.873	218.900	2.670	2.208
Jan - 2015	222.4	1.947	173.600	2.117	2.019
Feb - 2015	221.1	1.936	184.300	2.248	2.067
Mar - 2015	218.2	1.911	185.700	2.265	2.059

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Apr - 2015	213.3	1.868	178.200	2.173	1.996
May - 2015	217.0	1.900	196.600	2.398	2.109
Jun - 2015	237.2	2.077	193.400	2.359	2.195
Jul - 2015	237.3	2.078	187.000	2.280	2.163
Aug - 2015	236.8	2.074	180.400	2.200	2.127
Sep - 2015	234.2	2.051	163.100	1.989	2.025
Oct - 2015	218.2	1.911	165.300	2.016	1.955
Nov - 2015	213.4	1.869	159.700	1.948	1.902
Dec - 2015	214.8	1.881	131.100	1.599	1.762
Jan - 2016	205.3	1.798	114.400	1.395	1.629
Feb - 2016	204.3	1.789	107.700	1.313	1.589
Mar - 2016	204.5	1.791	113.800	1.388	1.621
Apr - 2016	202.4	1.772	116.800	1.424	1.626
May - 2016	206.3	1.806	137.800	1.680	1.754
Jun - 2016	220.4	1.930	149.400	1.822	1.885
Jul - 2016	226.2	1.981	152.200	1.856	1.928
Aug - 2016	227.3	1.990	143.500	1.750	1.889
Sep - 2016	228.1	1.997	155.500	1.896	1.955
Oct - 2016	214.9	1.882	153.400	1.871	1.877
Nov - 2016	211.3	1.850	152.900	1.865	1.856
Dec - 2016	211.7	1.854	153.300	1.870	1.860
Jan - 2017	231.8	2.030	158.000	1.927	1.987
Feb - 2017	232.9	2.039	159.700	1.948	2.001
Mar - 2017	234.2	2.051	158.000	1.927	1.999
Apr - 2017	234.3	2.052	157.900	1.926	1.999
May - 2017	237.1	2.076	165.300	2.016	2.051
Jun - 2017	251.0	2.198	163.100	1.989	2.110
Jul - 2017	253.4	2.219	169.100	2.062	2.153
Aug - 2017	251.2	2.200	179.000	2.183	2.193
Sep - 2017	249.0	2.180	192.500	2.348	2.251
Oct - 2017	238.7	2.090	202.900	2.474	2.252
Nov - 2017	236.8	2.074	211.200	2.576	2.284
Dec - 2017	237.4	2.079	212.700	2.594	2.295
Jan - 2018	243.4	2.131	218.000	2.659	2.353
Feb - 2018	245.3	2.148	216.600	2.641	2.355
Mar - 2018	241.0	2.110	214.000	2.610	2.320
Apr - 2018	237.7	2.081	220.500	2.689	2.337
May - 2018	241.3	2.113	238.800	2.912	2.449
Jun - 2018	255.2	2.235	248.900	3.035	2.571
Jul - 2018	258.8	2.266	244.200	2.978	2.565
Aug - 2018	258.7	2.265	242.000	2.951	2.553
Sep - 2018	255.4	2.236	249.800	3.046	2.577
Oct - 2018	246.6	2.159	258.400	3.151	2.576
Nov - 2018	240.2	2.103	252.600	3.080	2.514

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Dec - 2018	241.0	2.110	221.500	2.701	2.359
Jan - 2019	244.9	2.144	191.600	2.337	2.225
Feb - 2019	244.0	2.137	207.800	2.534	2.304
Mar - 2019	241.6	2.116	227.300	2.772	2.391
Apr - 2019	238.7	2.090	226.200	2.759	2.371
May - 2019	241.1	2.111	224.400	2.737	2.374
Jun - 2019	250.7	2.195	197.000	2.402	2.282
Jul - 2019	253.3	2.218	209.400	2.554	2.359
Aug - 2019	257.1	2.251	198.500	2.421	2.322
Sep - 2019	254.4	2.228	208.000	2.537	2.357
Oct - 2019	231.4	2.026	210.600	2.568	2.254
Nov - 2019	230.2	2.016	212.700	2.594	2.259
Dec - 2019	232.5	2.036	219.500	2.677	2.305
Jan - 2020	232.9	2.039	205.400	2.505	2.235
Feb - 2020	234.3	2.052	184.000	2.244	2.132
Mar - 2020	233.2	2.042	160.400	1.956	2.006
Apr - 2020	233.0	2.040	116.100	1.416	1.778
May - 2020	232.8	2.039	101.800	1.241	1.704
Jun - 2020	250.4	2.193	130.100	1.587	1.938
Jul - 2020	253.5	2.220	168.600	2.056	2.151
Aug - 2020	253.6	2.221	178.200	2.173	2.201
Sep - 2020	256.2	2.243	165.700	2.021	2.150
Oct - 2020	236.5	2.071	174.200	2.124	2.093
Nov - 2020	233.3	2.043	187.000	2.280	2.143
Dec - 2020	232.8	2.039	209.400	2.554	2.255
Jan - 2021	234.7	2.055	217.600	2.654	2.307
Feb - 2021	235.3	2.060	247.000	3.012	2.460
Mar - 2021	253.2	2.217	282.500	3.445	2.733
Apr - 2021	237.1	2.076	263.400	3.212	2.553
May - 2021	239.2	2.095	296.700	3.618	2.735
Jun - 2021	259.8	2.275	296.800	3.620	2.840
Jul - 2021	264.727	2.318	305.392	3.724	2.909
Aug - 2021	266.382	2.333	300.698	3.667	2.893
Sep - 2021	263.224	2.305	311.738	3.802	2.934
Oct - 2021	255.289	2.235	349.598	4.263	3.087
Nov - 2021	253.517	2.220	343.086	4.184	3.045
Dec - 2021	251.385	2.201	323.329	3.943	2.933
Jan - 2022	263.262	2.305	342.535	4.177	3.092
Feb - 2022	269.233	2.358	389.425	4.749	3.362
Mar - 2022	264.930	2.320	472.872	5.767	3.768
Apr - 2022	262.970	2.303	497.370	6.065	3.883
May - 2022	267.786	2.345	551.997	6.732	4.187
Jun - 2022	284.453	2.491	622.389	7.590	4.633
Jul - 2022	297.134	2.602	531.451	6.481	4.231

MINIMUM DECOMMISSIONING COST - PER 10 CFR 50.75 FORMULA PROCESS

Energy Adjustment Factor (Ex) Derivation

Ex = Px (Px Coefficient) + Fx (Fx Coefficient)

0.58 = Px Coefficient (For PWR)
0.42 = Fx Coefficient (For PWR)

Preliminary

Index Date	Px WPU0543		Fx WPU0573		Ex
Aug - 2022	300.917	2.635	466.971	5.695	3.920
Sep - 2022	304.327	2.665	512.191	6.246	4.169
Oct - 2022	285.264	2.498	565.417	6.895	4.345
Nov - 2022	274.040	2.400	544.954	6.646	4.183
Dec - 2022	279.934	2.451	394.700	4.813	3.443

Producer Price Index-Commodities
Original Data Value
Px Values

Series Id: WPU0543
Not Seasonally Adjusted
Group: Fuels and related products and power
Item: Industrial electric power
Base Date: 198200

Producer Price Index-Commodities
Original Data Value
Fx Values

Series Id: WPU0573
Not Seasonally Adjusted
Group: Fuels and related products and power
Item: Light fuel oils
Base Date: 198200

MINIMUM DECOMMISSIONING COST
PER 10 CFR 50.75 FORMULA PROCESS

Waste Burial Adjustment Factor (Bx) Determination

	Bx	
1986	1.000	
1987	1.000	
1988	2.007	
1989	2.007	
1990	2.007	
1991	2.494	
1992	2.494	
1993	11.408	
1994	11.873	
1995	12.824	
1996	12.771	
1997	15.852	
1998	15.886	
1999	15.886	
2000	8.052	
2001	8.052	
2002	9.467	
2003	9.467	
2004	7.934	
2005	7.934	
2006	8.683	
2007	8.683	
2008	9.872	
2009	9.872	
2010	12.280	NUREG-1307 Rev 14; Published November 2010
		Bx Values for Generic LLW Disposal Site(e)
2011	12.280	Direct Disposal with Vendors(f)
		PWR
2012	12.280	
2013	13.885	NUREG-1307 Rev 15; Final Report; Published January 2013
		Bx Values for Generic LLW Disposal Site(e)
2014	13.885	Combination of Compact Affiliated and Non-Compact Facility(f,g)
		PWR
2015	13.885	

MINIMUM DECOMMISSIONING COST
PER 10 CFR 50.75 FORMULA PROCESS

Waste Burial Adjustment Factor (Bx) Determination

	Bx	
		NUREG-1307 Rev 16; Final Report; Published March 2017
		Bx Values for Generators Located in the Unaffiliated States and those Located in Compact-Affiliated States having no Disposal Facility[(c)]
2016	12.471	PWR
2017	12.471	
		NUREG-1307 Rev 17; Final Report; Published February 2019
		Bx Values for Generators Located in the Unaffiliated States and those Located in Compact-Affiliated States having no Disposal Facility[(c)]
2018	12.853	PWR
2019	12.853	
		NUREG-1307 Rev 18; Final Report; Published January 2021
		Bx Values for Generators Located in the Unaffiliated States and those Located in Compact-Affiliated States having no Disposal Facility[(c)]
2020	12.793	PWR
2021	12.793	
		NUREG-1307 Rev 19; Final Report; Published February 2023
		Bx Values for Generators Located in the Unaffiliated States and those Located in Compact-Affiliated States having no Disposal Facility[(c)]
2022	13.711	PWR

NUREG-1307, Rev. 19, Page 6, Paragraph 1 states:

> *Licensees not located in the Northwest, Rocky Mountain, Atlantic, or Texas Compacts should use the B_x values for "Generators Located in States Not Affiliated with a Compact having a Disposal Facility" (see footnote (c) in Table 2-1).*

Footnote (c) to Table 2.1, "Values of B_x as a Function of LLW Burial Site and Year[(a)]" states:

> *Effective with NUREG-1307, Revision 16, the CWF in Andrews County, Texas, is also available as a full-service (i.e., Class A, B, and C) LLW disposal facility for waste generators located in States not affiliated with the Texas Compact. Out-of-compact generators, however, must submit an import petition to the Texas Compact Commission for approval prior to shipping. The State of Texas also limits total non-compact waste disposed at the CWF to 30-percent of licensed capacity and imposes additional fees on LLW disposed of from out-of-compact generators. With the availability of this full-service disposal facility to out-of-compact waste generators and the Clive, Utah disposal facility for any Class A LLW generated in the U.S., the Generic LLW Disposal Site scenario used in previous versions of NUREG-1307 is replaced with this scenario, which provides B_x values representing a composite of the disposal rates for these two disposal facilities. These B_x factors are recommended for use for plants that currently have no disposal site available within their designated LLW Compact.*

Decommissioning Cost Analysis for the Callaway Energy Center - October 2020

Document A22-1782-001, Rev. 0

DECOMMISSIONING COST ANALYSIS

for the

CALLAWAY ENERGY CENTER

prepared for

Ameren Missouri

prepared by

TLG Services, LLC
Bridgewater, Connecticut

October 2020

APPROVALS

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No.	Date	Item Revised	Reason for Revision
0	10-29-2020		Original Issue

EXECUTIVE SUMMARY

This report presents estimates of the cost to decommission the Callaway Energy Center (Callaway) for the selected decommissioning alternatives and scenarios following the scheduled cessation of plant operations. The estimates are designed to provide Ameren Missouri with sufficient information to assess its financial obligations, as they pertain to the eventual decommissioning of the nuclear unit.

The analysis relies upon site-specific, technical information from an evaluation prepared in 2017,[1] updated to reflect current assumptions pertaining to the disposition of the nuclear unit and relevant industry experience in undertaking such projects. The costs are based on several key assumptions in areas of regulation, component characterization, high-level radioactive waste management, low-level radioactive waste disposal, performance uncertainties (contingency) and site restoration requirements.

The analysis is not a detailed engineering evaluation, but represents estimates prepared in advance of the detailed engineering required to carry out the decommissioning of the nuclear unit. It may also not reflect the actual plan to decommission Callaway; the plan may differ from the assumptions made in this analysis based on facts that exist at the time of decommissioning.

The 2017 plant inventory, the basis for the decontamination and dismantling requirements and cost, and the decommissioning waste streams, was reviewed for this analysis. There have been no substantive changes made to the plant inventory that would impact the estimated decommissioning costs.

The costs to decommission Callaway for the base scenarios (disposal with low-level radioactive waste reprocessing) are presented at the end of this section. Costs are reported in 2020 dollars and include monies anticipated to be spent for radiological remediation and operating license termination, spent fuel management, and site restoration activities.

A complete discussion of the assumptions relied upon in this analysis is provided in Section 3, along with schedules of annual expenditures for the base scenarios. A sequence of significant project activities is provided in Section 4 with a timeline for each scenario. Detailed cost reports used to generate the summary tables contained

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1 "Decommissioning Cost Analysis for the Callaway Energy Center," Document A22-1739-001, Rev. 0, TLG Services, Inc., August 2017

within this document are provided in the appendices along with the costs for the alternative scenario (direct low-level radioactive waste disposal).

Consistent with the 2017 analysis, the current cost estimates assume that the shutdown of the nuclear unit is a scheduled and pre-planned event (e.g., there is no delay in transitioning the plant and workforce from operations or in obtaining regulatory relief from operating requirements, etc.). The estimates include the continued operation of the fuel building as an interim wet fuel storage facility for approximately five and one-half years after operations cease. During this time period, it is assumed that the spent fuel residing in the pool will be transferred to a Department of Energy (DOE) federal facility (e.g., a monitored retrievable storage facility). All spent fuel stored on site in the independent spent fuel storage installation (ISFSI) will also be removed by the DOE during this time period.

Alternatives and Regulations

The ultimate objective of the decommissioning process is to reduce the inventory of contaminated and activated material so that the license can be terminated. The Nuclear Regulatory Commission (NRC or Commission) provided initial decommissioning requirements in its rule adopted on June 27, 1988.[2] In this rule, the NRC set forth financial criteria for decommissioning licensed nuclear power facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB.

> DECON is defined as "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations."[3]
>
> SAFSTOR is defined as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use."[4]

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2 U.S. Code of Federal Regulations, Title 10, Parts 30, 40, 50, 51, 70 and 72 "General Requirements for Decommissioning Nuclear Facilities," Nuclear Regulatory Commission, Federal Register Volume 53, Number 123 (p 24018 et seq.), June 27, 1988

3 Ibid. Page FR24022, Column 3

4 Ibid.

Decommissioning is to be completed within 60 years, although longer time periods will be considered when necessary to protect public health and safety.

ENTOMB is defined as "the alternative in which radioactive contaminants are encased in a structurally long-lived material, such as concrete; the entombed structure is appropriately maintained and continued surveillance is carried out until the radioactive material decays to a level permitting unrestricted release of the property."[5] As with the SAFSTOR alternative, decommissioning is currently required to be completed within 60 years, although longer time periods will also be considered when necessary to protect public health and safety.

The 60-year restriction has limited the practicality for the ENTOMB alternative at commercial reactors that generate significant amounts of long-lived radioactive material. In 1997, the Commission directed its staff to re-evaluate this alternative and identify the technical requirements and regulatory actions that would be necessary for entombment to become a viable option. The resulting evaluation provided several recommendations; however, rulemaking has been deferred pending the completion of additional research studies, for example, on engineered barriers. In a draft regulatory basis document published in March 2017 in support of rulemaking that would amend NRC regulations concerning nuclear plant decommissioning, the NRC staff proposes removing any discussion of the ENTOMB option from existing guidance documents since the method is not deemed practically feasible.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process.[6] The amendments allow for greater public participation and better define the transition process from operations to decommissioning. Regulatory Guide 1.184, issued in July 2000, (as revised in October 2013), further described the methods and procedures that are acceptable to the NRC staff for implementing the requirements of the 1996 revised rule that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and sequence in the

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5 Ibid. Page FR24023, Column 2

6 U.S. Code of Federal Regulations, Title 10, Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," Nuclear Regulatory Commission, Federal Register Volume 61, (p 39278 et seq.), July 29, 1996

amended regulations. The format and content of the estimates is also consistent with the recommendations of Regulatory Guide 1.202, issued in February 2005.[7]

In 2011, the NRC issued regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy site.[8] The regulations require licensees to report additional details in their decommissioning cost estimate, including a decommissioning estimate for any on-site ISFSI. Since an ISFSI is required to support continued operation at Callaway, a representative decommissioning cost is included within the DECON and SAFSTOR estimates, and reported separately in Appendix G.

Decommissioning Scenarios

Two decommissioning alternatives were evaluated for the Callaway Energy Center. The scenarios selected are representative of alternatives currently available to the owner and are defined as follows:

1. The first scenario assumes that the nuclear unit is promptly decommissioned (DECON alternative) upon the expiration of the current operating license in 2044. Following the permanent cessation of operations, and over the first five and one-half years, the spent fuel is transferred directly from the wet storage pool to the DOE (the fuel stored on the ISFSI is also removed from the site during this time period). Concurrently, the majority of the plant components, including the nuclear steam supply system components, are removed. Once the spent fuel stored in the fuel building's pool has been transferred off-site, the remaining portions of the power block are decommissioned and the surrounding site is remediated. Following the termination of the operating license, non-essential structures (not designated for reuse) are dismantled.

2. In the second scenario, the nuclear unit is placed into safe-storage (SAFSTOR alternative) upon the expiration of the current operating license in 2044. As with the first scenario, the spent fuel is removed from the site (transferred to the DOE) during the first five and one-half years following the permanent cessation of operations. The facility is then placed into safe-storage (with non-essential systems de-energized and buildings secured).

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

8 U.S. Code of Federal Regulations, Title 10, Parts 20, 30, 40, 50, 70, and 72, "Decommissioning Planning," Nuclear Regulatory Commission, Federal Register Volume 76, (p 35512 et seq.), June 17, 2011

The start of decontamination and dismantling activities is deferred to the maximum extent (approximately 50 years from the cessation of operations) such that the license is terminated within the required 60-year period post cessation of operations.

In addition to the two decommissioning alternatives, two low-level radioactive waste disposal options were assessed for each decommissioning alternative: one assuming the use of radioactive waste processing; the other assuming all radioactive waste is directly disposed of by burial. Off-site processing of a portion of the radioactive waste stream is presented as the base option. This option considers the off-site processing of the plant equipment and commodities with low levels of radiological contamination and/or material suspected to be contaminated for volume reduction, decontamination, or segmentation and removal of clean portions prior to disposal as radioactive waste.

The direct disposal option assumes that all contaminated and suspect material is packaged at the site for disposal at a regulated disposal facility. The scenarios are summarized as follows.

Alternative	Low-Level Radioactive Waste Options	Cost Summaries and/or Detailed Estimates
DECON	Recycling	Sections 3, 6, Appendix C
	Direct Disposal	Appendix E
SAFSTOR	Recycling	Sections 3, 6, Appendix D
	Direct Disposal	Appendix F

Methodology

The methodology used to develop the estimates described within this document follows the basic approach originally presented in the cost estimating guidelines[9] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference describes a unit factor method for determining decommissioning activity costs. The unit factors used in this analysis incorporate site-specific costs and the latest available information on worker productivity in decommissioning.

An activity duration critical path is used to determine the total decommissioning program schedule. The schedule is relied upon in calculating the carrying costs, which include program management, administration, field engineering, equipment rental, and support services, such as quality control and security.

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

The estimates also reflect lessons learned from TLG's involvement in the Shippingport Station Decommissioning Project, completed in 1989, as well as the decommissioning of the Cintichem reactor, hot cells and associated facilities, completed in 1997. In addition, the planning and engineering for the Rancho Seco, Trojan, Yankee Rowe, Big Rock Point, Maine Yankee, Humboldt Bay-3, Oyster Creek, Connecticut Yankee, Crystal River, Vermont Yankee, Fort Calhoun and Pilgrim nuclear units have provided additional insight into the process, the regulatory aspects, and the technical challenges of decommissioning commercial nuclear units.

Contingency

Consistent with cost estimating practice, contingencies are applied to the decontamination and dismantling costs developed as "specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur."[10] The cost elements in the estimates are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

Contingency funds are expected to be fully expended throughout the program. As such, inclusion of contingency is necessary to provide assurance that sufficient funding will be available to accomplish the intended tasks.

Low-Level Radioactive Waste Disposal

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[11] and its Amendments of 1985,[12] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

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10 Project and Cost Engineers' Handbook, Second Edition, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, p. 239

11 "Low-Level Radioactive Waste Policy Act of 1980," Public Law 96-573, 1980

12 "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, 1986

With the exception of Texas, no new compact facilities have been successfully sited, licensed, and constructed. The Texas Compact disposal facility is now operational and waste is being accepted from generators within the Compact by the operator, Waste Control Specialists (WCS). The facility, located in Andrews, Texas, is also able to accept limited volumes of non-Compact waste.

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently available to Ameren Missouri. The majority of the low-level radioactive waste designated for controlled disposal (Class A[13]) can be sent to Energy*Solutions*' facility in Clive, Utah. Therefore, disposal costs for Class A waste were based upon Ameren Missouri's Utilities Service Alliance agreement with Energy*Solutions*. This facility is not licensed to receive the higher activity portion (Classes B and C) of the decommissioning waste stream.

The WCS facility is able to receive the Class B and C waste. As such, for this analysis, Class B and C waste was assumed to be shipped to the WCS facility for disposal. Disposal costs were based upon Ameren Missouri's current agreement with WCS.

The dismantling of the components residing closest to the reactor core generates radioactive waste that may be considered unsuitable for shallow-land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned the federal government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste. However, to date, the federal government has not identified a cost for disposing of GTCC or a schedule for acceptance.

For purposes of this analysis only, 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. The GTCC is packaged in the same canisters used for spent fuel and shipped directly to a DOE facility as it is generated.

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This material can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring direct disposal in a licensed low-level radioactive waste disposal facility can be accomplished through a variety of methods, including analyses

13 Waste is classified in accordance with U.S. Code of Federal Regulations, Title 10, Part 61.55

and surveys or decontamination to eliminate the portion of waste that does not require disposal as radioactive waste, compaction, incineration or metal melt. The estimates for the base case scenarios reflect the savings from waste recovery/volume reduction.

High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"[14] (NWPA) in 1982, assigning the federal government's long-standing responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. The DOE was to begin accepting spent fuel by January 31, 1998; however, to date no progress in the removal of spent fuel from commercial generating sites has been made.

Today, the country is at an impasse on high-level waste disposal, despite DOE's submittal of its License Application for a geologic repository to the NRC in 2008. The Obama administration eliminated the budget for the repository program while promising to "conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle ... and make recommendations for a new plan."[15] Towards this goal, the Obama administration appointed a Blue Ribbon Commission on America's Nuclear Future (Blue Ribbon Commission) to make recommendations for a new plan for nuclear waste disposal. The Blue Ribbon Commission's charter included a requirement that it consider "[o]ptions for safe storage of used nuclear fuel while final disposition pathways are selected and deployed."[16]

On January 26, 2012, the Blue Ribbon Commission issued its "Report to the Secretary of Energy" containing a number of recommendations on nuclear waste disposal. Two of the recommendations that may impact decommissioning planning are:

- "[T]he United States [should] establish a program that leads to the timely development of one or more consolidated storage facilities"[17]
- "[T]he United States should undertake an integrated nuclear waste management program that leads to the timely development of one or more

14 "Nuclear Waste Policy Act of 1982 and Amendments," DOE's Office of Civilian Radioactive Management, 1982

15 "Advisory Committee Charter, Blue Ribbon Commission on America's Nuclear Future," Appendix A, January 2012

16 Ibid.

17 "Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy," p. 32, January 2012

permanent deep geological facilities for the safe disposal of spent fuel and high-level nuclear waste."[18]

In January 2013, the DOE issued the "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," in response to the recommendations made by the Blue Ribbon Commission and as "a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel..."[19] This document states:

"With the appropriate authorizations from Congress, the Administration currently plans to implement a program over the next 10 years that:

- Sites, designs and licenses, constructs and begins operations of a pilot interim storage facility by 2021 with an initial focus on accepting used nuclear fuel from shut-down reactor sites;
- Advances toward the siting and licensing of a larger interim storage facility to be available by 2025 that will have sufficient capacity to provide flexibility in the waste management system and allows for acceptance of enough used nuclear fuel to reduce expected government liabilities; and
- Makes demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository by 2048."[20]

The NRC's review of DOE's license application to construct a geologic repository at Yucca Mountain was suspended in 2011 when the Obama administration significantly reduced the budget for completing that work. However, the US Court of Appeals for the District of Columbia Circuit issued a writ of mandamus (in August 2013)[21] ordering NRC to comply with federal law and resume its review of DOE's Yucca Mountain repository license application, to the extent allowed by previously appropriated funding for the review. That review is now complete with the publication of the five-volume safety evaluation report. A supplement to DOE's environmental impact statement and adjudicatory hearing on the contentions filed by interested parties must be completed before a licensing decision can be made.

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18 Ibid., p.27

19 "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," U.S. DOE, January 11, 2013

20 Ibid., p.2

21 U.S. Court of Appeals for the District Of Columbia Circuit, In Re: Aiken County, et al, Aug. 2013

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. In June 2011, Ameren Missouri and the DOE reached an agreement on a settlement. The terms include payment to Ameren Missouri for spent fuel storage and related costs through 2010, and thereafter, annual payment of such costs after they are incurred.

It is generally necessary that spent fuel be cooled and stored for a minimum period at the generating site prior to transfer. As such, the NRC requires that licensees establish a program to manage and provide funding for the management of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE, pursuant to 10 CFR Part 50.54(bb).[22] The post-shutdown costs incurred to satisfy this requirement include the isolation and continued operation of the spent fuel pool and the ISFSI during the five and one-half years following the cessation of plant operations.

At shutdown, the spent fuel pool is expected to contain freshly discharged assemblies (from the most recent refueling cycles) as well as the final reactor core. Over the following five and one-half years all the assemblies are packaged into multipurpose canisters for transfer to the DOE. It is assumed that this period provides the necessary cooling for the final core to meet the transportation system requirements for decay heat.

Costs are included within the decommissioning estimates for offloading the pool. These costs include the loading of DOE-provided multi-purpose canisters (MPCs) and the associated campaign costs to load the canisters into the DOE-provided transport vehicle.

Removal of the fuel from the ISFSI is expected to be fully reimbursable and therefore not addressed in this study. However, the eventual decommissioning of the ISFSI is included.

The estimates described in this analysis were developed with the assumption that the DOE would give priority to removing spent fuel from shutdown sites. The estimates further assume that the spent fuel would be removed from the Callaway site within five and one-half years of the cessation of plant operations (i.e., five and one-half years would provide sufficient cooling time for the spent fuel to meet DOE transportation requirements).

Site Restoration

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22 U.S. Code of Federal Regulations, Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," Subpart 54 (bb), "Conditions of Licenses"

The efficient removal of the contaminated materials at the site may result in damage to many of the site structures. Blasting, coring, drilling, and the other decontamination activities can substantially damage power block structures, potentially weakening the footings and structural supports. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized is more efficient and less costly than if the process is deferred.

Consequently, this study assumes that non-essential site structures addressed by this analysis are removed, once remediation is complete, to a nominal depth of three feet below the local grade level, wherever possible. The site is then graded and stabilized.

Summary

The costs to decommission Callaway assume the removal of all contaminated and activated plant components and structural materials such that the owner may then have unrestricted use of the site with no further requirements for an operating license. Low-level radioactive waste, other than GTCC waste, is sent to a commercial processor for treatment/conditioning or directly to a controlled disposal facility.

Decommissioning is accomplished within the 60-year period following permanent cessation of operations required by current NRC regulations. Regardless of the timing of the decommissioning activities, the estimates assume the eventual removal of all the contaminated and activated plant components and structural materials, such that the facility operator may then have unrestricted use of the site with no further requirement for an operating license.

The decommissioning scenarios are described in Section 2. The assumptions are presented in Section 3, along with schedules of annual expenditures for the base case scenario. The major cost contributors are identified in Section 6, with detailed activity costs, waste volumes, and associated manpower requirements delineated in the appendices to this report. The major cost components are also identified in the cost summary provided at the end of this section.

The cost elements in the estimates are assigned to one of three subcategories: NRC License Termination, Spent Fuel Management, and Site Restoration. The subcategory "NRC License Termination" is used to accumulate costs that are consistent with "decommissioning" as defined by the NRC in its financial assurance regulations (i.e., 10 CFR Part 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.

The "Spent Fuel Management" subcategory contains costs associated with the transfer of the spent fuel to the DOE, as well as the operation of the spent fuel pool until such time that the transfer is complete.

"Site Restoration" 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 grade.

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 three subcategories. For example, an owner 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 an NRC License Termination 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.

As noted within this document, the estimates were developed and costs are presented in 2020 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 reactor or during the decommissioning period.

For the purposes of this analysis, the costs presented in the following tables reflect the use of off-site low-level radioactive waste processing to minimize the volume designated for controlled disposal. Costs for the direct disposal of the low-level radioactive waste (without reprocessing) are presented in the appendices (E and F).

DECON COST SUMMARY
DECOMMISSIONING COST ELEMENTS [1]
(thousands of 2020 dollars)

Cost Element	Cost
Decontamination	21,730
Removal	189,813
Packaging	33,686
Transportation	17,644
Waste Disposal	121,093
Off-site Waste Processing [1]	35,935
Program Management [2]	366,980
Security	100,705
Corporate Allocations	9,270
Spent Fuel Pool Isolation	14,576
Spent Fuel Management [3]	69,200
Insurance and Regulatory Fees	16,621
Energy	11,623
Characterization and Licensing Surveys	29,298
Property Taxes	998
Miscellaneous Equipment	7,663
Total [4]	1,046,835

Cost Element	Cost
License Termination (excluding ISFSI)	855,393
ISFSI Decommissioning (License Termination)	9,152
Spent Fuel Management [3]	69,200
Site Restoration (excluding ISFSI)	111,667
ISFSI Demolition (Site Restoration)	1,423
Total [4]	1,046,835

[1] Assumes low-level radioactive waste processing for volume reduction
[2] Includes engineering costs
[3] Direct costs only. Excludes program management costs (staffing) but includes costs for spent fuel loading/spent fuel pool O&M and Emergency Planning fees
[4] Columns may not add due to rounding

SAFSTOR COST SUMMARY
DECOMMISSIONING COST ELEMENTS [1]
(thousands of 2020 dollars)

Cost Element	Cost
Decontamination	19,823
Removal	190,638
Packaging	28,554
Transportation	14,753
Waste Disposal	91,874
Off-site Waste Processing [1]	39,671
Program Management [2]	469,264
Security	264,218
Corporate Allocations	14,291
Spent Fuel Pool Isolation	14,576
Spent Fuel Management [3]	69,206
Insurance and Regulatory Fees	51,752
Energy	23,588
Characterization and Licensing Surveys	29,639
Property Taxes	7,287
Miscellaneous Equipment	23,293
Total [4]	1,352,428

Cost Element	Cost
License Termination (excluding ISFSI)	1,148,866
ISFSI Decommissioning (License Termination)	9,152
Spent Fuel Management [5]	82,400
Site Restoration (excluding ISFSI)	110,587
ISFSI Demolition (Site Restoration)	1,423
Total [4]	1,352,428

[1] Assumes low-level radioactive waste processing for volume reduction
[2] Includes engineering costs
[3] Direct costs only. Excludes program management costs (staffing) but includes costs for spent fuel loading/spent fuel pool O&M and Emergency Planning fees
[4] Columns may not add due to rounding
[5] Includes percentage of Period 2a (dormancy) plant operating costs until spent fuel pool is emptied, in addition to the direct costs.

1. INTRODUCTION

This report presents estimates of the costs to decommission the Callaway Energy Center (Callaway) for the selected decommissioning alternatives and scenarios following the scheduled cessation of plant operfations. The estimates are designed to provide Ameren Missouri with sufficient information to assess its financial obligations, as they pertain to the eventual decommissioning of the nuclear unit.

The analysis relies upon site-specific, technical information from an earlier evaluation prepared in 2017,[1]* updated to reflect current assumptions pertaining to the disposition of the nuclear station and relevant industry experience in undertaking such projects. The costs are based on several key assumptions in areas of regulation, component characterization, high-level radioactive waste management, low-level radioactive waste disposal, performance uncertainties (contingency) and site restoration requirements.

The analysis is not a detailed engineering evaluation, but rather estimates prepared in advance of the detailed engineering required to carry out the decommissioning of the nuclear unit. It may also not reflect the actual plan to decommission Callaway; the plan may differ from the assumptions made in this analysis based on facts that exist at the time of decommissioning.

The 2017 plant inventory, the basis for the decontamination and dismantling requirements and cost, and the decommissioning waste streams, were reviewed for this analysis. There were no substantive changes made to the plant inventory (that would impact decommissioning).

1.1 OBJECTIVES OF STUDY

The objectives of this study were to prepare comprehensive estimates of the costs to decommission Callaway, to provide a sequence or schedule for the associated activities, and to develop waste stream projections from the decontamination and dismantling activities.

An operating license was issued for Callaway in 1984 for a 40 year operating period. On December 19, 2011, Ameren Missouri submitted a request for renewal of the operating license for an additional period of 20 years. On March 6, 2015, the Nuclear Regulatory Commission (NRC) renewed the operating license through October 18, 2044.

* References provided in Section 7 of the document

For the purpose of this analysis, the base estimates reflect plant decommissioning at the expiration of its current operating license (2044) and the use of off-site low-level radioactive waste processing to minimize the volume designated for controlled disposal.

1.2 SITE DESCRIPTION

The nuclear unit is located in Callaway County, Missouri, approximately 80 miles west of the St. Louis metropolitan area. The nearest population center is Jefferson City, 25 miles west-southwest of the plant site. The station is an 1,171 MWe (net design electrical rating) pressurized water reactor with supporting facilities.

Westinghouse Electric Company designed the nuclear steam supply system (NSSS). The NSSS consists of a pressurized water reactor with four independent primary coolant loops, each of which contains a reactor coolant pump and a steam generator. An electrically heated pressurizer and connecting piping complete the system. The NSSS is rated at a thermal power level of 3,579 MWt (3,565 MWt reactor core plus 14 MWt for reactor coolant pumps), with a corresponding turbine-generator gross output of 1,284 MWe. The system is housed within a containment structure, a pre-stressed, post-tensioned concrete structure with cylindrical wall, a hemispherical dome, and a flat foundation slab. The wall and dome form a pre-stressed post-tensioned system. The inside surface of the structure is covered with a carbon steel liner, providing a leak tight membrane.

A power conversion system converts heat produced in the reactor to electrical energy. This system converts the thermal energy of the steam into mechanical shaft power and then into electrical energy. The turbine-generator is a tandem-compound, six-flow, four element, 1800-rpm unit. The unit consists of one high pressure and three low-pressure turbine elements driving a directly coupled generator. The turbine is operated in a closed feedwater cycle that condenses the steam; the feedwater is returned to the steam generators. Heat rejected in the main condensers is removed by the circulating water system.

The circulating water system supplies cooling water to the main condenser, condensing the steam exhausted from the turbine. Cooling for the condenser circulating water system is supplied by a large natural draft cooling tower. Makeup water for the cooling tower is drawn from the Missouri River.

1.3 REGULATORY GUIDANCE

The Nuclear Regulatory Commission (NRC or Commission) provided initial decommissioning requirements in its rule "General Requirements for Decommissioning Nuclear Facilities," issued in June 1988.[2] This rule set forth financial criteria for decommissioning licensed nuclear power facilities. The regulation addressed decommissioning planning needs, timing, funding methods, and environmental review requirements. The intent of the rule was to ensure that decommissioning would be accomplished in a safe and timely manner and that adequate funds would be available for this purpose. Subsequent to the rule, the NRC issued Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors,"[3] which provided additional guidance to the licensees of nuclear facilities on the financial methods acceptable to the NRC staff for complying with the requirements of the rule. The regulatory guide addressed the funding requirements and provided guidance on the content and form of the financial assurance mechanisms indicated in the rule.

The rule defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB. The DECON alternative assumes that any contaminated or activated portion of the plant's systems, structures and facilities are removed or decontaminated to levels that permit the site to be released for unrestricted use shortly after the cessation of plant operations. The rule also placed limits on the time allowed to complete the decommissioning process. For SAFSTOR, the process is restricted in overall duration to 60 years, unless it can be shown that a longer duration is necessary to protect public health and safety. The guidelines for ENTOMB are similar, providing the NRC with both sufficient leverage and flexibility to ensure that these deferred options are only used in situations where it is reasonable and consistent with the definition of decommissioning. At the conclusion of a 60-year dormancy period (or longer for ENTOMB if the NRC approves such a case), the site would still require significant remediation to meet the unrestricted release limits for license termination.

The ENTOMB alternative has not been viewed as a viable option for power reactors due to the significant time required to isolate the long-lived radionuclides for decay to permissible levels. However, with rulemaking permitting the controlled release of a site,[4] the NRC has re-evaluated this alternative. The resulting feasibility study, based upon an assessment by Pacific Northwest National Laboratory, concluded that the method did have conditional merit for some, if not most reactors. However, the staff also found that additional rulemaking would be needed before this option could be treated as a generic alternative. The NRC had considered rulemaking to alter the 60-

year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments.[5]

The NRC's staff has recommended that rulemaking be deferred, based upon several factors, e.g., no licensee has committed to pursuing the entombment option, and the NRC's current priorities, at least until after the additional research studies are complete. The NRC concurred with the staff's recommendation. In a draft regulatory basis document published in March 2017 in support of rulemaking that would amend NRC regulations concerning nuclear plant decommissioning, the NRC staff proposes removing any discussion of the ENTOMB option from existing guidance documents since the method is not deemed practically feasible.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants.[6] When the decommissioning regulations were adopted in 1988, it was assumed that the majority of licensees would decommission at the end of the facility's operating licensed life. Since that time, several licensees permanently and prematurely ceased operations. Exemptions from certain operating requirements were required once the reactor was defueled to facilitate the decommissioning. Each case was handled individually, without clearly defined generic requirements. The NRC amended the decommissioning regulations in 1996 to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The amendments allow for greater public participation and better define the transition process from operations to decommissioning.

Under the revised regulations, licensees will submit written certification to the NRC within 30 days after the decision to cease operations. Certification will also be required once the fuel is permanently removed from the reactor vessel. Submittal of these notices will entitle the licensee to a fee reduction and eliminate the obligation to follow certain requirements needed only during operation of the reactor. Within two years of submitting notice of permanent cessation of operations, the licensee is required to submit a Post-Shutdown Decommissioning Activities Report (PSDAR) to the NRC. The PSDAR describes the planned decommissioning activities, the associated sequence and schedule, and an estimate of expected costs. Prior to completing decommissioning, the licensee is required to submit an application to the NRC to terminate the license, which will include a license termination plan (LTP).

In 2011, the NRC issued regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy site.[7] The regulations require licensees to report additional details in

their decommissioning cost estimate including a decommissioning estimate for the ISFSI. This estimate is provided in Appendix G.

1.3.1 High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"[8] (NWPA) in 1982, assigning the federal government's long-standing responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the U.S. Department of Energy (DOE). The DOE was to begin accepting spent fuel by January 31, 1998; however, to date no progress in the removal of spent fuel from commercial generating sites has been made.

Today, the country is at an impasse on high-level waste disposal, even with the License Application for a geologic repository submitted by the DOE to the NRC in 2008. The Obama administration has cut the budget for the repository program while promising to "conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle ... and make recommendations for a new plan." Towards this goal, the Obama administration appointed a Blue Ribbon Commission on America's Nuclear Future (Blue Ribbon Commission) to make recommendations for a new plan for nuclear waste disposal. The Blue Ribbon Commission's charter includes a requirement that it consider "[o]ptions for safe storage of used nuclear fuel while final disposition pathways are selected and deployed."[9]

On January 26, 2012, the Blue Ribbon Commission issued its "Report to the Secretary of Energy" containing a number of recommendations on nuclear waste disposal. Two of the recommendations that may impact decommissioning planning are:

- "[T]he United States [should] establish a program that leads to the timely development of one or more consolidated storage facilities"
- "[T]he United States should undertake an integrated nuclear waste management program that leads to the timely development of one or more permanent deep geological facilities for the safe disposal of spent fuel and high-level nuclear waste."[10]

In January 2013, the DOE issued the "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," in response to the recommendations made by the Blue Ribbon Commission

and as "a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel..."[11]

"With the appropriate authorizations from Congress, the Administration currently plans to implement a program over the next 10 years that:

- Sites, designs and licenses, constructs and begins operations of a pilot interim storage facility by 2021 with an initial focus on accepting used nuclear fuel from shut-down reactor sites;
- Advances toward the siting and licensing of a larger interim storage facility to be available by 2025 that will have sufficient capacity to provide flexibility in the waste management system and allows for acceptance of enough used nuclear fuel to reduce expected government liabilities; and
- Makes demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository by 2048."

The NRC's review of DOE's license application to construct a geologic repository at Yucca Mountain was suspended in 2011 when the Obama administration significantly reduced the budget for completing that work. However, the US Court of Appeals for the District of Columbia Circuit issued a writ of mandamus (in August 2013)[12] ordering NRC to comply with federal law and resume its review of DOE's Yucca Mountain repository license application, to the extent allowed by previously appropriated funding for the review. That review is now complete with the publication of the five-volume safety evaluation report. A supplement to DOE's environmental impact statement and adjudicatory hearing on the contentions filed by interested parties must be completed before a licensing decision can be made. Although the DOE proposed it would start fuel acceptance in 2025, no progress has been made in the repository program since DOE's 2013 strategy was issued except for the completion of the Yucca Mountain safety evaluation report.

Holtec International submitted a license application to the NRC on March 30, 2017 for a consolidated interim spent fuel storage facility in southeast New Mexico called HI-STORE CIS (Consolidated Interim Storage) under the provisions of 10 CFR Part 72. The application is currently under NRC review.

Waste Control Specialists (WCS) submitted an application to the NRC on April 28, 2016, to construct and operate a Consolidated Interim Storage Facility (CISF) at its West Texas facility. On April 18, 2017, WCS requested that the NRC temporarily suspend all safety and environmental review activities, as well as public participation activities associated with WCS's license application. In March 2018, WCS and Orano USA, announced their intent to form a joint venture to license the facility. The joint venture has stated that they will request that the NRC resume its review of the original CISF license application.

On May 14, 2019, a bill was introduced in the U.S. House of Representatives, H.R. 2699, the "Nuclear Waste Policy Amendments Act of 2019." Proposed to amend the Nuclear Waste Policy Act of 1982, the legislation, if approved by the House and Senate and signed by the President, would provide the DOE the authority to site, construct, and operate one or more Monitored Retrieval Storage (MRS) facilities while a permanent repository is licensed and constructed and/or to enter into an MRS agreement with a non-Federal entity for temporary storage.

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. In June 2011, Ameren Missouri and the DOE reached an agreement on a settlement. The terms include payment to Ameren Missouri for spent fuel storage and related costs through 2010, and thereafter, annual payment of such costs after they are incurred.

It is generally necessary that spent fuel be cooled and stored for a minimum period at the generating site prior to transfer. As such, the NRC requires that licensees establish a program to manage and provide funding for the management of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE, pursuant to 10 CFR Part 50.54(bb).[13] The post-shutdown costs incurred to satisfy this requirement include the isolation and continued operation of the spent fuel pool and the ISFSI during the five and one-half years following the cessation of plant operations.

At shutdown, the spent fuel pool is expected to contain freshly discharged assemblies (from the most recent refueling cycles) as well as the final reactor core. During the next five and one-half years the assemblies are packaged into multipurpose canisters for transfer to the DOE. It is assumed that this period provides the necessary cooling for the final core to meet the transportation system requirements for decay heat.

Costs are included within the decommissioning estimates for offloading the pool. These costs include the loading of DOE-provided Transportation, Aging, and Disposal (TAD) canisters and the associated campaign costs to load the canisters into the DOE-provided transport vehicle.

Removal of the fuel from the ISFSI is expected to be fully reimbursable and therefore not addressed in this study. However, the eventual decommissioning of the ISFSI is included.

The estimates described in this analysis were developed with the assumption that the DOE would give priority to removing spent fuel from shutdown sites. The estimates further assume that the spent fuel would be removed from the Callaway site within five and one-half years of the cessation of plant operations (i.e., five and one-half years would provide sufficient cooling time for the spent fuel to meet DOE transportation requirements).

1.3.2 Low-Level Radioactive Waste Disposal

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[14] and its Amendments of 1985,[15] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

With the exception of Texas, no new compact facilities have been successfully sited, licensed, and constructed. The Texas Compact disposal facility is now operational and waste is being accepted from generators within the Compact by the operator, WCS. The facility is also able to accept limited quantities of non-Compact waste.

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently available to Ameren Missouri. The majority of the low-level radioactive waste designated for controlled disposal (Class A[16]) can be sent to Energy*Solutions*' facility in Clive, Utah. Therefore, disposal costs for Class A waste were based upon Ameren Missouri's Utilities Service Alliance agreement with Energy*Solutions*. This facility is not licensed to receive the higher activity portion (Classes B and C) of the decommissioning waste stream.

The WCS facility is able to receive the Class B and C waste. As such, for this analysis, Class B and C waste was assumed to be shipped to the WCS facility for disposal. Disposal costs were based upon Ameren Missouri's current agreement with WCS.

The dismantling of the components residing closest to the reactor core generates radioactive waste that may be considered unsuitable for shallow-land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned the federal government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste.

The DOE issued its final Environmental Impact Statement for the disposal of GTCC on January 2016.[17] The study evaluated the potential environmental impacts associated with constructing and operating a new facility or using an existing facility, disposal methods, and locations. DOE is awaiting Congressional action on the report and its recommendations. At this time, the federal government has not identified a specific cost for disposing of GTCC or a schedule for acceptance.

For purposes of this analysis only, 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. The GTCC is packaged in the same canisters used for spent fuel and shipped directly to a DOE facility as it is generated.

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This material can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring disposal in a licensed low-level radioactive waste disposal facility can be accomplished through a variety of methods, including analyses and surveys or decontamination to eliminate the portion of waste that does not require disposal as radioactive waste, compaction, incineration or metal melt. The estimates for the base case scenarios reflect the savings from waste recovery/volume reduction.

1.3.3 Radiological Criteria for License Termination

In 1997, the NRC published Subpart E, "Radiological Criteria for License Termination,"[18] amending 10 CFR Part 20. This subpart provides radiological criteria for releasing a facility for unrestricted use. The regulation states that the site can be released for unrestricted use if radioactivity levels are such that the average member of a critical group would not receive a Total Effective Dose Equivalent (TEDE) in excess of 25 millirem per year, and provided that residual radioactivity has been reduced to levels that are As Low As Reasonably Achievable (ALARA). The decommissioning estimates assume that the Callaway site will be remediated to a residual level consistent with the NRC-prescribed level.

It should be noted that the NRC and the Environmental Protection Agency (EPA) differ on the amount of residual radioactivity considered acceptable in site remediation. The EPA has two limits that apply to radioactive materials. An EPA limit of 15 millirem per year is derived from criteria established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund).[19] An additional and separate limit of 4 millirem per year, as defined in 40 CFR §141.16, is applied to drinking water.[20]

On October 9, 2002, the NRC signed an agreement with the EPA on the radiological decommissioning and decontamination of NRC-licensed sites. The Memorandum of Understanding (MOU)[21] provides that EPA will defer exercise of authority under CERCLA for the majority of facilities decommissioned under NRC authority. The MOU also includes provisions for NRC and EPA consultation for certain sites when, at the time of license termination, (1) groundwater contamination exceeds EPA-permitted levels; (2) NRC contemplates restricted release of the site; and/or (3) residual radioactive soil concentrations exceed levels defined in the MOU.

The MOU does not impose any new requirements on NRC licensees and should reduce the involvement of the EPA with NRC licensees who are decommissioning. Most sites are expected to meet the NRC criteria for unrestricted use, and the NRC believes that only a few sites will have groundwater or soil contamination in excess of the levels specified in the MOU that trigger consultation with the EPA. However, if there are other hazardous materials on the site, the EPA may be involved in the cleanup. As such, the possibility of dual regulation remains for certain licensees. The present study does not include any costs for this occurrence.

2. DECOMMISSIONING ALTERNATIVES

Two decommissioning alternatives, DECON and SAFSTOR, were evaluated for the Callaway Energy Center. Although the alternatives differ with respect to technique, process, cost, and schedule, they attain the same result: the ultimate release of the site for unrestricted use. The scenarios selected are representative of alternatives currently available to the owner and are defined as follows:

1. The first scenario assumes that the nuclear unit is promptly decommissioned (DECON alternative) upon the expiration of the current operating license in 2044. Following the permanent cessation of operations, and over the first five and one-half years, the spent fuel is transferred directly from the wet storage pool to the DOE (the fuel stored on the ISFSI is also removed from the site during this time period). Concurrently, the majority of the plant components, including the nuclear steam supply system components, are removed. Once the spent fuel stored in the fuel building's pool has been transferred off-site, the remaining portions of the power block are decommissioned and the surrounding site remediated. Following the termination of the operating license, all remaining site structures are dismantled.

2. In the second scenario, the nuclear unit is placed into safe-storage (SAFSTOR alternative) upon the expiration of the current operating license in 2044. As with the first scenario, the spent fuel is removed from the site (transferred to the DOE) during the first five and one-half years following the permanent cessation of operations. The facility is then placed into safe-storage (with non-essential systems de-energized and buildings secured). The start of decontamination and dismantling activities is deferred to the maximum extent (approximately 50 years from the cessation of operations) such that the license is terminated within the required 60-year period following permanent cessation of operations.

The following sections describe the basic activities associated with each alternative. Although detailed procedures for each activity identified are not provided, and the actual sequence of work may vary, the activity descriptions provide a basis not only for estimating but also for the expected scope of work, i.e., engineering and planning at the time of decommissioning.

In addition to the two decommissioning alternatives, two disposal options were assessed: recycling and direct disposal. Recycling is presented as the base option and considers the off-site processing of plant equipment and commodities with low levels of radiological contamination and/or material suspected to be contaminated for volume

reduction prior to disposal. The direct disposal option assumes that all contaminated and suspect material is packaged at the site for disposal at a regulated disposal facility. The scenarios are summarized as follows.

Alternative	Low-Level Radioactive Waste Options	Cost Summaries and/or Detailed Estimates
DECON	Recycling	Sections 3, 6, Appendix C
	Direct Disposal	Appendix E
SAFSTOR	Recycling	Sections 3, 6, Appendix D
	Direct Disposal	Appendix F

The conceptual approach that the NRC has described in its regulations divides decommissioning into three phases. The initial phase commences with the effective date of permanent cessation of operations and involves the transition of both plant and licensee from reactor operations (i.e., power production) to facility de-activation and closure. During the first phase, notification is to be provided to the NRC certifying the permanent cessation of operations and the removal of fuel from the reactor vessel. The licensee is then prohibited from reactor operation.

The second phase encompasses activities during the storage period or during major decommissioning activities, or a combination of the two. The third phase pertains to the activities involved in license termination. The decommissioning estimates developed for Callaway 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.

2.1 DECON

The DECON alternative, as defined by the NRC, is "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations." This study does not address the cost to dispose of the spent fuel residing at the site; such costs are funded through a surcharge on electrical generation. The study also assumes that the costs incurred with the removal of the spent fuel from the ISFSI are fully reimbursable, and are also not included.

2.1.1 Period 1 - Preparations

In anticipation of the cessation of plant operations, detailed preparations are undertaken to provide a smooth transition from plant operations to site decommissioning. Through implementation of a

staffing transition plan, the organization required to manage the intended decommissioning activities is assembled from available plant staff and outside resources. Preparations include the planning for permanent defueling of the reactor, revision of technical specifications applicable to the operating conditions and requirements, a characterization of the facility and major components, and the development of the PSDAR.

Engineering and Planning

The PSDAR, required prior to or within two years of permanent cessation of operations, provides a description of the licensee's planned decommissioning activities, a timetable, and the associated financial requirements of the intended decommissioning program. Upon receipt of the PSDAR, the NRC will make the document available to the public for comment in a local hearing to be held in the vicinity of the reactor site. Ninety days following submittal and NRC receipt of the PSDAR, the licensee may begin to perform major decommissioning activities under a modified 10 CFR §50.59 procedure, i.e., without specific NRC approval. Major activities are defined as any activity that results in permanent removal of major radioactive components, permanently modifies the structure of the containment, or results in dismantling components (for shipment) containing GTCC, as defined by 10 CFR §61. Major components are further defined as comprising the reactor vessel and internals, large bore reactor coolant system piping, and other large components that are radioactive. The NRC includes the following additional criteria for use of the §50.59 process in decommissioning. The proposed activity must not:

- foreclose release of the site for possible unrestricted use,
- significantly increase decommissioning costs,
- cause any significant environmental impact, or
- violate the terms of the licensee's existing license.

Existing operational technical specifications are reviewed and modified to reflect plant conditions and the safety concerns associated with permanent cessation of operations. The environmental impact associated with the planned decommissioning activities is also considered. Typically, a licensee will not be allowed to proceed if the consequences of a particular decommissioning activity are greater than that bounded by previously evaluated environmental assessments or impact statements.

In this instance, the licensee would have to submit a license amendment for the specific activity and update the environmental report.

The decommissioning program outlined in the PSDAR will be designed to accomplish the required tasks within the ALARA guidelines (as defined in 10 CFR §20) for protection of personnel from exposure to radiation hazards. It will also address the continued protection of the health and safety of the public and the environment during the dismantling activity. Consequently, with the development of the PSDAR, activity specifications, cost-benefit and safety analyses, work packages and procedures, would be assembled to support the proposed decontamination and dismantling activities.

Site Preparations

Following final plant shutdown, and in preparation for actual decommissioning activities, the following activities are initiated:

- Characterization of the site and surrounding environs. This includes radiation surveys of work areas, major components (including the reactor vessel and its internals), internal piping, and primary shield cores.
- Isolation of the spent fuel storage pool and fuel handling systems, such that decommissioning operations can commence on the balance of the plant. The pool will remain operational for approximately five and one-half years following the cessation of operations before the inventory resident at shutdown can be transferred to the ISFSI.
- Specification of transport and disposal requirements for activated materials and/or hazardous materials, including shielding and waste stabilization.
- Development of procedures for occupational exposure control, control and release of liquid and gaseous effluent, processing of radwaste (including dry-active waste, resins, filter media, metallic and non-metallic components generated in decommissioning), site security and emergency programs, and industrial safety.

2.1.2 Period 2 - Decommissioning Operations

This period includes the physical decommissioning activities associated with the removal and disposal of contaminated and activated components and structures, including the successful termination of the

10 CFR §50 operating license. Significant decommissioning activities in this phase include:

- Construction of temporary facilities and/or modification of existing facilities to support dismantling activities. This may include a centralized processing area to facilitate equipment removal and component preparations for off-site disposal.
- Reconfiguration and modification of site structures and facilities as needed to support decommissioning operations. This may include the upgrading of roads (on- and off-site) to facilitate hauling and transport. Modifications may be required to the containment structure to facilitate access of large/heavy equipment. Modifications may also be required to the refueling area of the reactor building to support the segmentation of the reactor vessel internals and component extraction.
- Design and fabrication of temporary and permanent shielding to support removal and transportation activities, construction of contamination control envelopes, and the procurement of specialty tooling.
- Procurement (lease or purchase) of shipping canisters, cask liners, and industrial packages for the disposition of low-level radioactive waste.
- Decontamination of components and piping systems as required to control (minimize) worker exposure.
- Removal of piping and components no longer essential to support decommissioning operations.
- Removal of control rod drive housings and the head service structure from the reactor vessel head. Segmentation of the vessel closure head.
- Removal and segmentation of the upper internals assemblies. Segmentation will maximize the loading of the shielded transport casks, i.e., by weight and activity. The operations are conducted under water using remotely operated tooling and contamination controls.
- Disassembly and segmentation of the remaining reactor internals, including the core shroud and lower core support assembly. Some material is expected to exceed Class C disposal requirements. As such, the segments will be packaged in modified fuel storage canisters for geologic disposal.

- Segmentation of the reactor vessel. A shielded platform is installed for segmentation as cutting operations are performed in-air using remotely operated equipment within a contamination control envelope. The water level is maintained just below the cut to minimize the working area dose rates. Segments are transferred in-air to containers that are stored under water, for example, in an isolated area of the refueling canal.
- Removal of the activated portions of the concrete biological shield and accessible contaminated concrete surfaces. If dictated by the steam generator and pressurizer removal scenarios, those portions of the associated cubicles necessary for access and component extraction are removed.
- Removal of the steam generators and pressurizer for material recovery and controlled disposal. The steam generators will be moved to an on-site processing center, the steam domes removed and the internal components segregated for recycling. The lower shell and tube bundle will be packaged for direct disposal. These components can serve as their own burial containers provided that all penetrations are properly sealed and the internal contaminants are stabilized, e.g., with grout. Steel shielding will be added, as necessary, to those external areas of the package to meet transportation limits and regulations. The pressurizer is disposed of intact.

At least two years prior to the anticipated date of license termination, an LTP is required. Submitted as a supplement to the Final Safety Analysis Report (FSAR) or its equivalent, the plan must include: a site characterization, description of the remaining dismantling activities, plans for site remediation, procedures for the final radiation survey, designation of the end use of the site, an updated cost estimate to complete the decommissioning, and any associated environmental concerns. The NRC will notice the receipt of the plan, make the plan available for public comment, and schedule a local hearing. LTP approval will be subject to any conditions and limitations as deemed appropriate by the Commission. The licensee may then commence with the final remediation of site facilities and services, including:

- Removal of remaining plant systems and associated components as they become nonessential to the decommissioning program or worker health and safety (e.g., waste collection and treatment systems, electrical power and ventilation systems).

- Removal of the steel liners from refueling canal, disposing of the activated and contaminated sections as radioactive waste. Removal of any activated/ contaminated concrete.
- Surveys of the decontaminated areas of the containment structure.
- Remediation and removal of the contaminated equipment and material from the fuel building and any other contaminated facility. Radiation and contamination controls will be utilized until residual levels indicate that the structures and equipment can be released for unrestricted access and conventional demolition. This activity may necessitate the dismantling and disposition of most of the systems and components (both clean and contaminated) located within these buildings. This activity facilitates surface decontamination and subsequent verification surveys required prior to obtaining release for demolition.
- Routing of material removed in the decontamination and dismantling to a central processing area. Material certified to be free of contamination is released for unrestricted disposition, e.g., as scrap, recycle, or general disposal. Contaminated material is characterized and segregated for additional off-site processing (disassembly, chemical cleaning, volume reduction, and waste treatment), and/or packaged for controlled disposal at a low-level radioactive waste disposal facility.

Incorporated into the LTP is the Final Survey Plan. This plan identifies the radiological surveys to be performed once the decontamination activities are completed and is developed using the guidance provided in the "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)."[22] This document incorporates the statistical approaches to survey design and data interpretation used by the EPA. It also identifies state-of-the-art, commercially available instrumentation and procedures for conducting radiological surveys. Use of this guidance ensures that the surveys are conducted in a manner that provides a high degree of confidence that applicable NRC criteria are satisfied. Once the survey is complete, the results are provided to the NRC in a format that can be verified. The NRC then reviews and evaluates the information, performs an independent confirmation of radiological site conditions, and makes a determination on the requested change to the operating license (that would release the property for unrestricted use).

The NRC will amend the operating licenses if it determines that site remediation has been performed in accordance with the LTP, and that

the terminal radiation survey and associated documentation demonstrate that the property is suitable for release.

2.1.3 Period 3 - Site Restoration

Following completion of decommissioning operations, site restoration activities will begin. Efficient removal of the contaminated materials and verification that residual radionuclide concentrations are below the NRC limits will result in substantial damage to many of the structures. Although performed in a controlled, safe manner, blasting, coring, drilling, scarification (surface removal), and the other decontamination activities will substantially degrade power block structures including the reactor, auxiliary, fuel, and radwaste buildings. Under certain circumstances, verifying that subsurface radionuclide concentrations meet NRC site release requirements will require removal of grade slabs and lower floors, potentially weakening footings and structural supports. This removal activity will be necessary for those facilities and plant areas where historical records, when available, indicate the potential for radionuclides having been present in the soil, where system failures have been recorded, or where it is required to confirm that subsurface process and drain lines were not breached over the operating life of the station.

It is not currently anticipated that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures, once remediation is complete, with a work force already mobilized on site is more efficient than if the process is deferred.

This cost study presumes that non-essential structures and site facilities are dismantled as a continuation of the decommissioning activity. Foundations and exterior walls are removed to a nominal depth of three feet below grade. The three-foot depth allows for the placement of gravel for drainage, as well as topsoil, so that vegetation can be established for erosion control. Site areas affected by the dismantling activities are restored and the plant area graded as required to prevent ponding and inhibit the refloating of subsurface materials.

Non-contaminated concrete rubble produced by demolition activities is processed to remove reinforcing steel and miscellaneous embedments. The processed material is then used on site to backfill foundation voids. Excess non-contaminated materials are trucked to an off-site area for disposal as construction debris.

2.2 SAFSTOR

The NRC defines SAFSTOR as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use." The facility is left intact (during the dormancy period), with structures maintained in a sound condition. Systems that are not required to support the spent fuel pool or site surveillance and security are drained, de-energized, and secured. Minimal cleaning/removal of loose contamination and/or fixation and sealing of remaining contamination is performed. Access to contaminated areas is secured to provide controlled access for inspection and maintenance.

The engineering and planning requirements are similar to those for the DECON alternative, although a shorter time period is expected for these activities due to the more limited work scope. Site preparations are also similar to those for the DECON alternative. However, with the exception of the required radiation surveys and site characterizations, the mobilization and preparation of site facilities is less extensive.

2.2.1 Period 1 - Preparations

Preparations for long-term storage include the planning for permanent defueling of the reactor, revision of technical specifications appropriate to the operating conditions and requirements, a characterization of the facility and major components, and the development of the PSDAR.

The process of placing the plant in safe-storage includes, but is not limited to, the following activities:

- Isolation of the spent fuel storage services and fuel handling systems so that safe-storage operations may commence on the balance of the plant. This activity may be carried out by plant personnel in accordance with existing operating technical specifications. Activities are scheduled around the fuel handling systems to the greatest extent possible.
- Transfer of all spent fuel from the storage pool and the ISFSI to the DOE by the end of the minimum required cooling period.
- Draining and de-energizing of the non-contaminated systems not required to support continued site operations or maintenance.

- Disposing of contaminated filter elements and resin beds not required for processing wastes from layup activities for future operations.
- Draining of the reactor vessel, with the internals left in place and the vessel head secured.
- Draining and de-energizing non-essential, contaminated systems with decontamination as required for future maintenance and inspection.
- Preparing lighting and alarm systems whose continued use is required; de-energizing portions of fire protection, electric power, and HVAC systems whose continued use is not required.
- Cleaning of the loose surface contamination from building access pathways.
- Performing an interim radiation survey of plant, posting warning signs where appropriate.
- Erecting physical barriers and/or securing all access to radioactive or contaminated areas, except as required for inspection and maintenance.
- Installing security and surveillance monitoring equipment and relocating security fence around secured structures, as required.

2.2.2 Period 2 - Dormancy

The second phase identified by the NRC in its rule addresses licensed activities during a storage period and is applicable to the dormancy phases of the deferred decommissioning alternative. Dormancy activities include a 24-hour security force, preventive and corrective maintenance on security systems, 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 perform equipment maintenance, inspection activities, routine services to maintain safe conditions, adequate lighting, heating, and ventilation, and periodic preventive maintenance on essential site services.

An environmental surveillance program is carried out during the dormancy period to ensure that releases of radioactive material to the environment are prevented and/or detected and controlled. Appropriate emergency procedures are established and initiated for potential

releases that exceed prescribed limits. The environmental surveillance program constitutes an abbreviated version of the program in effect during normal plant operations.

Security during the dormancy period is conducted primarily to prevent unauthorized entry and to protect the public from the consequences of its own actions. The security fence, sensors, alarms, and other surveillance equipment provide security. Fire and radiation alarms are also monitored and maintained.

Consistent with the DECON scenario, the spent fuel storage pool is emptied within five and one-half years of the cessation of operations. The pool is secured for storage and decommissioned along with the power block structures in Period 4.

After a period of storage (such that license termination is accomplished within 60 years of final shutdown), it is required that the licensee submit an application to terminate the license, along with an LTP (described in Section 2.1.2), thereby initiating the third phase.

2.2.3 Periods 3 and 4 - Delayed Decommissioning

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 activities and the writing of activity specifications and detailed procedures are also initiated at this time.

Much of the work in developing a termination plan is relevant to the development of the detailed engineering plans and procedures. The activities associated with this phase and the follow-on decontamination and dismantling processes are detailed in Sections 2.1.1 and 2.1.2. The primary difference between the sequences anticipated for the DECON and this deferred scenario is the absence, in the latter, of any constraint on the availability of the fuel storage facilities for decommissioning.

Variations in the length of the dormancy period are expected to have little effect upon the quantities of radioactive wastes generated from system and structure removal operations. Given the levels of radioactivity and spectrum of radionuclides expected from sixty years of plant operation, no plant process system identified as being

contaminated upon final shutdown will become releasable due to the decay period alone, i.e., there is no significant reduction in the waste generated from the decommissioning activities. However, due to the lower activity levels, a greater percentage of the waste volume can be designated for off-site processing and recovery.

The delay in decommissioning also yields lower working area radiation levels. As such, the estimate for this delayed scenario incorporates reduced ALARA controls for the SAFSTOR's lower occupational exposure potential.

Although the initial radiation levels due to ^{60}Co will decrease during the dormancy period, the internal components of the reactor vessel will still exhibit sufficiently high radiation dose rates to require remote sectioning under water due to the presence of long-lived radionuclides such as ^{94}Nb, ^{59}Ni, and ^{63}Ni. Therefore, the dismantling procedures described for the DECON alternative would still be employed during this scenario. Portions of the biological shield will still be radioactive due to the presence of activated trace elements with long half-lives (^{152}Eu and ^{154}Eu). Decontamination will require controlled removal and disposal. It is assumed that radioactive corrosion products on inner surfaces of piping and components will not have decayed to levels that will permit unrestricted use or allow conventional removal. These systems and components will be surveyed as they are removed and disposed of in accordance with the existing radioactive release criteria.

2.2.4 Period 5 - Site Restoration

Following completion of decommissioning operations, site-restoration activities can begin. Dismantling, as a continuation of the decommissioning process, is clearly the most appropriate and cost-effective option, as described in Section 2.1.3. The basis for the dismantling cost in this scenario is consistent with that described for DECON, presuming the removal of structures and site facilities to a nominal depth of three feet below grade and the limited restoration of the site.

3. COST ESTIMATE

The cost estimates prepared for decommissioning Callaway consider the unique features of the site, including the NSSS, power generation systems, support services, site buildings, and ancillary facilities. The basis of the estimates, including the sources of information relied upon, the estimating methodology employed, site-specific considerations, and other pertinent assumptions, is described in this section.

3.1 BASIS OF ESTIMATE

The current estimates were developed using the site-specific, technical information relied upon in the decommissioning analysis prepared in 2017. This information was reviewed for the current analysis and updated as deemed appropriate. The site-specific considerations and assumptions used in the previous evaluation were also revisited. Modifications were incorporated where new information was available or experience from ongoing decommissioning programs provided viable alternatives or improved processes.

3.2 METHODOLOGY

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,"[23] and the DOE "Decommissioning Handbook."[24] These documents present a unit factor method for estimating decommissioning activity costs, which simplifies the estimating calculations. Unit factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/inch) are developed using local labor rates. The activity-dependent costs are estimated with the item quantities (cubic yards and tons), developed from plant drawings and inventory documents. Removal rates and material costs for the conventional disposition of components and structures rely upon information available in the industry publication, "Building Construction Cost Data," published by RSMeans.[25]

The unit factor method provides a demonstrable basis for establishing reliable cost estimates. The detail provided in the unit factors, including activity duration, labor costs (by craft), and equipment and consumable costs, ensures that essential elements have not been omitted. Appendix A presents the detailed development of a typical unit factor. Appendix B provides the values contained within one set of factors developed for this analysis.

Regulatory Guide 1.184 [26] Revision 1, issued in October 2013, describes the methods and procedures that are acceptable to the NRC staff for implementing the requirements that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and sequence in the regulations. The format and content of the estimates is also consistent with the recommendations of Regulatory Guide 1.202,[27] issued February 2005.

This analysis reflects lessons learned from TLG's involvement in the Shippingport Station Decommissioning Project, completed in 1989, as well as the decommissioning of the Cintichem reactor, hot cells and associated facilities, completed in 1997. In addition, the planning and engineering for the Rancho Seco, Trojan, Yankee Rowe, Big Rock Point, Maine Yankee, Humboldt Bay-3, Oyster Creek, Connecticut Yankee, Crystal River, Vermont Yankee, Fort Calhoun and Pilgrim nuclear units have provided additional insight into the process, the regulatory aspects, and the technical challenges of decommissioning commercial nuclear units.

Work Difficulty Factors

TLG has historically applied work difficulty adjustment factors (WDFs) to account for the inefficiencies in working in a power plant environment. WDFs are assigned to each unique set of unit factors, commensurate with the inefficiencies associated with working in confined, hazardous environments. The ranges used for the WDFs are as follows:

- Access Factor 10% to 20%
- Respiratory Protection Factor 10% to 50%
- Radiation/ALARA Factor 10% to 37%
- Protective Clothing Factor 10% to 30%
- Work Break Factor 8.33%

The factors and their associated range of values were developed in conjunction with the AIF/NESP-036 study. The application of the factors is discussed in more detail in that publication.

Scheduling Program Durations

The unit factors, adjusted by the WDFs as described above, are applied against the inventory of materials to be removed in the radiological controlled areas. The resulting man-hours, or crew-hours, are used in the development of the

decommissioning program schedule, using resource loading and event sequencing considerations. The scheduling of conventional removal and dismantling activities is based upon productivity information available from the "Building Construction Cost Data" publication.

An activity duration critical path is used to determine the total decommissioning program schedule. The schedule is relied upon in calculating the carrying costs, which include program management, administration, field engineering, equipment rental, and support services such as quality control and security. This systematic approach for assembling decommissioning estimates ensures a high degree of confidence in the reliability of the resulting costs.

3.3 FINANCIAL COMPONENTS OF THE COST MODEL

TLG's proprietary decommissioning cost model, DECCER, produces a number of distinct cost elements. These direct expenditures, however, do not comprise the total cost to accomplish the project goal, i.e., license termination and site restoration.

Inherent in any cost estimate that does not rely on historical data is the inability to specify the precise source of costs imposed by factors such as tool breakage, accidents, illnesses, weather delays, and labor stoppages. In the DECCER cost model, contingency fulfills this role. Contingency is added to each line item to account for costs that are difficult or impossible to develop analytically. Such costs are historically inevitable over the duration of a job of this magnitude; therefore, this cost analysis includes funds to cover these types of expenses.

3.3.1 Contingency

The activity- and period-dependent costs are combined to develop the total decommissioning cost. A contingency is then applied on a line-item basis, using one or more of the contingency types listed in the AIF/NESP-036 study. "Contingencies" are defined in the American Association of Cost Engineers "Project and Cost Engineers' Handbook"[28] as "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." The cost elements in this analysis are based upon ideal conditions and maximum efficiency; therefore, consistent with industry practice, contingency is included. In the AIF/NESP-036 study, the types of

unforeseeable events that are likely to occur in decommissioning are discussed and guidelines are provided for percentage contingency in each category. It should be noted that contingency, as used in this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

Contingency funds are an integral part of the total cost to complete the decommissioning process. Exclusion of this component puts at risk a successful completion of the intended tasks and, potentially, subsequent related activities. For this study, TLG examined the major activity-related problems (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 from TLG's actual decommissioning experience. The contingency values used in this study are as follows:

• Decontamination	50%
• Contaminated Component Removal	25%
• Contaminated Component Packaging	10%
• Contaminated Component Transport	15%
• Low-Level Radioactive Waste Disposal	25%
• Low-Level Radioactive Waste Processing	15%
• Reactor Segmentation	75%
• NSSS Component Removal	25%
• Reactor Waste Packaging	25%
• Reactor Waste Transport	25%
• Reactor Vessel Component Disposal	50%
• GTCC Disposal	15%
• Staffing	15%
• Spent Fuel Management	15%
• Non-Radioactive Component Removal	15%
• Heavy Equipment and Tooling	15%
• Supplies	25%
• Engineering	15%
• Energy	15%
• Insurance and Fees	10%
• Characterization and Termination Surveys	30%
• Operations and Maintenance Expense	15%

- Construction 15%
- Property Taxes 10%
- ISFSI Decommissioning 25%

The contingency values are applied to the appropriate components of the estimates on a line item basis. A composite value is then reported at the end of each detailed estimate (as provided in Appendix C, D, E and F). A contingency of 25% is applied to the subtotal of the ISFSI decommissioning costs, as shown in Appendix G Table G-2 for ISFSI 72.30 decommissioning and license termination activities..

3.3.2 Financial Risk

In addition to the routine uncertainties addressed by contingency, another cost element that is sometimes necessary to consider when bounding decommissioning costs relates to uncertainty, or risk. Examples can include changes in work scope, pricing, job performance, and other variations that could conceivably, but not necessarily, occur. Consideration is sometimes necessary to generate a level of confidence in the estimate, within a range of probabilities. TLG considers these types of costs under the broad term "financial risk." Included within the category of financial risk are:

- Transition activities and costs: ancillary expenses associated with eliminating 50% to 80% of the site labor force shortly after the cessation of plant operations, added cost for worker separation packages throughout the decommissioning program, national or company-mandated retraining, and retention incentives for key personnel.
- Delays in approval of the decommissioning plan due to intervention, public participation in local community meetings, legal challenges, and national and local hearings.
- Changes in the project work scope from the baseline estimate, involving the discovery of unexpected levels of contaminants, contamination in places not previously expected, contaminated soil previously undiscovered (either radioactive or hazardous material contamination), variations in plant inventory or configuration not indicated by the as-built drawings.
- Regulatory changes, for example, affecting worker health and safety, site release criteria, waste transportation, and disposal.

- Policy decisions altering national commitments (e.g., in the ability to accommodate certain waste forms for disposition), or in the timetable for such, for example, the start and rate of acceptance of spent fuel by the DOE.
- Pricing changes for basic inputs such as labor, energy, materials, and disposal. Items subject to widespread price competition (such as materials) may not show significant variation; however, others such as waste disposal could exhibit large pricing uncertainties, particularly in markets where limited access to services is available.

However this cost study does not add any additional costs to the estimate 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 estimates.

3.4 SITE-SPECIFIC CONSIDERATIONS

There are a number of site-specific considerations that affect the method for dismantling and removal of equipment from the site and the degree of restoration required. The cost impact of the considerations identified below is included in this cost study.

3.4.1 Spent Fuel Management

The cost to dispose the spent fuel generated from plant operations is not reflected within the estimates to decommission Callaway. Ultimate disposition of the spent fuel is within the province of the DOE's Waste Management System, as defined by the Nuclear Waste Policy Act. As such, until recently, the disposal cost was being financed by a 1 mill/kWhr surcharge on nuclear generated energy delivered to customers, the fee being paid into the DOE's waste fund during operations. The D.C. Circuit ruling on November 19, 2013, ordered the DOE to submit a proposal to Congress to suspend the Nuclear Waste Fund fee "until such time as either the Secretary chooses to comply with the Act as it is currently written, or until Congress enacts an alternative waste management plan." The fee was reduced to 0.0 mill/kWh as of May 16, 2014. The fee is expected to be reinstated in the future.

Nonetheless, the NRC does requires licensees to establish a program to manage and provide funding for the management of all irradiated fuel at the reactor until title of the fuel is transferred to the Secretary of Energy. This funding requirement is fulfilled through inclusion of

certain high-level waste cost elements within the estimates, as described below.

For estimating purposes, Ameren Missouri has assumed that all spent fuel will be transferred to the DOE within five and one-half years after shutdown. This will allow Ameren Missouri to proceed with decommissioning (or safe-storage) operations in the shortest time possible. A delay in the start of fuel pickup, or a decrease in the spent fuel acceptance rate, will correspondingly prolong the transfer process and result in the fuel remaining at the Callaway site longer.

It is assumed that the five and one-half years provides the necessary cooling period for the final core to meet DOE's transport system requirements for decay heat. Once the pool is emptied, the spent fuel storage and handling facilities are available for decommissioning. Operation and maintenance costs for the spent fuel pool are included within the estimate as well as the costs to transfer the spent fuel from the pool to the DOE.

Storage Canister Design

A vertical underground dry storage system is used as a cost basis. The system consists of Holtec HI-STORM UMAX technology transportable Multi-Purpose Canisters (MPCs) stored within an underground metal and concrete structure, collectively known as Vertical Ventilated Modules (VVMs). A canister capacity of 37 pressurized water reactor fuel assemblies was assumed.

Canister Loading and Transfer

The estimates include the cost for the labor and equipment to load and transfer the spent fuel assemblies projected to reside in the pool at the cessation of plant operations. Any capital cost associated with the dry storage system is not included in the estimates.

Operations and Maintenance

The estimates include the cost of operating and maintaining the spent fuel pool for approximately five and one half years after the cessation of operations.

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 needs to contain sufficient information on the proposed practices and procedures for the decontamination of the ISFSI and for the disposal of residual radioactive materials after the spent fuel has been removed.

For purposes of this study only, the decommissioning cost for the ISFSI was included in the DECON and SAFSTOR estimates. The decommissioning estimate is based on the conservative premise that a small percentage of the (VVMs) would contain very low levels of neutron-induced residual radioactivity that would necessitate remediation at the time of decommissioning. As an allowance, 6 of the 48 VVMs are assumed to be affected, i.e., contain residual radioactivity. The allowance quantity is based upon the number of MPCs required for the final core off-load (i.e., 193 offloaded assemblies, 37 assemblies per MPC) which results in a total of 6 VVMs that contain residual radioactivity.

No contamination or activation of the balance of the ISFSI structures are assumed. It would be expected that this assumption would be confirmed as a result of good radiological practice of surveying potentially impacted areas after each spent fuel transfer campaign. As such, only verification surveys are included for the ISFSI 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.

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 an independent contractor performing the decommissioning activities; 2) an adequate contingency factor; and 3) the cost of meeting the criteria for unrestricted use.

GTCC

The dismantling of the reactor internals is expected to generate radioactive waste considered unsuitable for shallow land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of

1985 assigned the federal government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste. Although the DOE is responsible for disposing of GTCC waste, any costs for that service have not been determined. For purposes of this estimate, the GTCC radioactive waste has been assumed to be packaged in the same canisters used to store spent fuel and disposed of as high-level waste, at a cost equivalent to that envisioned for the spent fuel. The number of canisters required and the packaged volume for GTCC was based upon experience at Maine Yankee (e.g., the payload constraints as identified in the canister's certificate of compliance).

For purposes of this study, GTCC is packaged in the same canisters used to transport spent fuel. The GTCC is assumed to be disposed of as it is generated during reactor vessel segmentation operations.

3.4.2 Reactor Vessel and Internal Components

The reactor pressure vessel and internal components are segmented for disposal in shielded, reusable transportation casks. Segmentation is performed in the refueling canal, where a turntable and remote cutter are installed. The vessel is segmented in place, using a mast-mounted cutter supported off the lower head and directed from a shielded work platform installed overhead in the reactor cavity. Transportation cask specifications and transportation regulations dictate the segmentation and packaging methodology.

Intact disposal of reactor vessel shells has been successfully demonstrated at several of the sites currently being decommissioned. Access to navigable waterways has allowed these large packages to be transported to the Barnwell, South Carolina and Hanford, Washington disposal sites with minimal overland travel. Intact disposal of the reactor vessel and internal components can provide savings in cost and worker exposure by eliminating the complex segmentation requirements, isolation of the GTCC material, and transport/storage of the resulting waste packages. Portland General Electric (PGE) was able to dispose of the Trojan reactor as an intact package (including the internals). However, its location on the Columbia River simplified the transportation analysis since:

- the reactor package could be secured to the transport vehicle for the entire journey, i.e., the package was not lifted during transport,
- there were no man-made or natural terrain features between the plant site and the disposal location that could produce a large drop, and
- transport speeds were very low, limited by the overland transport vehicle and the river barge.

As a member of the Northwest Compact, PGE had a site available for disposal of the package - the US Ecology facility in Washington State. The characteristics of this arid site proved favorable in demonstrating compliance with land disposal regulations.

It is not known whether this option will be available when Callaway ceases operation. Future viability of this option will depend upon the ultimate location of the disposal site, as well as the disposal site licensee's ability to accept highly radioactive packages and effectively isolate them from the environment. Consequently, the study assumes the reactor vessel will require segmentation, as a bounding condition.

3.4.3 Primary System Components

In the DECON scenario, the reactor coolant system components are assumed to be decontaminated using chemical agents prior to the start of dismantling operations. This type of decontamination can be expected to have a significant ALARA impact, since in this scenario the removal work is done within the first few years of shutdown. A decontamination factor (average reduction) of 10 is assumed for the process. In the SAFSTOR scenario, radionuclide decay is expected to provide the same benefit and, therefore, a chemical decontamination is not included.

The following discussion deals with the removal and disposition of the steam generators, but the techniques involved are also applicable to other large components, such as heat exchangers, component coolers, and the pressurizer. The steam generators' size and weight, as well as their location within the reactor building, will ultimately determine the removal strategy.

A trolley crane is set up for the removal of the generators. It can also be used to move portions of the steam generator cubicle walls and floor slabs from the reactor building to a location where they can be

decontaminated and transported to the material handling area. Interferences within the work area, such as grating, piping, and other components are removed to create sufficient laydown space for processing these large components.
The generators are rigged for removal, disconnected from the surrounding piping and supports, and maneuvered into the open area where they are lowered onto a dolly. Each generator is rotated into the horizontal position for extraction from the containment and placed onto a multi-wheeled vehicle for transport to an on-site processing and storage area.

The generators are disassembled on-site with the steam dome and lightly contaminated subassemblies designated for off-site recycling. The more highly contaminated tube sheet and tube bundle are packaged for direct disposal. The interior volume is filled with low-density cellular concrete for stabilization of the internal contamination.

Reactor coolant piping is cut from the reactor vessel once the water level in the vessel (used for personnel shielding during dismantling and cutting operations in and around the vessel) is dropped below the nozzle zone. The piping is boxed and transported by shielded van. The reactor coolant pumps and motors are lifted out intact, packaged, and transported for processing and/or disposal.

3.4.4 Retired Components

The estimate includes the cost to dispose of four retired steam generators expected to be in storage at the site upon the cessation of plant operations. The components are processed for disposal in the same manner as described for the installed units.

A retired reactor closure head, with service structure, is also included in the decommissioning waste inventory. The component is currently stored in the steam generator storage facility.

3.4.5 Main Turbine and Condenser

The main turbine is dismantled using conventional maintenance procedures. The turbine rotors and shafts are removed to a laydown area. The lower turbine casings are removed from their anchors by controlled demolition. The main condensers are also disassembled and moved to a laydown area. Material is then prepared for transportation to an off-site recycling facility where it is surveyed and designated for

either decontamination or volume reduction, conventional disposal, or controlled disposal. Components are packaged and readied for transport in accordance with the intended disposition.

3.4.6 Transportation Methods

Contaminated piping, components, and structural material other than the highly activated reactor vessel and internal components will qualify as LSA-I, II or III or Surface Contaminated Object, SCO-I or II, as described in Title 49.[29] The contaminated material will be packaged in Industrial Packages (IP-1, IP-2, or IP-3, as defined in subpart 173.411) for transport unless demonstrated to qualify as their own shipping containers. The reactor vessel and internal components are expected to be transported in accordance with Part 71, as Type B. It is conceivable that the reactor, due to its limited specific activity, could qualify as LSA II or III. However, the high radiation levels on the outer surface would require that additional shielding be incorporated within the packaging so as to attenuate the dose to levels acceptable for transport.

Any fuel cladding failure that occurred during the lifetime of the plant is assumed to have released fission products at sufficiently low levels that the buildup of quantities of long-lived isotopes (e.g., ^{137}Cs, ^{90}Sr, or transuranics) has been prevented from reaching levels exceeding those that permit the major reactor components to be shipped under current transportation regulations and disposal requirements.

Transport of the highly activated metal, produced in the segmentation of the reactor vessel and internal components, will be by shielded truck cask. Cask shipments may exceed 95,000 pounds, including vessel segment(s), supplementary shielding, cask tie-downs, and tractor-trailer. The maximum level of activity per shipment assumed permissible was based upon the license limits of the available shielded transport casks. The segmentation scheme for the vessel and internal segments is designed to meet these limits.

The transport of large intact components (e.g., large heat exchangers and other oversized components) will be by a combination of truck, rail, and/or multi-wheeled transporter.

Transportation costs for Class A radioactive material requiring controlled disposal are based upon the mileage to the Energy*Solutions* facility in Clive, Utah. Transportation costs for the higher activity Class B and C radioactive material are based upon the mileage to the WCS

facility in Andrews County, Texas. The transportation cost for the GTCC material is assumed to be contained within the disposal cost. Transportation costs for off-site waste processing are based upon the mileage to Oak Ridge, Tennessee. Truck transport costs were developed from published tariffs from Tri-State Motor Transit.[30]

3.4.7 Low-Level Radioactive Waste Disposal

To the greatest extent practical, metallic material generated in the decontamination and dismantling processes is processed 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. Conditioning (preparing the material to meet the waste acceptance criteria of the disposal site) and recovery of the waste stream is performed off site at a licensed processing center. Any material leaving the site is subject to a survey and release charge, at a minimum.

The mass of radioactive waste generated during the various decommissioning activities at the site is shown on a line-item basis in the appendices and summarized in Section 5. The quantified waste summaries shown in these tables are consistent with 10 CFR Part 61 classifications. Commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations. The volumes are calculated based on the exterior package dimensions for containerized material or a specific calculation for components serving as their own waste containers.

The more highly activated reactor components will be shipped in reusable, shielded truck casks with disposable liners. In calculating disposal costs, the burial fees are applied against the liner volume, as well as the special handling requirements of the payload. Packaging efficiencies are lower for the highly activated materials (greater than Type A quantity waste), where high concentrations of gamma-emitting radionuclides limit the capacity of the shipping canisters.

The cost to dispose of the lowest level waste and the majority of the material generated from the decontamination and dismantling activities is based upon the current cost for disposal at Energy*Solutions* facility in Clive, Utah. Disposal costs for the higher activity waste (Class B and C) were based upon Ameren Missouri's current agreement with WCS for the Andrews County facility.

3.4.8 Site Conditions Following Decommissioning

The NRC will terminate the site license when it determines that site remediation has been performed in accordance with the license termination plan, and that the terminal radiation survey and associated documentation demonstrate that the facility is suitable for release. The NRC's involvement in the decommissioning process will end at this point. Local building codes and state environmental regulations will dictate the next step in the decommissioning process, as well as the owner's own future plans for the site.

The estimates presented herein include the dismantling of the major structures to three feet below grade level, backfilling and the collapsing of below grade voids, and regrading such that the site upon which the power block and supplemental structures are located is transformed into a "grassy plain."

Concrete rubble generated from demolition activities is processed and made available as clean fill for the power block foundations. Additional fill is brought in to cap the power block excavations and to permit seeding for erosion control.

A significant amount of the below grade piping is located around the perimeter of the power block. The estimate includes a cost to excavate this area to an average depth of six feet so as to expose the piping, duct bank, conduit, and any near-surface grounding grid. The overburden is surveyed and stockpiled on site for future use in backfilling the below grade voids.

The existing electrical switchyard and access roads will remain in support of the electrical transmission and distribution system. Site restoration does not include the remediation of the water treatment plant's settling basins, if required.

Sludge removed from the sewage treatment plant lagoon was assumed to contain low levels of contamination that would require controlled disposal. As such, 3,600 cubic feet of material from the lagoon was designated for disposition at Energy*Solutions*' facility.

The existing and replacement cooling tower discharge pipes will be left in place and assumed to be flow-filled with suitable material to prevent the pipes from collapsing. The intake line will also be filled.

The estimates do not assume the remediation of any significant volume of contaminated soil. This assumption may be affected by continued plant operations and/or future regulatory actions, such as the development of site-specific release criteria.

3.5 ASSUMPTIONS

The following are the major assumptions made in the development of the estimates for decommissioning the site.

3.5.1 Estimating Basis

Decommissioning costs are reported in the year of projected expenditure; however, the values are provided in 2020 dollars. Costs are not inflated, escalated, or discounted over the periods of performance.

The estimates rely upon the physical plant inventory that was the basis for the 2017 analysis. There were no substantive changes made to the plant inventory (that would impact decommissioning).

The study follows the principles of ALARA through the use of work duration adjustment factors. These factors address the impact of activities such as radiological protection instruction, mock-up training, and the use of respiratory protection and protective clothing. The factors lengthen a task's duration, increasing costs and lengthening the overall schedule. ALARA planning is considered in the costs for engineering and planning, and in the development of activity specifications and detailed procedures. Changes to worker exposure limits may impact the decommissioning cost and project schedule.

3.5.2 Labor Costs

Ameren Missouri, as the operator, will continue to provide site operations support, including decommissioning program management, licensing, radiological protection, and site security. A Decommissioning Operations Contractor (DOC) will provide the supervisory staff needed to oversee the labor subcontractors, consultants, and specialty contractors needed to perform the work required for the decontamination and dismantling effort. The DOC will also provide the engineering services needed to develop activity specifications, detailed procedures, detailed activation analyses, and support field activities such as structural modifications.

Personnel costs are based upon average salary information provided by Ameren Missouri. Overhead costs were also provided by Ameren Missouri for site and corporate support; they are reduced commensurate with the staffing of the project.

The craft labor required to decontaminate and dismantle the nuclear unit is acquired through standard site contracting practices. The current cost of labor at the site is used as an estimating basis.

Security, while reduced from operating levels, is maintained throughout the decommissioning for access control, material control, and to safeguard the spent fuel.

A profile of the staffing levels for decommissioning, including contractors and craft, is provided in Figures 3.1 and 3.2 for the DECON and SAFSTOR scenarios, respectively. Utility staffing levels will gradually decrease after completing the removal of physical systems. Staffing levels and management support will vary based upon the amount and type of decommissioning work. Craft manpower levels decrease after systems removal and structures decontamination and drop substantially during the license termination survey period. However, craft levels increase again during the site restoration period due to the work associated with structures demolition.

3.5.3 Design Conditions

Any fuel cladding failure that occurred during the lifetime of the plant is assumed to have released fission products at sufficiently low levels that the buildup of quantities of long-lived isotopes (e.g., ^{137}Cs, ^{90}Sr, or transuranics) has been prevented from reaching levels exceeding those that permit the major NSSS components to be shipped under current transportation regulations and disposal requirements.

The curie contents of the vessel and internals at final shutdown are derived from those listed in NUREG/CR-3474.[31] Actual estimates are derived from the curie/gram values contained therein and adjusted for the different mass of the Callaway components, projected operating life, and different periods of decay. Additional short-lived isotopes are derived from CR-0130[32] and CR-0672,[33] and benchmarked to the long-lived values from CR-3474.

The control elements are disposed of along with the spent fuel, i.e., there is no additional cost provided for their disposal.

Activation of the containment building structure is confined to the biological shield.

3.5.4 General

Transition Activities

Existing warehouses are cleared of non-essential material and remain for use by Ameren Missouri and its subcontractors. The plant's operating staff performs the following activities at no additional cost or credit to the project during the transition period:

- Drain and collect fuel oils, lubricating oils, and transformer oils for recycle and/or sale.
- Drain and collect acids, caustics, and other chemical stores for recycle and/or sale.
- Process operating waste inventories, i.e., the estimates do not address the disposition of any legacy wastes; the disposal of operating wastes during this initial period is not considered a decommissioning expense.

Scrap and Salvage

The existing plant equipment is considered obsolete and suitable for scrap as deadweight quantities only. Ameren Missouri will make economically reasonable efforts to salvage equipment following final plant shutdown. However, dismantling techniques assumed by TLG for equipment in this analysis are not consistent with removal techniques required for salvage (resale) of equipment. Experience has indicated that some buyers wanted equipment stripped down to very specific requirements before they would consider purchase. This requires expensive rework after the equipment had been removed from its installed location. Since placing a salvage value on this machinery and equipment would be speculative, and the value would be small in comparison to the overall decommissioning expenses, this analysis does not attempt to quantify the value that an owner may realize based upon those efforts.

It is assumed, for purposes of this analysis, that any value received from the sale of scrap generated in the dismantling process would be more than offset by the on-site processing costs. The dismantling techniques assumed in the decommissioning estimates do not include the additional

cost for size reduction and preparation to meet "furnace ready" conditions. For example, the recovery of copper from electrical cabling may require the removal and disposition of any contaminated insulation, an added expense. With a volatile market, the potential profit margin in scrap recovery is highly speculative, regardless of the ability to free release this material. This assumption is an implicit recognition of scrap value in the disposal of clean metallic waste at no additional cost to the project.

Furniture, tools, mobile equipment such as forklifts, trucks, bulldozers, and other property is removed at no cost or credit to the decommissioning project. Disposition may include relocation to other facilities. Spare parts are also made available for alternative use.

Energy

For estimating purposes, the plant is assumed to be de-energized, with the exception of those facilities associated with spent fuel storage. Replacement power costs are used to calculate the cost of energy consumed during decommissioning for tooling, lighting, ventilation, and essential services.

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. Reductions in premiums, throughout the decommissioning process, are based upon the guidance provided in SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning"[34] The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

Taxes

Property tax payments are included for the land only and will continue through the decommissioning project.

Site Modifications

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.

3.6 COST ESTIMATE SUMMARY

Schedules of expenditures for the base case are provided in Tables 3.1 and 3.2. The tables delineate the cost contributors by year of expenditures as well as cost contributor (labor, equipment and materials, energy, radioactive waste disposal, and other costs).

The cost elements are also assigned to one of three subcategories: "License Termination," "Spent Fuel Management," and "Site Restoration." The subcategory "License Termination" is 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. These costs are identified in Tables 3.1a and 3.2a.

The "Spent Fuel Management" subcategory contains costs associated with the five and one-half years of post-shutdown pool operations and the transfer of the fuel from the pool to the ISFSI. These costs are identified in Tables 3.1b and 3.2b.

"Site Restoration" 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 grade. These costs are identified in Tables 3.1c and 3.2c.

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 three subcategories. For example, an owner 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 an NRC License Termination 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.

As discussed in Section 3.4.1, while designated for disposal at the geologic repository along with the spent fuel, GTCC waste is still classified as low-level radioactive waste and, as such, included as a "License Termination" expense.

The estimates were developed and costs are presented in 2020 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 reactor or during the decommissioning period. The schedules are based upon the detailed activity costs reported in Appendices C and D, along with the timeline presented in Section 4.

For the purposes of this analysis, the costs presented in the following tables reflect plant decommissioning at the expiration of its current license (2044) and the use of off-site low-level radioactive waste processing to minimize the volume designated for controlled disposal. Costs for the "direct disposal only" scenarios are presented in the appendices (E and F).

TABLE 3.1
DECON ALTERNATIVE
TOTAL ANNUAL EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
Plant Costs						
2044	17,446	2,055	403	9	1,992	21,904
2045	88,376	13,238	2,362	1,819	15,589	121,383
2046	96,687	35,127	2,475	36,554	25,886	196,730
2047	94,512	39,116	1,861	48,421	20,563	204,473
2048	87,772	20,758	1,510	21,106	9,913	141,058
2049	86,817	18,815	1,469	18,245	8,792	134,139
2050	60,785	10,559	969	12,541	6,054	90,908
2051	39,627	8,303	336	24	3,608	51,897
2052	30,264	24,010	196	0	6,201	60,672
2053	6,532	5,183	42	0	1,338	13,096
Plant Subtotal	608,819	177,163	11,623	138,719	99,936	1,036,260
ISFSI 72.30 Costs						
2050	674	202	0	3,890	4,386	9,152
ISFSI Subtotal	674	202	0	3,890	4,386	9,152
ISFSI Site Restoration Costs						
2051	154	97	0	0	19	270
2052	543	340	0	0	66	949
2053	117	73	0	0	14	205
Subtotal ISFSI SR	815	510	0	0	98	1,423
Total	**610,307**	**177,875**	**11,623**	**142,610**	**104,421**	**1,046,835**

[1] Includes property taxes, insurance, fees, surveys, and GTCC disposal
[2] Columns may not add due to rounding

TABLE 3.1a
DECON ALTERNATIVE
LICENSE TERMINATION EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
Plant Costs						
2044	16,750	477	403	9	1,414	19,053
2045	84,695	5,575	2,362	1,819	12,777	107,228
2046	91,816	27,985	2,475	36,554	23,524	182,354
2047	89,616	32,174	1,861	48,421	18,392	190,463
2048	80,216	11,610	1,510	21,106	7,370	121,812
2049	79,012	9,469	1,469	18,245	6,219	114,414
2050	58,496	7,819	969	12,541	5,300	85,126
2051	31,082	1,480	280	24	1,846	34,711
2052	191	0	0	0	0	191
2053	41	0	0	0	0	41
Plant Subtotal	531,915	96,589	11,328	138,719	76,842	855,393
ISFSI 72.30 Costs						
2050	674	202	0	3,890	4,386	9,152
ISFSI Subtotal	674	202	0	3,890	4,386	9,152
Total	**532,588**	**96,791**	**11,328**	**142,610**	**81,229**	**864,546**

[1] Includes property taxes, insurance, fees, surveys, and GTCC disposal
[2] Columns may not add due to rounding

TABLE 3.1b
DECON ALTERNATIVE
SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total [1]
2044	526	1,577	0	0	578	2,681
2045	2,554	7,663	0	0	2,811	13,029
2046	2,358	7,074	0	0	2,362	11,794
2047	2,281	6,844	0	0	2,171	11,297
2048	2,748	8,245	0	0	2,177	13,171
2049	2,788	8,364	0	0	2,171	13,323
2050	817	2,452	0	0	636	3,906
2051	0	0	0	0	0	0
2052	0	0	0	0	0	0
2053	0	0	0	0	0	0
Total	**14,073**	**42,219**	**0**	**0**	**12,907**	**69,200**

[1] Columns may not add due to rounding

TABLE 3.1c
DECON ALTERNATIVE
SITE RESTORATION EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total [1]
Plant Costs						
2044	170	0	0	0	0	170
2045	1,126	0	0	0	0	1,126
2046	2,513	69	0	0	0	2,582
2047	2,615	98	0	0	0	2,713
2048	4,808	902	0	0	365	6,076
2049	5,018	982	0	0	402	6,402
2050	1,471	288	0	0	118	1,877
2051	8,545	6,823	56	0	1,762	17,186
2052	30,073	24,010	196	0	6,201	60,481
2053	6,491	5,183	42	0	1,338	13,055
Plant Subtotal	62,831	38,354	295	0	10,186	111,667
ISFSI Site Restoration Costs						
2051	154	97	0	0	19	270
2052	543	340	0	0	66	949
2053	117	73	0	0	14	205
Subtotal ISFSI SR	815	510	0	0	98	1,423
Total	**63,646**	**38,864**	**295**	**0**	**10,285**	**113,090**

[1] Columns may not add due to rounding

TABLE 3.2
SAFSTOR ALTERNATIVE
TOTAL ANNUAL EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
Plant Costs						
2044	14,681	1,936	403	9	1,936	18,965
2045	74,253	13,294	1,959	625	9,480	99,612
2046	40,577	10,624	860	886	20,583	73,530
2047	27,395	8,005	392	17	4,409	40,217
2048	27,470	8,027	393	17	4,421	40,327
2049	27,395	8,005	392	17	4,409	40,217
2050	11,388	2,616	254	10	1,873	16,140
2051	4,661	351	196	7	807	6,023
2052	4,674	352	196	7	809	6,039
2053	4,661	351	196	7	807	6,023
2054	4,661	351	196	7	807	6,023
2055	4,661	351	196	7	807	6,023
2056	4,674	352	196	7	809	6,039
2057	4,661	351	196	7	807	6,023
2058	4,661	351	196	7	807	6,023
2059	4,661	351	196	7	807	6,023
2060	4,674	352	196	7	809	6,039
2061	4,661	351	196	7	807	6,023
2062	4,661	351	196	7	807	6,023
2063	4,661	351	196	7	807	6,023
2064	4,674	352	196	7	809	6,039
2065	4,661	351	196	7	807	6,023
2066	4,661	351	196	7	807	6,023
2067	4,661	351	196	7	807	6,023
2068	4,674	352	196	7	809	6,039
2069	4,661	351	196	7	807	6,023
2070	4,661	351	196	7	807	6,023
2071	4,661	351	196	7	807	6,023
2072	4,674	352	196	7	809	6,039
2073	4,661	351	196	7	807	6,023
2074	4,661	351	196	7	807	6,023

TABLE 3.2 (continued)
SAFSTOR ALTERNATIVE
TOTAL ANNUAL EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
2075	4,661	351	196	7	807	6,023
2076	4,674	352	196	7	809	6,039
2077	4,661	351	196	7	807	6,023
2078	4,661	351	196	7	807	6,023
2079	4,661	351	196	7	807	6,023
2080	4,674	352	196	7	809	6,039
2081	4,661	351	196	7	807	6,023
2082	4,661	351	196	7	807	6,023
2083	4,661	351	196	7	807	6,023
2084	4,674	352	196	7	809	6,039
2085	4,661	351	196	7	807	6,023
2086	4,661	351	196	7	807	6,023
2087	4,661	351	196	7	807	6,023
2088	4,674	352	196	7	809	6,039
2089	4,661	351	196	7	807	6,023
2090	4,661	351	196	7	807	6,023
2091	4,661	351	196	7	807	6,023
2092	4,674	352	196	7	809	6,039
2093	4,661	351	196	7	807	6,023
2094	4,661	351	196	7	807	6,023
2095	4,661	351	196	7	807	6,023
2096	4,674	352	196	7	809	6,039
2097	4,661	351	196	7	807	6,023
2098	13,339	695	520	13	1,034	15,600
2099	54,686	3,859	1,959	38	2,094	62,636
2100	72,179	28,979	1,892	36,662	15,219	154,932
2101	72,673	30,215	1,758	43,722	17,373	165,741
2102	67,109	10,077	1,469	15,096	6,367	100,119
2103	67,109	10,077	1,469	15,096	6,367	100,119
2104	41,371	6,862	400	687	3,335	52,656
2105	30,173	23,948	196	0	5,447	59,763

TABLE 3.2 (continued)
SAFSTOR ALTERNATIVE
TOTAL ANNUAL EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
2106	9,093	7,217	59	0	1,641	18,011
Plant Subtotal	870,118	190,960	23,588	113,236	143,951	1,341,853
ISFSI 72.30 Costs						
2101	77	23	0	444	500	1,044
2102	292	88	0	1,686	1,901	3,967
2103	292	88	0	1,686	1,901	3,967
2104	13	4	0	74	83	174
ISFSI Subtotal	674	202	0	3,890	4,386	9,152
ISFSI Site Restoration Costs						
2104	110	69	0	0	13	192
2105	542	339	0	0	65	946
2106	163	102	0	0	20	285
Subtotal ISFSI SR	815	510	0	0	98	1,423
Total	**871,606**	**191,671**	**23,588**	**117,126**	**148,436**	**1,352,428**

[1] Includes property taxes, insurance, fees, surveys, and GTCC disposal
[2] Columns may not add due to rounding

TABLE 3.2a
SAFSTOR ALTERNATIVE
LICENSE TERMINATION EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
Plant Costs						
2044	14,155	359	403	9	1,358	16,284
2045	71,595	5,318	1,959	625	6,669	86,165
2046	35,742	2,646	722	886	18,220	58,217
2047	21,797	521	196	17	2,237	24,768
2048	21,857	523	196	17	2,243	24,836
2049	21,797	521	196	17	2,237	24,768
2050	9,731	402	196	10	1,230	11,569
2051	4,661	351	196	7	807	6,023
2052	4,674	352	196	7	809	6,039
2053	4,661	351	196	7	807	6,023
2054	4,661	351	196	7	807	6,023
2055	4,661	351	196	7	807	6,023
2056	4,674	352	196	7	809	6,039
2057	4,661	351	196	7	807	6,023
2058	4,661	351	196	7	807	6,023
2059	4,661	351	196	7	807	6,023
2060	4,674	352	196	7	809	6,039
2061	4,661	351	196	7	807	6,023
2062	4,661	351	196	7	807	6,023
2063	4,661	351	196	7	807	6,023
2064	4,674	352	196	7	809	6,039
2065	4,661	351	196	7	807	6,023
2066	4,661	351	196	7	807	6,023
2067	4,661	351	196	7	807	6,023
2068	4,674	352	196	7	809	6,039
2069	4,661	351	196	7	807	6,023
2070	4,661	351	196	7	807	6,023
2071	4,661	351	196	7	807	6,023
2072	4,674	352	196	7	809	6,039
2073	4,661	351	196	7	807	6,023
2074	4,661	351	196	7	807	6,023

TABLE 3.2a (continued)
SAFSTOR ALTERNATIVE
LICENSE TERMINATION EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
2075	4,661	351	196	7	807	6,023
2076	4,674	352	196	7	809	6,039
2077	4,661	351	196	7	807	6,023
2078	4,661	351	196	7	807	6,023
2079	4,661	351	196	7	807	6,023
2080	4,674	352	196	7	809	6,039
2081	4,661	351	196	7	807	6,023
2082	4,661	351	196	7	807	6,023
2083	4,661	351	196	7	807	6,023
2084	4,674	352	196	7	809	6,039
2085	4,661	351	196	7	807	6,023
2086	4,661	351	196	7	807	6,023
2087	4,661	351	196	7	807	6,023
2088	4,674	352	196	7	809	6,039
2089	4,661	351	196	7	807	6,023
2090	4,661	351	196	7	807	6,023
2091	4,661	351	196	7	807	6,023
2092	4,674	352	196	7	809	6,039
2093	4,661	351	196	7	807	6,023
2094	4,661	351	196	7	807	6,023
2095	4,661	351	196	7	807	6,023
2096	4,674	352	196	7	809	6,039
2097	4,661	351	196	7	807	6,023
2098	13,179	695	520	13	1,034	15,440
2099	53,556	3,859	1,959	38	2,094	61,506
2100	69,199	28,899	1,892	36,662	15,219	151,871
2101	68,971	29,880	1,758	43,722	17,272	161,604
2102	62,318	9,140	1,469	15,096	5,983	94,006
2103	62,318	9,140	1,469	15,096	5,983	94,006
2104	35,083	1,966	361	687	2,214	40,310
2105	190	0	0	0	0	190

TABLE 3.2a (continued)
SAFSTOR ALTERNATIVE
LICENSE TERMINATION EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
2106	57	0	0	0	0	57
Plant Subtotal	780,771	110,388	22,510	113,236	121,961	1,148,866
ISFSI 72.30 Costs						
2101	77	23	0	444	500	1,044
2102	292	88	0	1,686	1,901	3,967
2103	292	88	0	1,686	1,901	3,967
2104	13	4	0	74	83	174
ISFSI Subtotal	674	202	0	3,890	4,386	9,152
Total	**781,445**	**110,590**	**22,510**	**117,126**	**126,347**	**1,158,018**

[1] Includes property taxes, insurance, fees, surveys, and GTCC disposal
[2] Columns may not add due to rounding

TABLE 3.2b
SAFSTOR ALTERNATIVE
SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total [1]
2044	526	1,577	0	0	578	2,681
2045	2,659	7,976	0	0	2,811	13,446
2046	4,835	7,978	137	0	2,362	15,313
2047	5,597	7,484	196	0	2,171	15,449
2048	5,613	7,505	196	0	2,177	15,491
2049	5,597	7,484	196	0	2,171	15,449
2050	1,656	2,215	58	0	642	4,571
Total	**26,484**	**42,219**	**784**	**0**	**12,913**	**82,400**

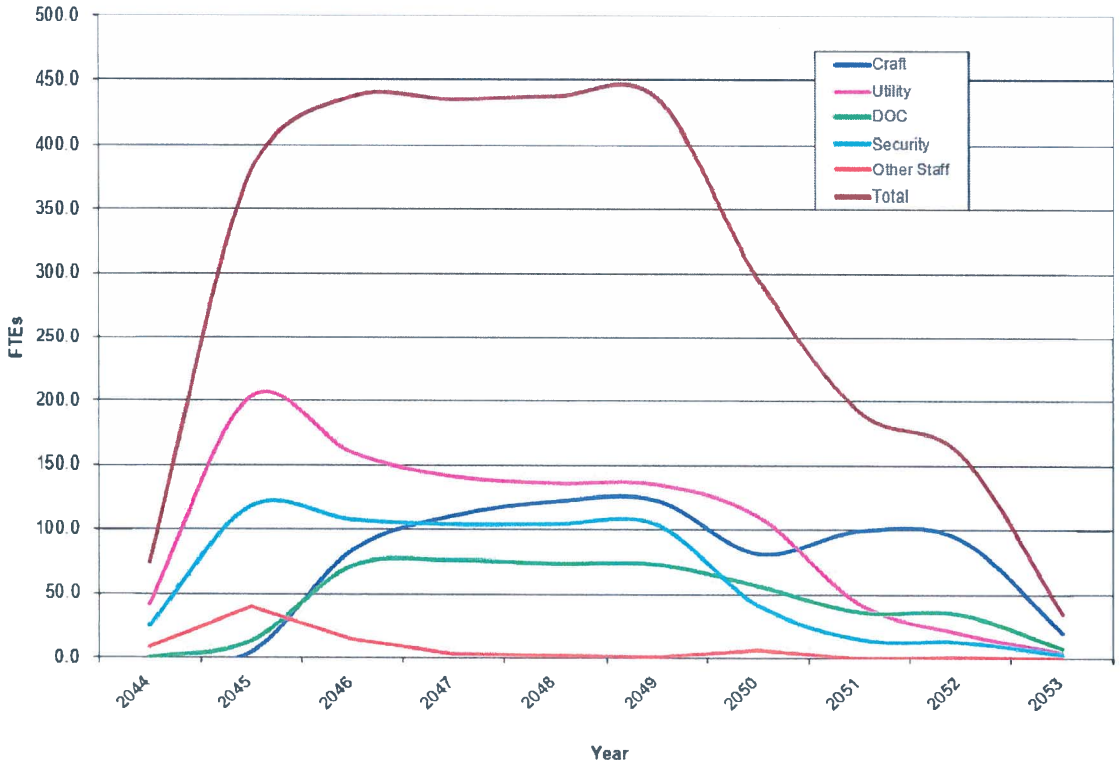
[1] Columns may not add due to rounding

TABLE 3.2c
SAFSTOR ALTERNATIVE
SITE RESTORATION EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total [1]
Plant Costs						
2044-97	0	0	0	0	0	0
2098	160	0	0	0	0	160
2099	1,131	0	0	0	0	1,131
2100	2,980	81	0	0	0	3,061
2101	3,702	334	0	0	101	4,137
2102	4,791	938	0	0	384	6,113
2103	4,791	938	0	0	384	6,113
2104	6,289	4,896	40	0	1,121	12,346
2105	29,982	23,948	196	0	5,447	59,573
2106	9,036	7,217	59	0	1,641	17,954
Plant Subtotal	62,863	38,352	295	0	9,077	110,587
ISFSI Site Restoration Costs						
2104	110	69	0	0	13	192
2105	542	339	0	0	65	946
2106	163	102	0	0	20	285
Subtotal ISFSI SR	815	510	0	0	98	1,423
Total	**63,677**	**38,862**	**295**	**0**	**9,176**	**112,010**

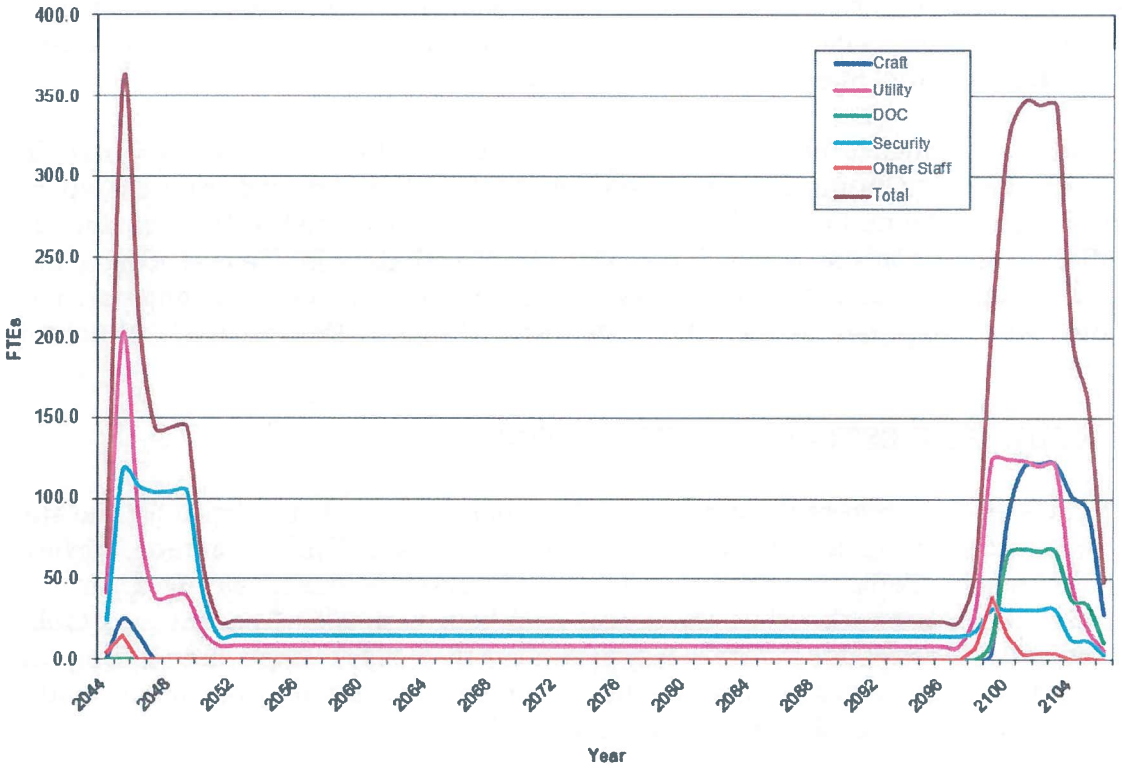
[1] Columns may not add due to rounding

FIGURE 3.1
DECOMMISSIONING PERSONNEL LEVELS
DECON



Note that the labor hour basis of this chart was taken from Appendix C; however not all line items in Appendix C have labor hour values available (e.g. spent fuel canister loading estimates)

FIGURE 3.2
DECOMMISSIONING PERSONNEL LEVELS
SAFSTOR



Note that the labor hour basis of this chart was taken from Appendix D; however not all line items in Appendix D have labor hour values available (e.g. spent fuel canister loading estimates)

4. SCHEDULE ESTIMATE

The schedules for the decommissioning scenarios considered in this study follow the sequences 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 the spent fuel management plan described in Section 3.4.1.

A schedule or sequence of activities for the DECON alternative is presented in Figure 4.1. The scheduling sequence assumes that fuel is removed from the spent fuel pool within five and one-half years. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the cost tables, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project Professional" computer software.[35]

4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule reflects the results of a precedence network developed for the site decommissioning activities, i.e., a PERT (Program Evaluation and Review Technique) Software Package. The work activity durations used in the precedence network reflect the actual man-hour estimates from the cost table, adjusted by stretching certain activities over their slack range and shifting the start and end dates of others. The following assumptions were made in the development of the decommissioning schedule:

- The fuel building is isolated until such time that all spent fuel has been transferred from the spent fuel pool to the DOE. Decontamination and dismantling of the storage pool is initiated once the transfer of spent fuel is complete (DECON option).
- All work (except vessel and internals removal) is performed during an 8-hour workday, 5 days per week, with no overtime. There are eleven paid holidays per year.
- Reactor and internals removal activities are performed by using separate crews for different activities working on different shifts, with a corresponding backshift charge for the second shift.
- Multiple crews work parallel activities to the maximum extent possible, consistent with optimum efficiency, adequate access for cutting, removal and laydown space, and with the stringent safety measures necessary during demolition of heavy components and structures.

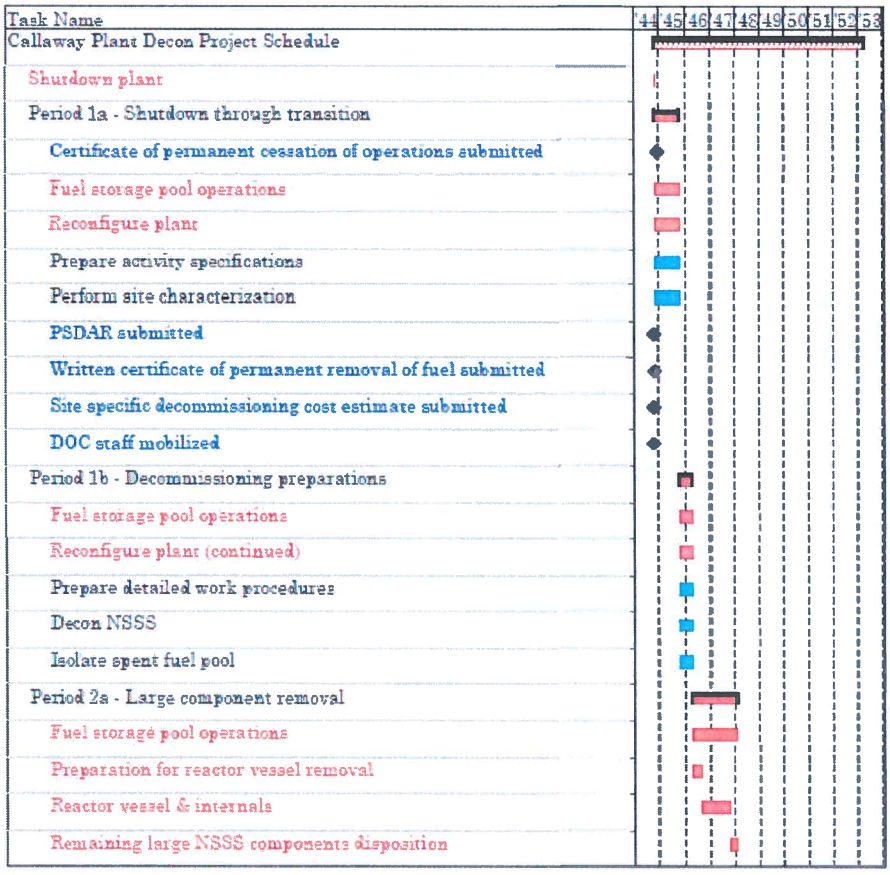
- For plant systems removal, the systems with the longest removal durations in areas on the critical path are considered to determine the duration of the activity.

4.2 PROJECT SCHEDULE

The period-dependent costs presented in the detailed cost tables are based upon the durations developed in the schedules for decommissioning. Durations are established between several milestones in each project 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 shown for the spent fuel storage period, which determines the release of the fuel building for final decontamination.

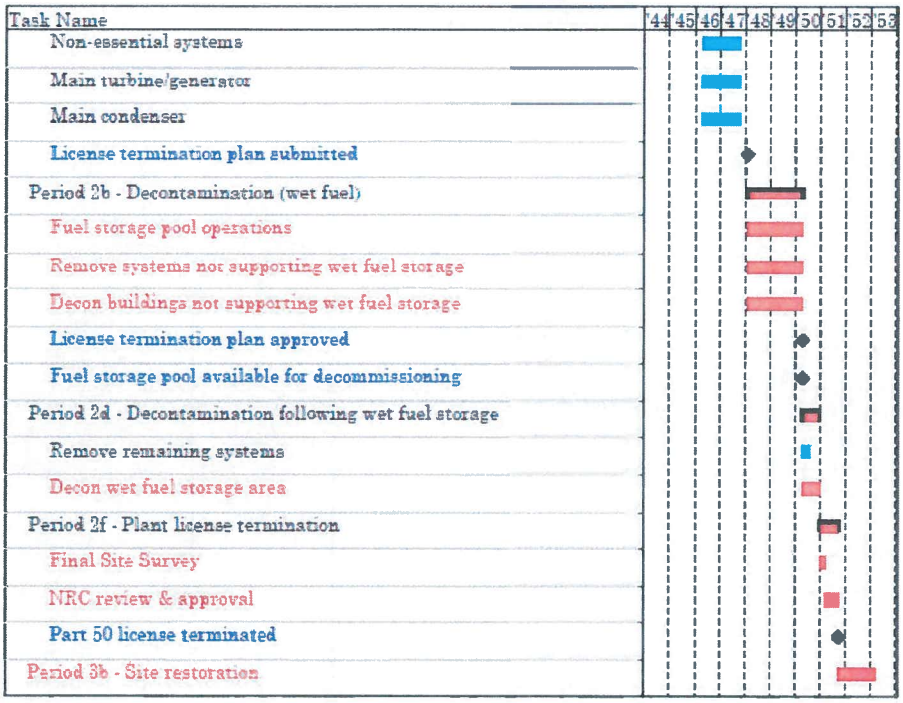
Project timelines are provided in Figures 4.2 and 4.3 with milestone dates based on a 2044 shutdown date. The fuel pool is emptied approximately five and one-half years after shutdown. Deferred decommissioning in the SAFSTOR scenarios is assumed to commence so that the operating license is terminated within a 60-year period from the cessation of plant operations.

FIGURE 4.1
ACTIVITY SCHEDULE



Legend:
1. Red text and/or scheduling bars indicate critical path activities
2. Diamond symbols indicate major milestones

FIGURE 4.1 (continued)
ACTIVITY SCHEDULE



Legend:
1. Red text and/or scheduling bars indicate critical path activities
2. Diamond symbols indicate major milestones

FIGURE 4.2
DECOMMISSIONING TIMELINE
DECON
(not to scale)

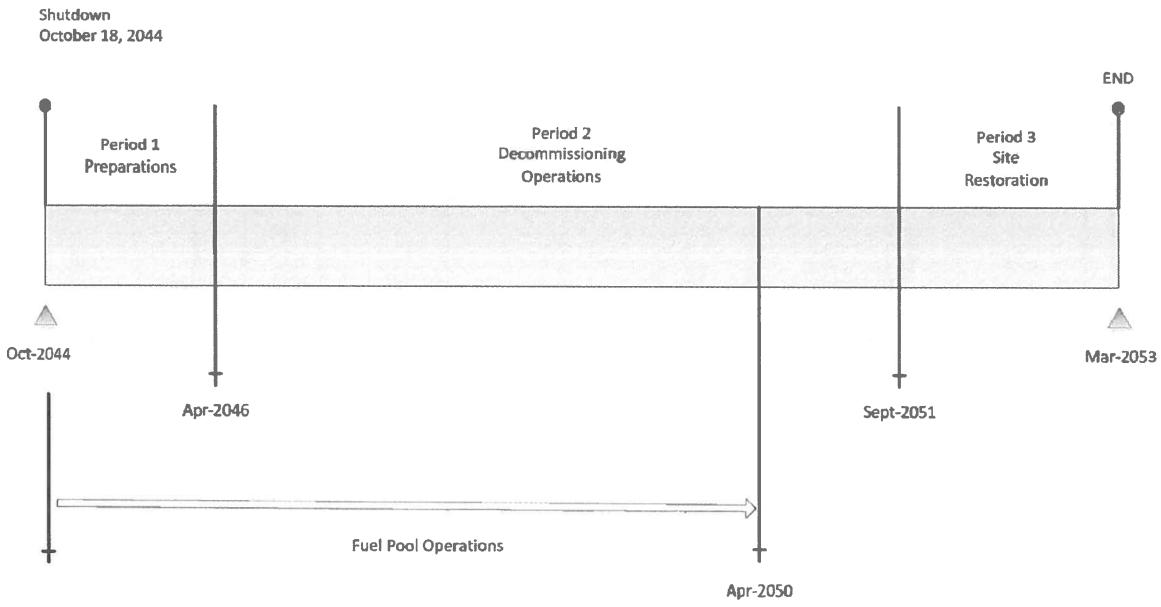
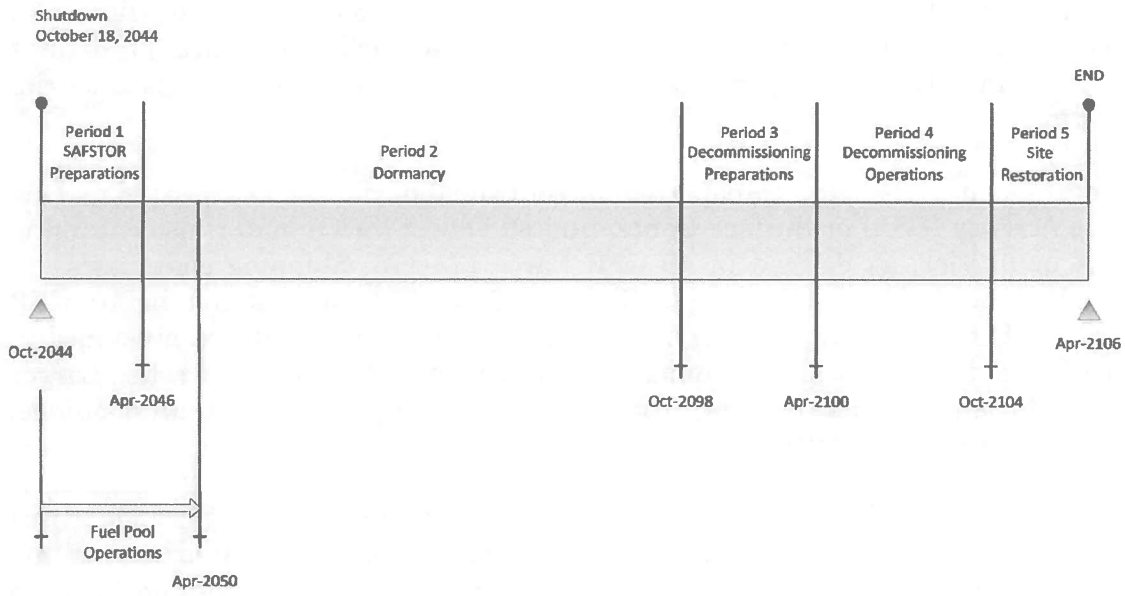


FIGURE 4.3
DECOMMISSIONING TIMELINE
SAFSTOR
(not to scale)



5. RADIOACTIVE WASTES

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. This currently requires the remediation of all radioactive material at the site in excess of applicable legal limits. Under the Atomic Energy Act,[36] the NRC is responsible for protecting the public from sources of ionizing radiation. Title 10 of the Code of Federal Regulations delineates the production, utilization, and disposal of radioactive materials and processes. In particular, Part 71 defines radioactive material as it pertains to transportation and Part 61 specifies its disposition.

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, as defined in 49 CFR Parts 173-178. Shipping containers are required to be Industrial Packages (IP-1, IP-2 or IP-3, as defined in 10 CFR §173.411). For this study, commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations.

The destinations for the various waste streams from decommissioning are identified in Figures 5.1 and 5.2. The volumes of radioactive waste generated during the various decommissioning activities at the site are shown on a line-item basis in appendices, and summarized in Tables 5.1 and 5.2 (base case). The quantified waste volume summaries shown in these tables are consistent with Part 61 classifications. The volumes are calculated based on the exterior dimensions for containerized material and on the displaced volume of components serving as their own waste containers.

The reactor vessel and internals are categorized as large quantity shipments and, accordingly, will be shipped in reusable, shielded truck casks with disposable liners. In calculating disposal costs, the burial fees are applied against the liner volume, as well as the special handling requirements of the payload. Packaging efficiencies are lower for the highly activated materials (greater than Type A quantity waste), where high concentrations of gamma-emitting radionuclides limit the capacity of the shipping canisters.

No process system containing/handling radioactive substances at shutdown is presumed to meet material release criteria by decay alone (i.e., systems radioactive at shutdown will still be radioactive over the time period during which the decommissioning is accomplished, due to the presence of long-lived radionuclides).

While the dose rates decrease with time, radionuclides such as ^{137}Cs will still control the disposition requirements.

The waste material produced in the decontamination and dismantling of the nuclear units is primarily generated during Period 2 of DECON and Period 4 of SAFSTOR. Material that is considered potentially contaminated when removed from the radiological controlled area is sent to processing facilities in Tennessee for conditioning and disposal. Heavily contaminated components and activated materials are routed for controlled disposal. The disposal volumes reported in the tables reflect the savings resulting from reprocessing and recycling.

For purposes of constructing the estimates, the cost for disposal at the Energy*Solutions* facility was used as a proxy for future disposal facilities. Separate rates were used for containerized waste and large components, including the steam generators and reactor coolant pump motors. Demolition debris including miscellaneous steel, scaffolding, and concrete was disposed of at a bulk rate. The decommissioning waste stream also included resins and dry active waste.

Since Energy*Solutions* is not currently able to receive the more highly radioactive components generated in the decontamination and dismantling of the reactor, disposal costs for the Class B and C material were based upon Ameren Missouri's current agreement with WCS for the Andrews County disposal facility.

A small quantity of material generated during the decommissioning will not be considered suitable for near-surface disposal, and is assumed to be disposed of in a geologic repository, in a manner similar to that envisioned for spent fuel disposal. Such material, known as Greater-Than-Class-C or GTCC material, is estimated to require five spent fuel storage canisters (or the equivalent) to dispose of the most radioactive portions of the reactor vessel internals. The volume and weight reported in Tables 5.1 and 5.2 represent the packaged weight and volume of the GTCC storage canisters.

FIGURE 5.1
RADIOACTIVE WASTE DISPOSITION

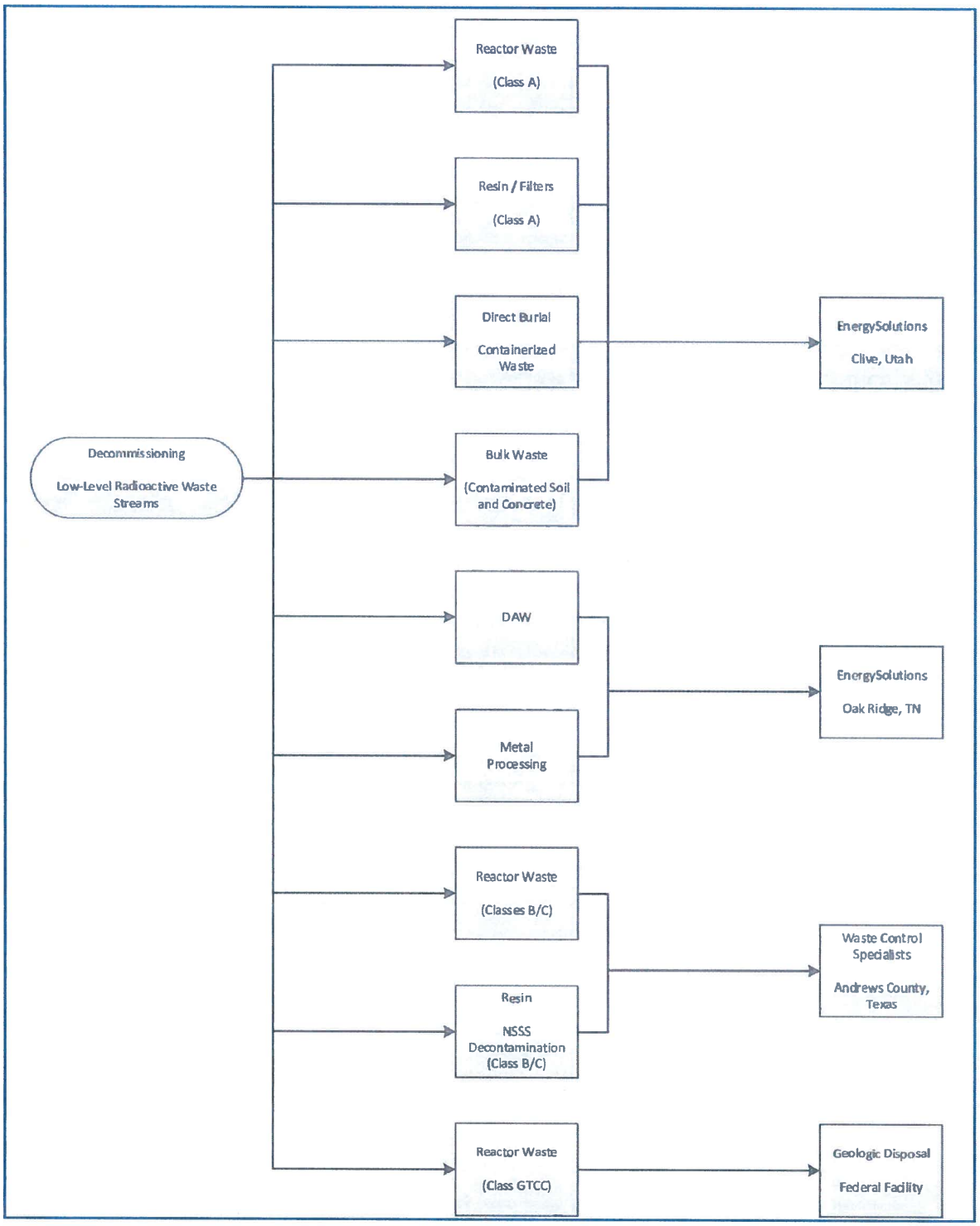


FIGURE 5.2
DECOMMISSIONING WASTE DESTINATIONS
RADIOLOGICAL

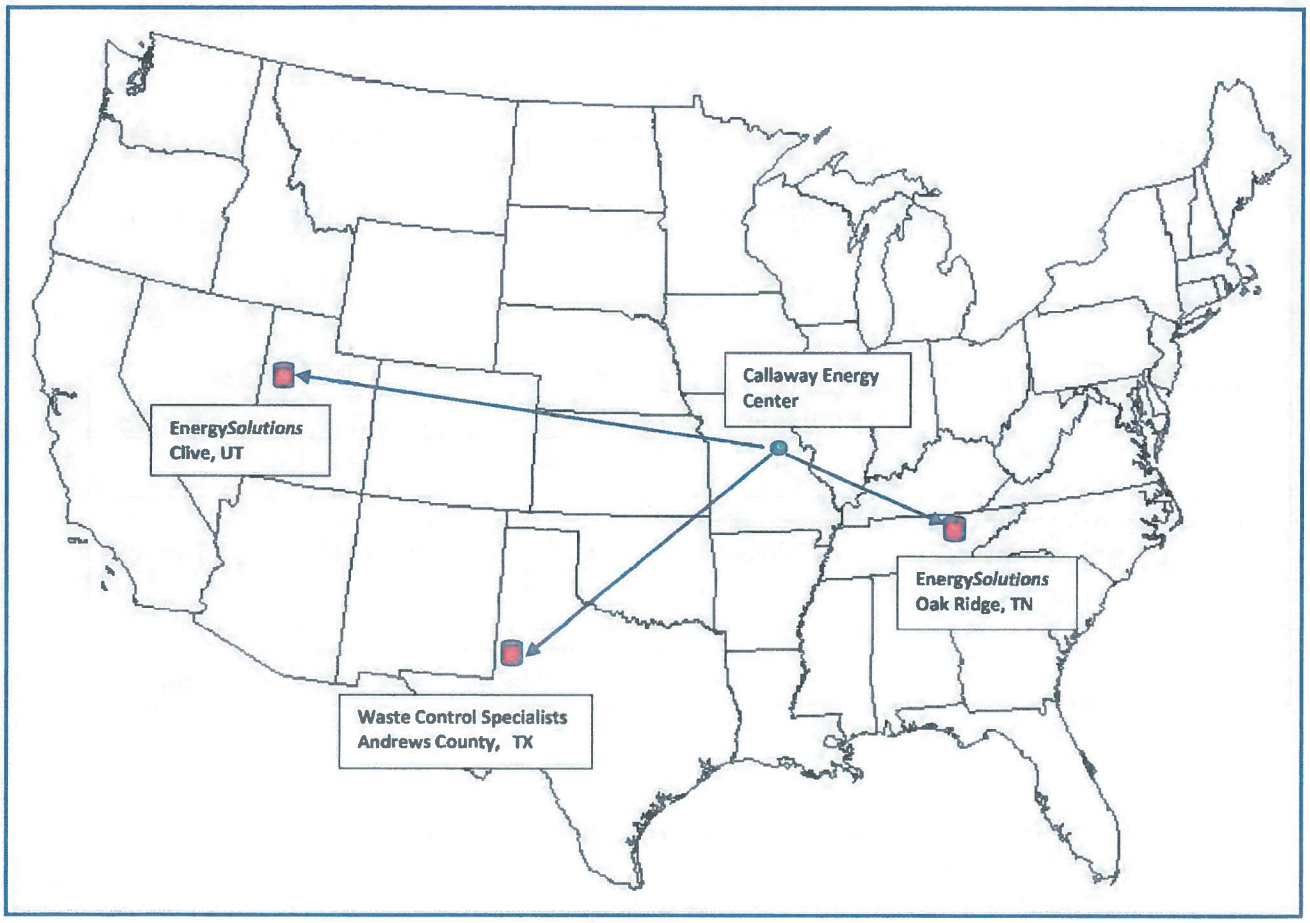


TABLE 5.1
DECON ALTERNATIVE
DECOMMISSIONING WASTE SUMMARY

Waste	Cost Basis	Class [1]	Waste Volume (cubic feet)	Mass (pounds)
Low-Level Radioactive Waste (near-surface disposal)	Energy*Solutions*	A	233,370	15,344,125
	WCS	B	1,750	191,469
	WCS	C	393	47,411
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,217	433,180
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	286,837	10,789,320
Totals [2]			524,566	26,805,506

[1] Waste is classified according to the requirements as delineated in Title 10 CFR, Part 61.55

[2] Columns may not add due to rounding.

TABLE 5.2
SAFSTOR ALTERNATIVE
DECOMMISSIONING WASTE SUMMARY

Waste	Cost Basis	Class [1]	Waste Volume (cubic feet)	Mass (pounds)
Low-Level Radioactive Waste (near-surface disposal)	Energy*Solutions*	A	193,215	12,751,697
	WCS	B	501	50,254
	WCS	C	393	47,411
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,217	433,180
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	313,812	11,921,120
Totals [2]			510,137	25,203,662

[1] Waste is classified according to the requirements as delineated in Title 10 CFR, Part 61.55

[2] Columns may not add due to rounding.

6. RESULTS

The analysis to estimate the costs to decommission Callaway relied upon the site-specific, technical information developed for a previous analysis prepared in 2017. While not an engineering study, the estimates provide the plant owner with sufficient information to assess its financial obligations, as they pertain to the eventual decommissioning of the nuclear station.

The estimates described in this report are based on numerous fundamental assumptions, including regulatory requirements, project contingencies, low-level radioactive waste disposal practices, high-level radioactive waste management options, and site restoration requirements. The decommissioning scenarios assume continued operation of the station's spent fuel pool for a minimum of five and one-half years following the cessation of operations for continued cooling of the assemblies. Once sufficiently cooled, the assemblies will be moved to the ISFSI for interim storage and to await transfer to a DOE facility (e.g., geologic repository).

The cost projected to promptly decommission (DECON) Callaway, assuming the use of off-site low-level radioactive waste processing to reduce the volume requiring controlled disposal, is estimated to be $1,046.1 million. The majority of this cost (approximately 82.6%) is associated with the physical decontamination and dismantling of the nuclear unit so that the operating license can be terminated. Another 6.6% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 10.8% is for the demolition of the designated structures and limited restoration of the site.

The cost projected for deferred decommissioning (SAFSTOR), assuming the use of off-site low-level radioactive waste processing to reduce the volume requiring controlled disposal, is estimated to be $1,352.4 million. The majority of this cost (approximately 85.6%) is associated with placing the unit in storage, ongoing caretaking of the unit during dormancy, and the eventual physical decontamination and dismantling of the nuclear unit so that the operating license can be terminated. Another 6.1% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 8.3% is for the demolition of the designated structures and limited restoration of the site.

The primary cost contributors, identified in Tables 6.1 and 6.2, are either labor-related or associated with the management and disposition of the radioactive waste. Program management is the largest single contributor to the overall cost. The magnitude of the expense is a function of both the size of the organization required to manage the decommissioning, as well as the duration of the program. It is assumed, for purposes of this analysis, that Ameren Missouri will oversee the

decommissioning program, using a DOC to manage the decommissioning labor force and the associated subcontractors. The size and composition of the management organization varies with the decommissioning phase and associated site activities. However, once the operating license is terminated, the staff is substantially reduced for the conventional demolition and restoration of the site (for the DECON alternative).

As described in this report, the spent fuel pool will remain operational for a minimum of five and one-half years following the cessation of operations. The pool will be isolated and an independent spent fuel island created. This will allow decommissioning operations to proceed in and around the pool area. Over the five and one-half year period, the spent fuel will be packaged into multi-purpose canisters and transferred to the DOE. The spent fuel stored at the ISFSI will also be transferred to DOE during this period.

The cost for waste disposal includes those costs associated with the controlled disposition of the low-level radioactive waste generated from decontamination and dismantling activities, including plant equipment and components, structural material, filters, resins and dry-active waste. As described in Section 5, disposition of the low-level radioactive material required controlled disposal is at the Energy*Solutions*' facility. Highly activated components, requiring additional isolation from the environment (GTCC), are packaged for geologic disposal. The cost of geologic disposal is based upon a cost equivalent for spent fuel.

A significant portion of the metallic waste is designated for additional processing and treatment at an off-site facility. Processing reduces the volume of material requiring controlled disposal through such techniques and processes as survey and sorting, decontamination, and volume reduction. The material that cannot be unconditionally released is packaged for controlled disposal at one of the currently operating facilities. The cost identified in the summary tables for processing is all-inclusive, incorporating the ultimate disposition of the material.

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. Decontamination and packaging costs also have a large labor component that is based upon prevailing union wages. Non-radiological demolition is a natural extension of the decommissioning process. The methods employed in decontamination and dismantling are generally destructive and indiscriminate in inflicting collateral damage. With a work force mobilized to support decommissioning operations, non-radiological demolition can be an integrated activity and a logical expansion of the work being performed in the process of terminating the operating license. Prompt demolition reduces future liabilities and

can be more cost effective than deferral, due to the deterioration of the facilities (and therefore the working conditions) with time.

The reported cost for transport includes the tariffs and surcharges associated with moving large components and/or overweight shielded casks overland, as well as the general expense, e.g., labor and fuel, of transporting material to the destinations identified in this report. For purposes of this analysis, material is primarily moved overland by truck.

Decontamination is used to reduce the plant's radiation fields and minimize worker exposure. Slightly contaminated material or material located within a contaminated area is sent to an off-site processing center, i.e., this analysis does not assume that contaminated plant components and equipment can be decontaminated for uncontrolled release in-situ. Centralized processing centers have proven to be a more economical means of handling the large volumes of material produced in the dismantling of a nuclear unit.

License termination survey costs are associated with the labor intensive and complex activity of verifying that contamination has been removed from the site to the levels specified by the regulating agency. This process involves a systematic survey of all remaining plant surface areas and surrounding environs, sampling, isotopic analysis, and documentation of the findings. The status of any plant components and materials not removed in the decommissioning process will also require confirmation and will add to the expense of surveying the facilities alone.

The remaining costs include allocations for heavy equipment and temporary services, as well as for other expenses such as regulatory fees and the premiums for nuclear insurance. While site operating costs are greatly reduced following the final cessation of plant operations, certain administrative functions do need to be maintained either at a basic functional or regulatory level.

TABLE 6.1
DECON ALTERNATIVE
DECOMMISSIONING COST ELEMENTS
(thousands of 2020 dollars)

Cost Element	Total	Percentage
Decontamination	21,730	2.1
Removal	189,813	18.1
Packaging	33,686	3.2
Transportation	17,644	1.7
Waste Disposal	121,093	11.6
Off-site Waste Processing	35,935	3.4
Program Management [1]	366,980	35.1
Security	100,705	9.6
Corporate Allocations	9,270	0.9
Spent Fuel Pool Isolation	14,576	1.4
Spent Fuel Management [2]	69,200	6.6
Insurance and Regulatory Fees	16,621	1.6
Energy	11,623	1.1
Characterization and Licensing Surveys	29,298	2.8
Property Taxes	998	0.1
Miscellaneous Equipment	7,663	0.7
Total [3]	1,046,835	100.0

Cost Element	Total	Percentage
License Termination (excluding ISFSI)	855,393	81.7
ISFSI Decommissioning (License Termination)	9,152	0.9
Spent Fuel Management [2]	69,200	6.6
Site Restoration (excluding ISFSI)	111,667	10.7
ISFSI Demolition (Site Restoration)	1,423	0.1
Total [3]	1,046,835	100.0

[1] Includes engineering costs
[2] Direct costs only. Excludes program management costs (staffing) but includes costs for spent fuel loading/spent fuel pool O&M and Emergency Planning fees
[3] Columns may not add due to rounding

TABLE 6.2
SAFSTOR ALTERNATIVE
DECOMMISSIONING COST ELEMENTS
(thousands of 2020 dollars)

Cost Element	Total	Percentage
Decontamination	19,823	1.5
Removal	190,638	14.1
Packaging	28,554	2.1
Transportation	14,753	1.1
Waste Disposal	91,874	6.8
Off-site Waste Processing	39,671	2.9
Program Management [1]	469,264	34.7
Security	264,218	19.5
Corporate Allocations	14,291	1.1
Spent Fuel Pool Isolation	14,576	1.1
Spent Fuel Management [2]	69,206	5.1
Insurance and Regulatory Fees	51,752	3.8
Energy	23,588	1.7
Characterization and Licensing Surveys	29,639	2.2
Property Taxes	7,287	0.5
Miscellaneous Equipment	23,293	1.7
Total [3]	1,352,428	100.0

Cost Element	Total	Percentage
License Termination (excluding ISFSI)	1,148,866	84.9
ISFSI Decommissioning (License Termination)	9,152	0.7
Spent Fuel Management [4]	82,400	6.1
Site Restoration (excluding ISFSI)	110,587	8.2
ISFSI Demolition (Site Restoration)	1,423	0.1
Total [3]	1,352,428	100.0

[1] Includes engineering costs
[2] Direct costs only. Excludes program management costs (staffing) but includes costs for spent fuel loading/spent fuel pool O&M and Emergency Planning fees
[3] Columns may not add due to rounding
[4] Includes percentage of Period 2a (dormancy) plant operating costs until spent fuel pool is emptied, in addition to the direct costs.

7. REFERENCES

1. "Decommissioning Cost Analysis for the Callaway Energy Center," Document A22-1739-001, Rev. 0, TLG Services, Inc., August 2017

2. U.S. Code of Federal Regulations, Title 10, Parts 30, 40, 50, 51, 70 and 72, "General Requirements for Decommissioning Nuclear Facilities," Nuclear Regulatory Commission, 53 Fed. Reg. 24018, June 27, 1988 [Open]

3. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors," Rev. 2, October 2011 [Open]

4. U.S. Code of Federal Regulations, Title 10, Part 20, Subpart E, "Radiological Criteria for License Termination" [Open]

5. U.S. Code of Federal Regulations, Title 10, Parts 20 and 50, "Entombment Options for Power Reactors," Advance Notice of Proposed Rulemaking, 66 Fed. Reg. 52551, October 16, 2001 [Open]

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11. "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," U.S. DOE, January 11, 2013 [Open]

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17. "Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste," (DOE/EIS-0375), January 2016 [Open]

18. U.S. Code of Federal Regulations, Title 10, Part 20, Subpart E, "Final Rule, Radiological Criteria for License Termination," 62 Fed. Reg. 39058, July 21, 1997 [Open]

19. "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination," EPA Memorandum OSWER No. 9200.4-18, August 22, 1997 [Open]

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APPENDIX A

UNIT COST FACTOR DEVELOPMENT

APPENDIX A
UNIT COST FACTOR DEVELOPMENT

Example: Unit Factor for Removal of Contaminated Heat Exchanger < 3,000 lbs.

1. SCOPE

Heat exchangers weighing < 3,000 lbs. will be removed in one piece using a crane or small hoist. They will be disconnected from the inlet and outlet piping. The heat exchanger will be sent to the waste processing area.

2. CALCULATIONS

Act ID	Activity Description	Activity Duration (minutes)	Critical Duration (minutes)*
a	Remove insulation	60	(b)
b	Mount pipe cutters	60	60
c	Install contamination controls	20	(b)
d	Disconnect inlet and outlet lines	60	60
e	Cap openings	20	(d)
f	Rig for removal	30	30
g	Unbolt from mounts	30	30
h	Remove contamination controls	15	15
i	Remove, wrap, send to waste processing area	60	60
	Totals (Activity/Critical)	355	255

Duration adjustment(s):	
+ Respiratory protection adjustment (50% of critical duration)	128
+ Radiation/ALARA adjustment (37% of critical duration)	95
Adjusted work duration	478
+ Protective clothing adjustment (30% of adjusted duration)	143
Productive work duration	621
+ Work break adjustment (8.33 % of productive duration)	52
Total work duration (minutes)	673

***** Total duration = 11.217 hour *****

* alpha designators indicate activities that can be performed in parallel

APPENDIX A
(continued)

3. LABOR REQUIRED

Crew	Number	Duration (hours)	Rate ($/hour)	Cost
Laborers	3.00	11.217	$46.08	$1,550.64
Craftsmen	2.00	11.217	$70.78	$1,587.88
Foreman	1.00	11.217	$72.78	$816.37
General Foreman	0.25	11.217	$74.78	$209.70
Fire Watch	0.05	11.217	$46.08	$25.84
Health Physics Technician	1.00	11.217	$49.51	$555.35
Total Labor Cost				$4,745.78

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
• Universal Polypropylene Sorbent 50 @ $0.62/sq ft [1]	$31.00
• Tarpaulin, oil resistant, fire retardant 50 @ $0.47/sq ft [2]	$23.50
• Gas torch consumables 1 @ $20.65 1 /hr [3]	$20.65
Subtotal cost of equipment and materials	$75.15
Overhead & profit on equipment and materials @ 15.725 %	$11.82
Total costs, equipment & material	$86.97

TOTAL COST:

Removal of contaminated **heat exchanger <3000 pounds:**	**$4,832.75**
Total labor cost:	$4,745.75
Total equipment/material costs:	$86.97
Total craft labor man-hours required per unit:	81.88

5. NOTES AND REFERENCES

- Work difficulty factors were developed in conjunction with the Atomic Industrial Forum's (now NEI) program to standardize nuclear decommissioning cost estimates and are delineated in Volume 1, Chapter 5 of the "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," AIF/NESP-036, May 1986.

- References for equipment & consumables costs:

    1. www.mcmaster.com online catalog, McMaster Carr Spill Control (7193T88)
    2. R.S. Means (2020) Division 01 56, Section 13.60-0600, page 22
    3. R.S. Means (2020) Division 01 54 33, Section 40-6360, page 734

- Material and consumable costs were adjusted using the regional indices for Jefferson City, MO.

APPENDIX B

UNIT COST FACTOR LISTING
(DECON: Power Block Structures Only)

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean instrument and sampling tubing, $/linear foot	0.53
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	5.56
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	8.07
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	16.34
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	31.05
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	40.44
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	59.48
Removal of clean pipe >36 inches diameter, $/linear foot	70.64
Removal of clean valve >2 to 4 inches	106.62
Removal of clean valve >4 to 8 inches	163.43
Removal of clean valve >8 to 14 inches	310.46
Removal of clean valve >14 to 20 inches	404.41
Removal of clean valve >20 to 36 inches	594.83
Removal of clean valve >36 inches	706.40
Removal of clean pipe hanger for small bore piping	36.82
Removal of clean pipe hanger for large bore piping	127.27
Removal of clean pump, <300 pound	277.28
Removal of clean pump, 300-1000 pound	781.49
Removal of clean pump, 1000-10,000 pound	3,056.29
Removal of clean pump, >10,000 pound	5,916.26
Removal of clean pump motor, 300-1000 pound	326.13
Removal of clean pump motor, 1000-10,000 pound	1,269.15
Removal of clean pump motor, >10,000 pound	2,855.59
Removal of clean heat exchanger <3000 pound	1,642.62
Removal of clean heat exchanger >3000 pound	4,142.57
Removal of clean feedwater heater/deaerator	11,667.46
Removal of clean moisture separator/reheater	23,971.44
Removal of clean tank, <300 gallons	356.46
Removal of clean tank, 300-3000 gallon	1,121.01
Removal of clean tank, >3000 gallons, $/square foot surface area	9.61

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean electrical equipment, <300 pound	149.62
Removal of clean electrical equipment, 300-1000 pound	530.96
Removal of clean electrical equipment, 1000-10,000 pound	1,061.94
Removal of clean electrical equipment, >10,000 pound	2,536.52
Removal of clean electrical transformer < 30 tons	1,761.58
Removal of clean electrical transformer > 30 tons	5,073.05
Removal of clean standby diesel generator, <100 kW	1,799.30
Removal of clean standby diesel generator, 100 kW to 1 MW	4,016.16
Removal of clean standby diesel generator, >1 MW	8,314.26
Removal of clean electrical cable tray, $/linear foot	14.11
Removal of clean electrical conduit, $/linear foot	6.17
Removal of clean mechanical equipment, <300 pound	149.62
Removal of clean mechanical equipment, 300-1000 pound	530.96
Removal of clean mechanical equipment, 1000-10,000 pound	1,061.94
Removal of clean mechanical equipment, >10,000 pound	2,536.52
Removal of clean HVAC equipment, <300 pound	180.92
Removal of clean HVAC equipment, 300-1000 pound	638.00
Removal of clean HVAC equipment, 1000-10,000 pound	1,271.53
Removal of clean HVAC equipment, >10,000 pound	2,536.52
Removal of clean HVAC ductwork, $/pound	0.56
Removal of contaminated instrument and sampling tubing, $/linear foot	1.61
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	23.44
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	39.96
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	64.69
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	125.23
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	150.16
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	207.07
Removal of contaminated pipe >36 inches diameter, $/linear foot	244.35
Removal of contaminated valve >2 to 4 inches	480.08
Removal of contaminated valve >4 to 8 inches	584.59

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated valve >8 to 14 inches	1,189.25
Removal of contaminated valve >14 to 20 inches	1,509.93
Removal of contaminated valve >20 to 36 inches	2,007.65
Removal of contaminated valve >36 inches	2,380.45
Removal of contaminated pipe hanger for small bore piping	155.52
Removal of contaminated pipe hanger for large bore piping	513.91
Removal of contaminated pump, <300 pound	1,045.44
Removal of contaminated pump, 300-1000 pound	2,466.62
Removal of contaminated pump, 1000-10,000 pound	8,015.48
Removal of contaminated pump, >10,000 pound	19,523.70
Removal of contaminated pump motor, 300-1000 pound	1,058.11
Removal of contaminated pump motor, 1000-10,000 pound	3,271.37
Removal of contaminated pump motor, >10,000 pound	7,344.71
Removal of contaminated heat exchanger <3000 pound	4,832.75
Removal of contaminated heat exchanger >3000 pound	14,041.22
Removal of contaminated tank, <300 gallons	1,740.12
Removal of contaminated tank, >300 gallons, $/square foot	34.44
Removal of contaminated electrical equipment, <300 pound	805.46
Removal of contaminated electrical equipment, 300-1000 pound	2,006.16
Removal of contaminated electrical equipment, 1000-10,000 pound	3,864.61
Removal of contaminated electrical equipment, >10,000 pound	7,641.28
Removal of contaminated electrical cable tray, $/linear foot	38.97
Removal of contaminated electrical conduit, $/linear foot	19.41
Removal of contaminated mechanical equipment, <300 pound	895.83
Removal of contaminated mechanical equipment, 300-1000 pound	2,214.71
Removal of contaminated mechanical equipment, 1000-10,000 pound	4,259.37
Removal of contaminated mechanical equipment, >10,000 pound	7,641.28
Removal of contaminated HVAC equipment, <300 pound	895.83
Removal of contaminated HVAC equipment, 300-1000 pound	2,214.71
Removal of contaminated HVAC equipment, 1000-10,000 pound	4,259.37

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated HVAC equipment, >10,000 pound	7,641.28
Removal of contaminated HVAC ductwork, $/pound	2.28
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	4.38
Additional decontamination of surface by washing, $/square foot	8.61
Additional decontamination of surfaces by hydrolasing, $/square foot	41.33
Decontamination rig hook up and flush, $/ 250 foot length	7,534.69
Chemical flush of components/systems, $/gallon	21.10
Removal of clean standard reinforced concrete, $/cubic yard	74.66
Removal of grade slab concrete, $/cubic yard	84.91
Removal of clean concrete floors, $/cubic yard	417.22
Removal of sections of clean concrete floors, $/cubic yard	1,248.58
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	107.78
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	2,400.46
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	146.08
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	3,174.72
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cubic yard	508.32
Removal of below-grade suspended floors, $/cubic yard	204.83
Removal of clean monolithic concrete structures, $/cubic yard	1,026.49
Removal of contaminated monolithic concrete structures, $/cubic yard	2,386.17
Removal of clean foundation concrete, $/cubic yard	806.88
Removal of contaminated foundation concrete, $/cubic yard	2,223.12
Explosive demolition of bulk concrete, $/cubic yard	55.95
Removal of clean hollow masonry block wall, $/cubic yard	26.69
Removal of contaminated hollow masonry block wall, $/cubic yard	69.22
Removal of clean solid masonry block wall, $/cubic yard	26.69
Removal of contaminated solid masonry block wall, $/cubic yard	69.22
Backfill of below-grade voids, $/cubic yard	35.79
Removal of subterranean tunnels/voids, $/linear foot	123.02
Placement of concrete for below-grade voids, $/cubic yard	136.82
Excavation of clean material, $/cubic yard	3.22

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Excavation of contaminated material, $/cubic yard	45.97
Removal of clean concrete rubble (tipping fee included), $/cubic yard	26.49
Removal of contaminated concrete rubble, $/cubic yard	27.99
Removal of building by volume, $/cubic foot	0.32
Removal of clean building metal siding, $/square foot	1.45
Removal of contaminated building metal siding, $/square foot	4.72
Removal of standard asphalt roofing, $/square foot	2.48
Removal of transite panels, $/square foot	2.50
Scarifying contaminated concrete surfaces (drill & spall), $/square foot	13.63
Scabbling contaminated concrete floors, $/square foot	8.45
Scabbling contaminated concrete walls, $/square foot	22.43
Scabbling contaminated ceilings, $/square foot	77.06
Scabbling structural steel, $/square foot	6.86
Removal of clean overhead crane/monorail < 10 ton capacity	758.48
Removal of contaminated overhead crane/monorail < 10 ton capacity	2,065.08
Removal of clean overhead crane/monorail >10-50 ton capacity	1,820.34
Removal of contaminated overhead crane/monorail >10-50 ton capacity	4,955.34
Removal of polar crane > 50 ton capacity	7,619.83
Removal of gantry crane > 50 ton capacity	28,324.49
Removal of structural steel, $/pound	0.22
Removal of clean steel floor grating, $/square foot	5.70
Removal of contaminated steel floor grating, $/square foot	15.95
Removal of clean free standing steel liner, $/square foot	14.41
Removal of contaminated free standing steel liner, $/square foot	40.26
Removal of clean concrete-anchored steel liner, $/square foot	7.20
Removal of contaminated concrete-anchored steel liner, $/square foot	46.94
Placement of scaffolding in clean areas, $/square foot	17.37
Placement of scaffolding in contaminated areas, $/square foot	27.99
Landscaping with topsoil, $/acre	24,772.56
Cost of CPC B-88 LSA box & preparation for use	2,113.85

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Cost of CPC B-25 LSA box & preparation for use	1,720.62
Cost of CPC B-12V 12 gauge LSA box & preparation for use	1,647.37
Cost of CPC B-144 LSA box & preparation for use	10,592.69
Cost of LSA drum & preparation for use	239.32
Cost of cask liner for CNSI 8 120A cask (resins)	12,401.62
Cost of cask liner for CNSI 8 120A cask (filters)	8,947.16
Decontamination of surfaces with vacuuming, $/square foot	0.88

APPENDIX C

DETAILED COST ANALYSIS

DECON

with

LOW-LEVEL RADIOACTIVE WASTE PROCESSING

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
1a.1.2	Notification of Cessation of Operations									a											
1a.1.3	Remove fuel & source material									n/a											
1a.1.4	Notification of Permanent Defueling									a											
1a.1.5	Deactivate plant systems & process waste									a											
1a.1.6	Prepare and submit PSDAR	-	-	-	-	-	-	319	48	367	367	-	-	-	-	-	-	-	-	-	2,000
1a.1.7	Review plant dwgs & specs.	-	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-	-	-	-	4,600
1a.1.8	Perform detailed rad survey									a											
1a.1.9	Estimate by-product inventory	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.10	End product description	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	Detailed by-product inventory	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
1a.1.12	Define major work sequence	-	-	-	-	-	-	1,196	179	1,375	1,375	-	-	-	-	-	-	-	-	-	7,500
1a.1.13	Perform SER and EA	-	-	-	-	-	-	494	74	568	568	-	-	-	-	-	-	-	-	-	3,100
1a.1.14	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	1,196	179	1,375	1,375	-	-	-	-	-	-	-	-	-	7,500
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	797	120	917	917	-	-	-	-	-	-	-	-	-	5,000
1a.1.16	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
1a.1.17.1	Plant & temporary facilities	-	-	-	-	-	-	784	118	902	812	-	90	-	-	-	-	-	-	-	4,920
1a.1.17.2	Plant systems	-	-	-	-	-	-	664	100	764	688	-	76	-	-	-	-	-	-	-	4,167
1a.1.17.3	NSSS Decontamination Flush	-	-	-	-	-	-	80	12	92	92	-	-	-	-	-	-	-	-	-	500
1a.1.17.4	Reactor internals	-	-	-	-	-	-	1,132	170	1,302	1,302	-	-	-	-	-	-	-	-	-	7,100
1a.1.17.5	Reactor vessel	-	-	-	-	-	-	1,036	155	1,192	1,192	-	-	-	-	-	-	-	-	-	6,500
1a.1.17.6	Biological shield	-	-	-	-	-	-	80	12	92	92	-	-	-	-	-	-	-	-	-	500
1a.1.17.7	Steam generators	-	-	-	-	-	-	497	75	572	572	-	-	-	-	-	-	-	-	-	3,120
1a.1.17.8	Reinforced concrete	-	-	-	-	-	-	255	38	293	147	-	147	-	-	-	-	-	-	-	1,600
1a.1.17.9	Main Turbine	-	-	-	-	-	-	64	10	73	-	-	73	-	-	-	-	-	-	-	400
1a.1.17.10	Main Condensers	-	-	-	-	-	-	64	10	73	-	-	73	-	-	-	-	-	-	-	400
1a.1.17.11	Plant structures & buildings	-	-	-	-	-	-	497	75	572	286	-	286	-	-	-	-	-	-	-	3,120
1a.1.17.12	Waste management	-	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-	-	-	-	4,600
1a.1.17.13	Facility & site closeout	-	-	-	-	-	-	144	22	165	55	-	83	-	-	-	-	-	-	-	900
1a.1.17	Total	-	-	-	-	-	-	6,031	905	6,936	6,108	-	829	-	-	-	-	-	-	-	37,827
Planning & Site Preparations																					
1a.1.18	Prepare dismantling sequence	-	-	-	-	-	-	383	57	440	440	-	-	-	-	-	-	-	-	-	2,400
1a.1.19	Plant prep. & temp. svces	-	-	-	-	-	-	3,500	525	4,025	4,025	-	-	-	-	-	-	-	-	-	-
1a.1.20	Design water clean-up system	-	-	-	-	-	-	223	33	257	257	-	-	-	-	-	-	-	-	-	1,400
1a.1.21	Rigging/Const. Cntrl Eqvlps/tooling/etc.	-	-	-	-	-	-	2,400	360	2,760	2,760	-	-	-	-	-	-	-	-	-	-
1a.1.22	Procure casks/liners & containers	-	-	-	-	-	-	196	29	226	226	-	-	-	-	-	-	-	-	-	1,230
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	18,362	2,754	21,116	20,288	-	829	-	-	-	-	-	-	-	78,157
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	8,900	1,335	10,235	-	10,235	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	8,900	1,335	10,235	-	10,235	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	3,644	364	4,009	4,009	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	108	11	118	118	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	614	-	-	-	-	-	153	767	767	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	753	-	-	-	-	-	113	866	866	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	12	4	-	35	-	11	62	62	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,703	256	1,959	1,959	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	1,137	114	1,251	1,251	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,556	156	1,711	-	1,711	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	346	52	398	398	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	845	127	971	-	971	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	112	17	129	-	129	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate Allocations	-	-	-	-	-	-	1,000	100	1,100	1,100	-	-	-	-	-	-	-	-	-	-
1a.4.13	Security Staff Cost	-	-	-	-	-	-	16,233	2,435	18,668	18,668	-	-	-	-	-	-	-	-	-	246,315
1a.4.14	Utility Staff Cost	-	-	-	-	-	-	37,599	5,640	43,239	43,239	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,367	12	4	-	35	64,283	9,847	75,248	72,437	2,811	-	-	610	-	-	-	12,190	20	668,555
1a.0	TOTAL PERIOD 1a COST	-	1,367	12	4	-	35	91,545	13,937	106,600	92,725	13,046	829	-	610	-	-	-	12,190	20	746,712

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1b - Decommissioning Preparations																					
Period 1b Direct Decommissioning Activities																					
Detailed Work Procedures																					
1b.1.1.1	Plant systems	-	-	-	-	-	-	755	113	868	781	-	87	-	-	-	-	-	-	-	4,738
1b.1.1.2	NSSS Decontamination Flush	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.3	Reactor internals	-	-	-	-	-	-	399	60	458	458	-	-	-	-	-	-	-	-	-	2,500
1b.1.1.4	Remaining buildings	-	-	-	-	-	-	215	32	248	62	-	186	-	-	-	-	-	-	-	1,350
1b.1.1.5	CRD cooling assembly	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.6	CRD housings & ICI tubes	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.7	Incore instrumentation	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.8	Reactor vessel	-	-	-	-	-	-	579	87	666	666	-	-	-	-	-	-	-	-	-	3,630
1b.1.1.9	Facility closeout	-	-	-	-	-	-	191	29	220	110	-	110	-	-	-	-	-	-	-	1,200
1b.1.1.10	Missile shields	-	-	-	-	-	-	72	11	83	83	-	-	-	-	-	-	-	-	-	450
1b.1.1.11	Biological shield	-	-	-	-	-	-	191	29	220	220	-	-	-	-	-	-	-	-	-	1,200
1b.1.1.12	Steam generators	-	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-	-	-	-	4,600
1b.1.1.13	Reinforced concrete	-	-	-	-	-	-	159	24	183	92	-	92	-	-	-	-	-	-	-	1,000
1b.1.1.14	Main Turbine	-	-	-	-	-	-	249	37	286	-	-	286	-	-	-	-	-	-	-	1,560
1b.1.1.15	Main Condensers	-	-	-	-	-	-	249	37	286	-	-	286	-	-	-	-	-	-	-	1,560
1b.1.1.16	Auxiliary building	-	-	-	-	-	-	435	65	501	451	-	50	-	-	-	-	-	-	-	2,730
1b.1.1.17	Reactor building	-	-	-	-	-	-	435	65	501	451	-	50	-	-	-	-	-	-	-	2,730
1b.1.1	Total	-	-	-	-	-	-	5,301	795	6,096	4,949	-	1,146	-	-	-	-	-	-	-	33,243
1b.1.2	Decon primary loop	740	-	-	-	-	-	-	370	1,110	1,110	-	-	-	-	-	-	-	-	1,067	-
1b.1	Subtotal Period 1b Activity Costs	740	-	-	-	-	-	5,301	1,165	7,206	6,060	-	1,146	-	-	-	-	-	-	1,067	33,243
Period 1b Additional Costs																					
1b.2.1	Spent Fuel Pool Isolation	-	-	-	-	-	-	12,675	1,901	14,576	14,576	-	-	-	-	-	-	-	-	-	-
1b.2.2	Site Characterization	-	-	-	-	-	-	3,134	940	4,074	4,074	-	-	-	-	-	-	-	-	19,100	7,852
1b.2	Subtotal Period 1b Additional Costs	-	-	-	-	-	-	15,809	2,841	18,650	18,650	-	-	-	-	-	-	-	-	19,100	7,852
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	1,055	-	-	-	-	-	-	158	1,213	1,213	-	-	-	-	-	-	-	-	-	-
1b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
1b.3.3	Process decommissioning water waste	46	-	29	53	-	140	-	69	337	337	-	-	-	253	-	-	-	16,989	55	-
1b.3.4	Process decommissioning chemical flush waste	2	-	78	261	-	3,842	-	833	4,566	4,566	-	-	-	-	788	-	-	83,917	147	-
1b.3.5	Small tool allowance	-	2	-	-	-	-	-	0	3	3	-	-	-	-	-	-	-	-	-	-
1b.3.6	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-
1b.3.7	Decon rig	2,083	-	-	-	-	-	-	312	2,396	2,396	-	-	-	-	-	-	-	-	-	-
1b.3.8	Spent Fuel Capital and Transfer	-	-	-	-	-	-	4,450	668	5,118	-	5,118	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	3,186	1,202	107	314	-	3,981	6,086	2,516	16,894	11,777	5,118	-	-	253	788	-	-	100,906	203	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	38	-	-	-	-	-	-	9	47	47	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	1,837	184	2,021	2,021	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	54	5	60	60	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	347	-	-	-	-	-	87	434	434	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	380	-	-	-	-	-	57	436	436	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	7	8	-	21	-	6	36	36	-	-	-	360	-	-	-	7,197	12	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	1,717	258	1,975	1,975	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	326	33	359	359	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	784	78	863	-	863	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	426	64	490	-	490	-	-	-	-	-	-	-	-	-
1b.4.11	ISFSI Operating Costs	-	-	-	-	-	-	56	8	65	-	65	-	-	-	-	-	-	-	-	-
1b.4.12	Corporate Allocations	-	-	-	-	-	-	504	50	555	555	-	-	-	-	-	-	-	-	-	-
1b.4.13	Security Staff Cost	-	-	-	-	-	-	8,004	1,201	9,205	9,205	-	-	-	-	-	-	-	-	-	121,471
1b.4.14	DOC Staff Cost	-	-	-	-	-	-	7,649	1,147	8,797	8,797	-	-	-	-	-	-	-	-	-	63,961
1b.4.15	Utility Staff Cost	-	-	-	-	-	-	16,056	2,858	21,915	21,915	-	-	-	-	-	-	-	-	-	213,804
1b.4	Subtotal Period 1b Period-Dependent Costs	38	727	7	8	-	21	40,415	6,046	47,256	45,839	1,417	-	-	360	-	-	-	7,197	12	399,237
1b.0	TOTAL PERIOD 1b COST	3,964	1,929	114	317	-	3,502	67,611	12,568	90,006	82,825	6,535	1,146	-	643	788	-	-	108,103	20,381	440,432
PERIOD 1 TOTALS		3,964	3,296	126	321	-	3,537	159,156	26,206	196,606	175,060	19,581	1,975	-	1,253	788	-	-	120,293	20,401	1,187,143

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 2a - Large Component Removal																					
Period 2a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
2a.1.1.1	Reactor Coolant Piping	218	220	37	71	-	745	-	365	1,658	1,658	-	-	-	2,046	-	-	-	142,726	6,863	-
2a.1.1.2	Pressurizer Relief Tank	37	31	10	20	-	211	-	83	392	392	-	-	-	578	-	-	-	40,338	1,077	-
2a.1.1.3	Reactor Coolant Pumps & Motors	111	112	151	240	-	1,440	-	495	2,549	2,549	-	-	-	3,386	-	-	-	816,140	744	60
2a.1.1.4	Pressurizer	-	71	706	199	-	1,590	-	516	3,082	3,082	-	-	-	3,789	-	-	-	293,734	1,866	1,875
2a.1.1.5	Steam Generators	-	6,060	3,732	2,944	3,622	9,875	-	5,347	31,599	31,598	-	-	40,262	23,217	-	-	-	3,570,150	23,227	3,500
2a.1.1.6	Retired Steam Generator Units	-	-	2,733	2,889	3,622	9,589	-	3,647	22,480	22,480	-	-	40,262	22,546	-	-	-	3,349,305	10,800	2,250
2a.1.1.7	CRDMs/ICIs/Service Structure Removal	185	313	238	74	-	761	-	395	1,961	1,961	-	-	-	3,881	-	-	-	145,494	7,976	-
2a.1.1.8	Reactor Vessel Internals	165	7,187	13,655	1,382	-	14,987	416	16,780	54,482	54,482	-	-	-	1,878	963	393	-	329,968	34,307	1,531
2a.1.1.9	Vessel & Internals GTCC Disposal	-	-	-	-	-	12,538	-	1,881	14,419	14,419	-	-	-	-	-	-	2,217	433,180	-	-
2a.1.1.10	Reactor Vessel	132	8,777	3,058	1,137	-	5,740	416	10,690	29,890	29,890	-	-	-	13,554	-	-	-	972,336	34,307	1,531
2a.1.1	Totals	648	23,772	24,315	8,905	7,243	57,477	832	40,119	162,511	162,511	-	-	80,523	74,825	963	393	2,217	10,093,370	120,966	10,746
Removal of Major Equipment																					
2a.1.2	Main Turbine/Generator	-	612	374	42	847	860	-	539	3,274	3,274	-	-	4,921	2,740	-	-	-	469,360	9,888	-
2a.1.3	Main Condensers	-	1,718	212	115	995	1,069	-	883	4,989	4,989	-	-	7,701	3,216	-	-	-	550,847	27,762	-
Cascading Costs from Clean Building Demolition																					
2a.1.4.1	Reactor	-	561	-	-	-	-	-	84	645	645	-	-	-	-	-	-	-	-	4,632	-
2a.1.4.2	Auxiliary	-	276	-	-	-	-	-	41	317	317	-	-	-	-	-	-	-	-	2,113	-
2a.1.4.3	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	7	-
2a.1.4.4	Radwaste	-	53	-	-	-	-	-	8	62	62	-	-	-	-	-	-	-	-	387	-
2a.1.4.5	Fuel Building	-	117	-	-	-	-	-	17	134	134	-	-	-	-	-	-	-	-	795	-
2a.1.4	Totals	-	1,007	-	-	-	-	-	151	1,158	1,158	-	-	-	-	-	-	-	-	6,134	-
Disposal of Plant Systems																					
2a.1.5.1	100 Aux.Bldg Non-System Specific RCA	-	841	15	50	889	-	-	353	2,147	2,147	-	-	7,629	-	-	-	-	308,812	13,471	-
2a.1.5.2	100 Auxiliary Bldg Non-System Specific	-	137	6	9	55	94	-	68	368	368	-	-	474	282	-	-	-	37,164	2,252	-
2a.1.5.3	AB - Main Steam	-	324	-	-	-	-	-	49	373	-	-	373	-	-	-	-	-	-	6,893	-
2a.1.5.4	AB - Main Steam RCA	-	93	4	14	251	-	-	64	427	427	-	-	2,156	-	-	-	-	87,550	1,515	-
2a.1.5.5	AC - Main Turbine	-	320	-	-	-	-	-	48	368	-	-	368	-	-	-	-	-	-	5,641	-
2a.1.5.6	AD - Condensate	-	355	-	-	-	-	-	53	409	-	-	409	-	-	-	-	-	-	6,144	-
2a.1.5.7	AE - Feedwater	-	244	-	-	-	-	-	37	280	-	-	280	-	-	-	-	-	-	4,271	-
2a.1.5.8	AF - Feedwater Heater Extraction	-	299	-	-	-	-	-	45	344	-	-	344	-	-	-	-	-	-	5,352	-
2a.1.5.9	AK - Condensate Demineralizer	-	110	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	1,944	-
2a.1.5.10	AL - Auxiliary Feedwater	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	852	-
2a.1.5.11	AQ - Condensate & Feedwater Chem Addtn	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	468	-
2a.1.5.12	BM - Steam Generator Blowdown	-	143	6	10	104	64	-	69	396	396	-	-	892	191	-	-	-	48,483	2,394	-
2a.1.5.13	BM - Steam Generator Blowdown - RCA	-	447	8	27	479	-	-	188	1,149	1,149	-	-	4,109	-	-	-	-	166,857	7,066	-
2a.1.5.14	BN - Borated Refueling Water Storage	-	412	21	45	642	178	-	253	1,552	1,552	-	-	5,512	583	-	-	-	257,902	6,939	-
2a.1.5.15	CA - Steam Seal	-	26	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	455	-
2a.1.5.16	CB - Main Turbine Lube Oil	-	73	-	-	-	-	-	11	84	-	-	84	-	-	-	-	-	-	1,207	-
2a.1.5.17	CC - Generator Hydrogen Seal & CO2	-	12	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	198	-
2a.1.5.18	CD - Generator Seal Oil	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	287	-
2a.1.5.19	CE - Stator Cooling Water	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	241	-
2a.1.5.20	CF - Lube Oil Storage Xfer & Prfication	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	812	-
2a.1.5.21	CG - Condenser Air Removal	-	36	-	-	-	-	-	6	43	-	-	43	-	-	-	-	-	-	657	-
2a.1.5.22	CH - Main Turbine Control Oil	-	75	-	-	-	-	-	11	86	-	-	86	-	-	-	-	-	-	1,219	-
2a.1.5.23	DA - Circulating Water	-	419	-	-	-	-	-	63	482	-	-	482	-	-	-	-	-	-	7,502	-
2a.1.5.24	DB - Cooling Tower Makeup & Blowdown	-	71	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,260	-
2a.1.5.25	DD - Cooling Water Chemical Control Sys	-	63	-	-	-	-	-	9	72	-	-	72	-	-	-	-	-	-	1,084	-
2a.1.5.26	DD - Cooling Wtr Chem Control RCA	-	329	7	23	414	-	-	148	922	922	-	-	3,556	-	-	-	-	144,376	4,951	-
2a.1.5.27	EJ - Residual Heat Removal	-	473	54	64	320	805	-	383	2,100	2,100	-	-	2,744	2,413	-	-	-	265,356	6,042	-
2a.1.5.28	EM - High Pressure Coolant Injection	-	398	18	21	153	218	-	182	991	991	-	-	1,315	648	-	-	-	95,068	6,623	-
2a.1.5.29	EN - Containment Spray	-	282	6	20	368	-	-	122	762	762	-	-	9,026	-	-	-	-	122,874	4,134	-
2a.1.5.30	EP - Accumulator Safety Injection	-	209	11	16	186	96	-	108	626	626	-	-	1,599	283	-	-	-	83,200	3,478	-
2a.1.5.31	FA - Auxiliary Steam Generator	-	28	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	521	-
2a.1.5.32	FB - Auxiliary Steam	-	116	-	-	-	-	-	18	135	-	-	135	-	-	-	-	-	-	2,106	-
2a.1.5.33	FB - Auxiliary Steam RCA	-	99	2	5	95	-	-	40	241	241	-	-	816	-	-	-	-	33,148	1,537	-
2a.1.5.34	FC - Auxiliary Turbines	-	77	-	-	-	-	-	12	88	-	-	88	-	-	-	-	-	-	1,320	-
2a.1.5.35	FE - Auxiliary Steam Chemical Addition	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	105	-
2a.1.5.36	GE - Turbine Building HVAC	-	213	-	-	-	-	-	32	245	-	-	245	-	-	-	-	-	-	3,957	-
2a.1.5.37	GS - Containment Hydrogen Control	-	82	4	5	77	35	-	45	259	259	-	-	668	104	-	-	-	33,502	1,559	-
2a.1.5.38	HE - Boron Recycle	461	606	38	44	303	473	-	556	2,482	2,482	-	-	2,800	1,411	-	-	-	196,130	16,680	-

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems (continued)																					
2a.1.5.39	HF - Secondary Liquid Waste	849	1,193	85	102	721	1,073	-	1,123	5,147	5,147	-	-	6,186	3,203	-	-	-	456,359	31,896	-
2a.1.5.40	JA - Auxiliary Oil & Transfer	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	600	-
2a.1.5.41	KS - Bulk Chemical Storage	-	110	13	42	752	-	-	148	1,065	1,065	-	-	6,449	-	-	-	-	281,890	1,825	-
2a.1.5.42	LE - Oily Waste	-	218	-	-	-	-	-	33	250	-	-	250	-	-	-	-	-	-	3,866	-
2a.1.5.43	LE - Oily Waste RCA	-	285	4	15	263	-	-	113	681	681	-	-	2,256	-	-	-	-	91,628	4,296	-
2a.1.5.44	Turbine Bldg Non-System Specific	-	913	-	-	-	-	-	137	1,050	-	-	1,050	-	-	-	-	-	-	15,405	-
2a.1.5	Totals	1,311	10,320	303	516	6,068	3,036	-	4,591	26,135	21,314	-	4,822	51,976	9,068	-	-	-	2,691,208	192,076	-
2a.1.6	Scaffolding in support of decommissioning	-	1,856	26	11	159	36	-	501	2,589	2,589	-	-	1,233	109	-	-	-	62,991	36,741	-
2a.1	Subtotal Period 2a Activity Costs	2,159	38,280	25,230	9,592	15,302	62,477	832	46,785	200,658	195,836	-	4,822	148,354	89,956	963	393	2,217	13,667,890	395,566	10,746
Period 2a Collateral Costs																					
2a.3.1	Process decommissioning water waste	198	-	128	233	-	614	-	300	1,474	1,474	-	-	-	1,248	-	-	-	74,552	242	-
2a.3.2	Process decommissioning chemical flush waste	1	-	41	136	-	360	-	115	653	653	-	-	-	410	-	-	-	43,711	77	-
2a.3.3	Small tool allowance	-	411	-	-	-	-	-	62	473	426	-	47	-	-	-	-	-	-	-	-
2a.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	14,240	2,136	16,376	-	16,376	-	-	-	-	-	-	-	-	-
2a.3.5	On-site survey and release of 60.87 tons clean metallic waste	-	-	-	-	-	-	96	10	106	106	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	199	411	169	369	-	973	14,336	2,623	19,081	2,658	16,376	47	-	1,658	-	-	-	118,262	319	-
Period 2a Period-Dependent Costs																					
2a.4.1	Decon supplies	134	-	-	-	-	-	-	33	167	167	-	-	-	-	-	-	-	-	-	-
2a.4.2	Insurance	-	-	-	-	-	-	1,203	120	1,323	1,323	-	-	-	-	-	-	-	-	-	-
2a.4.3	Property taxes	-	-	-	-	-	-	193	19	212	212	-	-	-	-	-	-	-	-	-	-
2a.4.4	Health physics supplies	-	3,379	-	-	-	-	-	845	4,223	4,223	-	-	-	-	-	-	-	-	-	-
2a.4.5	Heavy equipment rental	-	4,490	-	-	-	-	-	674	5,164	5,164	-	-	-	-	-	-	-	-	-	-
2a.4.6	Disposal of DAW generated	-	-	128	47	-	378	-	114	666	666	-	-	-	6,591	-	-	-	131,817	215	-
2a.4.7	Plant energy budget	-	-	-	-	-	-	2,904	436	3,340	3,340	-	-	-	-	-	-	-	-	-	-
2a.4.8	NRC Fees	-	-	-	-	-	-	1,060	106	1,166	1,166	-	-	-	-	-	-	-	-	-	-
2a.4.9	Emergency Planning Fees	-	-	-	-	-	-	1,748	175	1,922	-	1,922	-	-	-	-	-	-	-	-	-
2a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,515	227	1,743	-	1,743	-	-	-	-	-	-	-	-	-
2a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	201	30	231	-	231	-	-	-	-	-	-	-	-	-
2a.4.12	Corporate Allocations	-	-	-	-	-	-	1,795	179	1,974	1,974	-	-	-	-	-	-	-	-	-	-
2a.4.13	Remedial Actions Surveys	-	-	-	-	-	-	1,847	277	2,124	2,124	-	-	-	-	-	-	-	-	-	-
2a.4.14	Security Staff Cost	-	-	-	-	-	-	25,509	3,826	29,335	29,335	-	-	-	-	-	-	-	-	-	387,925
2a.4.15	DOC Staff Cost	-	-	-	-	-	-	33,384	5,000	38,385	38,385	-	-	-	-	-	-	-	-	-	283,678
2a.4.16	Utility Staff Cost	-	-	-	-	-	-	48,059	7,209	55,268	55,268	-	-	-	-	-	-	-	-	-	528,163
2a.4	Subtotal Period 2a Period-Dependent Costs	134	7,869	128	47	-	378	119,368	19,271	147,193	143,297	3,896	-	-	6,591	-	-	-	131,817	215	1,199,766
2a.0	TOTAL PERIOD 2a COST	2,492	46,561	25,525	10,009	15,302	63,829	134,536	68,678	366,932	341,791	20,272	4,869	148,354	98,202	963	393	2,217	14,117,760	396,100	1,210,513
PERIOD 2b - Site Decontamination																					
Period 2b Direct Decommissioning Activities																					
Disposal of Plant Systems																					
2b.1.1.1	200 Reactor Bldg Non-System Specific	-	110	4	5	31	62	-	49	261	261	-	-	269	186	-	-	-	22,727	1,760	-
2b.1.1.2	200 Reactor Bldg Non-System Specific RCA	-	693	9	31	556	-	-	262	1,552	1,552	-	-	4,768	-	-	-	-	193,612	10,425	-
2b.1.1.3	300 Control Bldg Non-System Specific	-	216	4	14	249	-	-	94	577	577	-	-	2,139	-	-	-	-	86,849	3,413	-
2b.1.1.4	300 Control Bldg Non-System Specific Cln	-	1,653	-	-	-	-	-	248	1,901	-	-	1,901	-	-	-	-	-	-	29,076	-
2b.1.1.5	700 Radwaste Bldg Non-Sys Specific RCA	-	1,396	25	89	1,478	-	-	583	3,555	3,555	-	-	12,684	-	-	-	-	515,103	21,919	-
2b.1.1.6	700 Radwaste Bldg Non-System Specific	-	221	10	14	82	165	-	112	605	605	-	-	705	497	-	-	-	60,190	3,653	-
2b.1.1.7	AN - Demineralized Wtr Storage & Xfer	-	186	-	-	-	-	-	28	212	-	-	212	-	-	-	-	-	-	3,283	-
2b.1.1.8	AN - Demineralized Wtr Strg & Xfer RCA	-	48	1	2	37	-	-	18	106	106	-	-	314	-	-	-	-	12,759	740	-
2b.1.1.9	AP -HCST/Condensate Stor.& Transfr	-	244	-	-	-	-	-	37	281	-	-	281	-	-	-	-	-	-	4,018	-
2b.1.1.10	BB - Reactor Coolant System	-	410	37	44	211	561	-	285	1,548	1,548	-	-	1,812	1,655	-	-	-	180,839	7,074	-
2b.1.1.11	BG - Chemical & Volume Control	925	1,157	115	127	575	1,648	-	1,281	5,830	5,830	-	-	4,931	4,928	-	-	-	515,455	28,147	-
2b.1.1.12	BL - Reactor Makeup Water	-	369	24	29	225	285	-	204	1,136	1,136	-	-	1,928	850	-	-	-	132,766	6,136	-
2b.1.1.13	DE - Intake & Water Treatment	-	148	-	-	-	-	-	22	170	-	-	170	-	-	-	-	-	-	2,517	-
2b.1.1.14	DE - Intake & Water Treatment RCA	-	299	24	78	1,390	-	-	297	2,088	2,088	-	-	11,923	-	-	-	-	484,206	5,014	-
2b.1.1.15	EA - Service Water	-	175	-	-	-	-	-	26	201	-	-	201	-	-	-	-	-	-	3,145	-
2b.1.1.16	EA - Service Water RCA	-	54	2	5	145	-	-	37	246	246	-	-	1,248	-	-	-	-	50,693	839	-
2b.1.1.17	EB - Closed Cooling Water	-	71	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,267	-
2b.1.1.18	EF - Essential Service Water	-	406	-	-	-	-	-	61	467	-	-	467	-	-	-	-	-	-	7,244	-
2b.1.1.19	EF - Essential Service Water RCA	-	236	11	35	621	-	-	159	1,063	1,063	-	-	5,326	-	-	-	-	216,267	3,862	-
2b.1.1.20	EG - Component Cooling Water RCA	-	298	-	-	-	-	-	45	343	-	-	343	-	-	-	-	-	-	5,385	-
2b.1.1.21	GA - Plant Heating	-	106	-	-	-	-	-	16	122	-	-	122	-	-	-	-	-	-	1,912	-

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems (continued)																					
2b.1.1.22	GA - Plant Heating RCA	-	115	1	4	74	-	-	41	236	236	-	-	638	-	-	-	-	25,924	1,765	-
2b.1.1.23	GB - Central Chilled Water	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	1,803	-
2b.1.1.24	GB - Central Chilled Water RCA	-	31	0	1	22	-	-	11	66	66	-	-	187	-	-	-	-	7,691	482	-
2b.1.1.25	GD - Essential Serv Wtr Pumphouse HVAC	-	22	-	-	-	-	-	3	26	-	-	26	-	-	-	-	-	-	427	-
2b.1.1.26	GF - Miscellaneous Building HVAC	-	138	4	13	237	-	-	73	465	465	-	-	2,034	-	-	-	-	82,602	2,026	-
2b.1.1.27	GH - Radwaste Building HVAC	-	215	7	18	283	33	-	108	662	662	-	-	2,425	98	-	-	-	104,702	3,455	-
2b.1.1.28	GK - Control Building HVAC	-	205	-	-	-	-	-	31	236	-	-	236	-	-	-	-	-	-	3,959	-
2b.1.1.29	GL - Auxiliary Building HVAC	-	530	14	38	590	76	-	247	1,496	1,496	-	-	6,064	228	-	-	-	220,197	8,491	-
2b.1.1.30	GM - Diesel Generator Building HVAC	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	696	-
2b.1.1.31	GN - Containment Cooling	-	594	26	61	869	214	-	343	2,097	2,097	-	-	7,367	643	-	-	-	340,122	9,601	-
2b.1.1.32	GP - Containment Integrtd Leak Rate Test	-	47	1	4	68	-	-	23	142	142	-	-	580	-	-	-	-	23,570	760	-
2b.1.1.33	GR - Containment Atmospheric Control	-	24	3	8	127	14	-	30	204	204	-	-	1,086	41	-	-	-	46,886	392	-
2b.1.1.34	GT - Containment Purge HVAC	-	139	7	16	227	57	-	86	532	532	-	-	1,948	170	-	-	-	89,946	2,259	-
2b.1.1.35	HA - Gaseous Radwaste	-	431	25	31	324	226	-	220	1,258	1,258	-	-	2,782	666	-	-	-	166,216	7,037	-
2b.1.1.36	HB - Liquid Radwaste	926	1,050	79	90	648	923	-	1,074	4,789	4,789	-	-	5,660	2,745	-	-	-	402,251	30,903	-
2b.1.1.37	HC - Solid Radwaste	-	449	36	43	246	497	-	283	1,554	1,554	-	-	2,114	1,487	-	-	-	180,874	7,445	-
2b.1.1.38	HD - Decontamination	-	125	6	10	115	58	-	65	378	378	-	-	983	171	-	-	-	50,978	2,051	-
2b.1.1.39	JE - Emergency Fuel Oil	-	76	-	-	-	-	-	11	88	-	-	88	-	-	-	-	-	-	1,260	-
2b.1.1.40	KA - Compressed Air	-	233	-	-	-	-	-	35	268	-	-	268	-	-	-	-	-	-	4,187	-
2b.1.1.41	KA - Compressed Air RCA	-	155	2	5	93	-	-	54	308	308	-	-	801	-	-	-	-	32,538	2,339	-
2b.1.1.42	KB - Breathing Air	-	29	-	-	-	-	-	4	34	-	-	34	-	-	-	-	-	-	516	-
2b.1.1.43	KB - Breathing Air RCA	-	24	0	0	8	-	-	7	40	40	-	-	71	-	-	-	-	2,874	402	-
2b.1.1.44	KC - Fire Protection	-	456	-	-	-	-	-	68	524	-	-	524	-	-	-	-	-	-	8,376	-
2b.1.1.45	KC - Fire Protection RCA	-	453	9	29	514	-	-	203	1,237	1,237	-	-	4,411	-	-	-	-	179,151	7,064	-
2b.1.1.46	KD - Domestic Water	-	212	-	-	-	-	-	32	244	-	-	244	-	-	-	-	-	-	3,857	-
2b.1.1.47	KD - Domestic Water RCA	-	31	0	2	29	-	-	12	74	74	-	-	247	-	-	-	-	10,039	459	-
2b.1.1.48	KE - Fuel Handling & Storage Rctor vssl	-	23	4	7	77	52	-	32	196	196	-	-	661	158	-	-	-	36,889	375	-
2b.1.1.49	KH - Service Gas (CO2 N2 H2 & O2)	-	67	-	-	-	-	-	10	77	-	-	77	-	-	-	-	-	-	1,226	-
2b.1.1.50	KH - Service Gas (CO2 N2 H2 & O2) RCA	-	303	5	16	284	-	-	121	729	729	-	-	2,433	-	-	-	-	98,813	4,481	-
2b.1.1.51	KJ - Standby Diesel Engine	-	403	-	-	-	-	-	60	463	-	-	463	-	-	-	-	-	-	6,749	-
2b.1.1.52	LA - Sanitary Drains	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	972	-
2b.1.1.53	LA - Sanitary Drains RCA	-	127	3	8	148	-	-	56	342	342	-	-	1,273	-	-	-	-	51,884	1,811	-
2b.1.1.54	LB - Roof Drains	-	72	-	-	-	-	-	11	82	-	-	82	-	-	-	-	-	-	1,276	-
2b.1.1.55	LB - Roof Drains RCA	-	173	4	14	249	-	-	83	524	524	-	-	2,139	-	-	-	-	86,858	2,694	-
2b.1.1.56	LD - Chemical & Detergent Waste	79	144	5	7	59	70	-	104	469	469	-	-	504	211	-	-	-	33,951	3,490	-
2b.1.1.57	LF - Floor & Equipment Drains	-	1,795	119	135	436	1,907	-	1,020	5,402	5,402	-	-	8,739	5,724	-	-	-	516,484	29,350	-
2b.1.1.58	RM - Process Sampling & Analysis	-	164	9	9	77	82	-	75	416	416	-	-	661	240	-	-	-	42,526	2,774	-
2b.1.1.59	SJ - Nuclear Sampling	-	95	6	8	49	63	-	48	268	268	-	-	423	184	-	-	-	29,191	1,620	-
2b.1.1.60	UB - Services Stores Sito Security Bldg	-	217	-	-	-	-	-	33	250	-	-	250	-	-	-	-	-	-	3,815	-
2b.1.1.61	Yard Non-System Specific	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	603	-
2b.1.1	Totals	1,930	18,100	642	1,048	11,443	6,993	-	8,626	48,781	42,452	-	6,329	98,179	20,912	-	-	-	5,324,166	323,987	-
2b.1.2	Scaffolding in support of decommissioning	-	2,320	32	14	199	45	-	626	3,236	3,236	-	-	1,541	136	-	-	-	77,989	45,226	-
Decontamination of Site Buildings																					
2b.1.3.1	Reactor	1,464	2,225	164	848	699	8,204	-	3,588	17,193	17,193	-	-	5,995	57,454	-	-	-	2,681,023	56,906	-
2b.1.3.2	Auxiliary	759	443	28	133	240	443	-	660	2,705	2,705	-	-	2,058	6,938	-	-	-	412,089	19,438	-
2b.1.3.3	Communication Corridor - Contaminated	17	7	1	3	2	9	-	13	52	52	-	-	17	152	-	-	-	7,854	395	-
2b.1.3.4	Hot Machine Shop	21	16	1	3	-	11	-	18	70	70	-	-	-	188	-	-	-	8,892	597	-
2b.1.3.5	RAM Storage Building	52	18	1	7	2	24	-	38	143	143	-	-	19	389	-	-	-	19,136	1,162	-
2b.1.3.6	Radioactive and Personnel Tunnel	7	14	0	2	-	6	-	9	39	39	-	-	-	106	-	-	-	5,022	355	-
2b.1.3.7	Radwaste	404	213	14	69	98	233	-	340	1,372	1,372	-	-	844	3,681	-	-	-	208,817	10,006	-
2b.1.3.8	Radwaste Drum Storage	45	22	1	8	8	26	-	37	147	147	-	-	66	413	-	-	-	22,243	1,093	-
2b.1.3.9	Reactor Head Assembly Building	40	-	-	-	-	-	-	20	59	59	-	-	-	-	-	-	-	-	691	-
2b.1.3.10	Steam Generator Replacement Bldgs	295	-	-	-	-	-	-	148	444	444	-	-	-	-	-	-	-	-	4,358	-
2b.1.3	Totals	3,105	2,959	210	1,072	1,049	8,967	-	4,871	22,223	22,223	-	-	8,999	69,322	-	-	-	3,364,877	93,979	-
2b.1.4	Prepare/submit License Termination Plan	-	-	-	-	-	-	653	98	751	751	-	-	-	-	-	-	-	-	-	4,096
2b.1.5	Receive NRC approval of termination plan									a											
2b.1	Subtotal Period 2b Activity Costs	5,034	23,379	884	2,134	12,691	15,995	653	14,221	74,992	68,663	-	6,329	108,720	90,370	-	-	-	8,767,052	463,873	4,096

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 2b Additional Costs																					
2b.2.1	Sanitary Treatment Lagoon	-	6	86	121	-	524	-	159	896	896	-	-	-	4,606	-	-	-	392,140	423	-
2b.2.2	Cooling Tower Asbestos Panel Removal	-	5,989	-	167	-	-	613	1,014	7,772	-	-	7,772	-	-	-	-	-	-	71,419	-
2b.2.3	Operational Equipment	-	-	22	85	644	-	-	138	1,089	1,089	-	-	11,760	-	-	-	-	294,000	32	-
2b.2.4	Retired Reactor Closure Head	-	136	623	1,040	-	1,078	-	522	3,399	3,399	-	-	-	2,764	-	-	-	338,540	3,167	2,000
2b.2	Subtotal Period 2b Additional Costs	-	6,131	731	1,382	844	1,602	613	1,833	13,156	5,364	-	7,772	11,760	7,372	-	-	-	1,024,680	76,081	2,000
Period 2b Collateral Costs																					
2b.3.1	Process decommissioning water waste	173	-	115	210	-	551	-	267	1,817	1,317	-	-	-	1,116	-	-	-	66,951	218	-
2b.3.2	Process decommissioning chemical flush waste	3	-	133	444	-	1,173	-	375	2,128	2,128	-	-	-	1,338	-	-	-	142,540	260	-
2b.3.3	Small tool allowance	-	516	-	-	-	-	-	77	592	592	-	-	-	-	-	-	-	-	-	-
2b.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	21,380	3,204	24,564	-	24,564	-	-	-	-	-	-	-	-	-
2b.3.5	On-site survey and release of 309.6 tons clean metallic waste	-	-	-	-	-	-	489	49	538	538	-	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	177	516	248	653	-	1,724	21,849	3,972	29,139	4,575	24,564	-	-	2,453	-	-	-	209,491	468	-
Period 2b Period-Dependent Costs																					
2b.4.1	Decon supplies	1,648	-	-	-	-	-	-	412	2,060	2,060	-	-	-	-	-	-	-	-	-	-
2b.4.2	Insurance	-	-	-	-	-	-	1,477	148	1,624	1,624	-	-	-	-	-	-	-	-	-	-
2b.4.3	Property taxes	-	-	-	-	-	-	237	24	261	261	-	-	-	-	-	-	-	-	-	-
2b.4.4	Health physics supplies	-	4,432	-	-	-	-	-	1,108	5,540	5,540	-	-	-	-	-	-	-	-	-	-
2b.4.5	Heavy equipment rental	-	5,661	-	-	-	-	-	849	6,510	6,510	-	-	-	-	-	-	-	-	-	-
2b.4.6	Disposal of DAW generated	-	-	126	47	-	377	-	114	664	664	-	-	-	6,571	-	-	-	131,421	214	-
2b.4.7	Plant energy budget	-	-	-	-	-	-	2,814	422	3,236	3,236	-	-	-	-	-	-	-	-	-	-
2b.4.8	NRC Fees	-	-	-	-	-	-	1,301	130	1,431	1,431	-	-	-	-	-	-	-	-	-	-
2b.4.9	Emergency Planning Fees	-	-	-	-	-	-	2,145	215	2,360	-	2,360	-	-	-	-	-	-	-	-	-
2b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,860	279	2,139	-	2,139	-	-	-	-	-	-	-	-	-
2b.4.11	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	468	70	538	538	-	-	-	-	-	-	-	-	-	-
2b.4.12	ISFSI Operating Costs	-	-	-	-	-	-	247	37	284	-	284	-	-	-	-	-	-	-	-	-
2b.4.13	Corporate Allocations	-	-	-	-	-	-	2,203	220	2,423	2,423	-	-	-	-	-	-	-	-	-	-
2b.4.14	Remedial Actions Surveys	-	-	-	-	-	-	2,267	340	2,607	2,607	-	-	-	-	-	-	-	-	-	-
2b.4.15	Security Staff Cost	-	-	-	-	-	-	31,311	4,697	36,008	36,008	-	-	-	-	-	-	-	-	-	476,171
2b.4.16	DOC Staff Cost	-	-	-	-	-	-	39,440	5,916	45,356	45,356	-	-	-	-	-	-	-	-	-	334,464
2b.4.17	Utility Staff Cost	-	-	-	-	-	-	56,665	8,500	65,165	65,165	-	-	-	-	-	-	-	-	-	620,820
2b.4	Subtotal Period 2b Period-Dependent Costs	1,648	10,093	126	47	-	377	142,435	23,460	178,206	178,424	4,783	-	-	6,571	-	-	-	131,421	214	1,431,455
2b.0	TOTAL PERIOD 2b COST	6,859	40,118	1,989	4,216	13,535	19,698	165,550	43,606	295,473	252,025	29,347	14,101	120,480	106,766	-	-	-	10,132,520	538,596	1,437,551
PERIOD 2d - Decontamination Following Wet Fuel Storage																					
Period 2d Direct Decommissioning Activities																					
2d.1.1	Remove spent fuel racks	955	100	276	134	-	2,322	-	1,131	4,918	4,918	-	-	-	6,988	-	-	-	443,960	1,925	-
Disposal of Plant Systems																					
2d.1.2.1	600 Fuel Bldg Non-Specific Systems RCA	-	377	6	21	373	-	-	154	931	931	-	-	3,200	-	-	-	-	129,974	5,869	-
2d.1.2.2	600 Fuel Bldg Non-System Specific	-	59	3	8	20	40	-	28	153	153	-	-	170	120	-	-	-	14,568	954	-
2d.1.2.3	EC - Fuel Pool Cooling & Cleanup	-	486	27	38	303	364	-	266	1,484	1,484	-	-	2,602	1,090	-	-	-	175,237	8,051	-
2d.1.2.4	GA- Plant Heating Fuel Building	-	27	1	1	6	14	-	11	61	61	-	-	50	41	-	-	-	4,700	449	-
2d.1.2.5	GG - Fuel Building HVAC	-	292	10	27	435	52	-	156	972	972	-	-	3,729	156	-	-	-	161,297	4,673	-
2d.1.2.6	KC- Fire Protection Fuel Building	-	143	2	8	144	-	-	59	356	356	-	-	1,239	-	-	-	-	50,329	2,115	-
2d.1.2	Totals	-	1,382	50	99	1,281	470	-	675	3,957	3,957	-	-	10,991	1,407	-	-	-	536,105	22,102	-
Decontamination of Site Buildings																					
2d.1.3.1	Fuel Building	958	1,026	14	48	315	143	-	827	3,331	3,331	-	-	2,705	1,864	-	-	-	199,762	31,564	-
2d.1.3	Totals	958	1,026	14	48	315	143	-	827	3,331	3,331	-	-	2,705	1,864	-	-	-	199,762	31,564	-
2d.1.4	Scaffolding in support of decommissioning	-	464	6	3	40	9	-	125	647	647	-	-	308	27	-	-	-	15,598	9,185	-
2d.1	Subtotal Period 2d Activity Costs	1,913	2,972	346	284	1,636	2,943	-	2,788	12,853	12,853	-	-	14,004	10,287	-	-	-	1,195,425	64,776	-
Period 2d Additional Costs																					
2d.2.1	License Termination Survey Planning	-	-	-	-	-	-	1,759	528	2,287	2,287	-	-	-	-	-	-	-	-	-	12,480
2d.2.2	License Termination ISFSI	-	591	110	98	-	3,112	3,411	1,830	9,152	9,152	-	-	-	13,299	-	-	-	851,056	17,021	10,896
2d.2	Subtotal Period 2d Additional Costs	-	591	110	98	-	3,112	5,170	2,358	11,439	11,439	-	-	-	13,299	-	-	-	851,056	17,021	23,376

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 2d Collateral Costs																					
2d.3.1	Process decommissioning water waste	93	-	62	113	-	297	-	144	708	708	-	-	-	601	-	-	-	36,084	117	-
2d.3.2	Process decommissioning chemical flush waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2d.3.3	Small tool allowance	-	88	-	-	-	-	-	13	101	101	-	-	-	-	-	-	-	-	-	-
2d.3.4	Decommissioning Equipment Disposition	-	-	125	61	775	176	-	182	1,319	1,319	-	-	6,000	529	-	-	-	303,608	147	-
2d.3	Subtotal Period 2d Collateral Costs	93	88	187	174	775	473	-	339	2,128	2,128	-	-	6,000	1,130	-	-	-	339,672	264	-
Period 2d Period-Dependent Costs																					
2d.4.1	Decon supplies	241	-	-	-	-	-	-	60	302	302	-	-	-	-	-	-	-	-	-	-
2d.4.2	Insurance	-	-	-	-	-	-	446	45	491	491	-	-	-	-	-	-	-	-	-	-
2d.4.3	Property taxes	-	-	-	-	-	-	72	7	79	79	-	-	-	-	-	-	-	-	-	-
2d.4.4	Health physics supplies	-	837	-	-	-	-	-	209	1,047	1,047	-	-	-	-	-	-	-	-	-	-
2d.4.5	Heavy equipment rental	-	1,711	-	-	-	-	-	257	1,968	1,968	-	-	-	-	-	-	-	-	-	-
2d.4.6	Disposal of DAW generated	-	-	40	15	-	119	-	36	210	210	-	-	-	2,081	-	-	-	41,624	68	-
2d.4.7	Plant energy budget	-	-	-	-	-	-	454	68	522	522	-	-	-	-	-	-	-	-	-	-
2d.4.8	NRC Fees	-	-	-	-	-	-	375	37	412	412	-	-	-	-	-	-	-	-	-	-
2d.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	283	42	326	326	-	-	-	-	-	-	-	-	-	-
2d.4.10	Corporate Allocations	-	-	-	-	-	-	666	67	732	732	-	-	-	-	-	-	-	-	-	-
2d.4.11	Remedial Actions Surveys	-	-	-	-	-	-	685	103	788	788	-	-	-	-	-	-	-	-	-	-
2d.4.12	Security Staff Cost	-	-	-	-	-	-	1,878	252	1,930	1,930	-	-	-	-	-	-	-	-	-	20,772
2d.4.13	DOC Staff Cost	-	-	-	-	-	-	8,178	1,226	9,399	9,399	-	-	-	-	-	-	-	-	-	69,238
2d.4.14	Utility Staff Cost	-	-	-	-	-	-	12,280	1,842	14,122	14,122	-	-	-	-	-	-	-	-	-	130,861
2d.4	Subtotal Period 2d Period-Dependent Costs	241	2,548	40	15	-	119	25,111	4,251	32,326	32,326	-	-	-	2,081	-	-	-	41,624	68	220,870
2d.0	TOTAL PERIOD 2d COST	2,247	6,199	684	570	2,411	6,647	30,281	9,706	58,746	58,746	-	-	20,004	28,797	-	-	-	2,427,777	82,129	244,246
PERIOD 2f - License Termination																					
Period 2f Direct Decommissioning Activities																					
2f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	168	49	212	212	-	-	-	-	-	-	-	-	-	-
2f.1.2	Terminate license									a											
2f.1	Subtotal Period 2f Activity Costs	-	-	-	-	-	-	168	49	212	212	-	-	-	-	-	-	-	-	-	-
Period 2f Additional Costs																					
2f.2.1	License Termination Survey	-	-	-	-	-	-	9,385	2,815	12,200	12,200	-	-	-	-	-	-	-	-	153,878	6,240
2f.2	Subtotal Period 2f Additional Costs	-	-	-	-	-	-	9,385	2,815	12,200	12,200	-	-	-	-	-	-	-	-	153,878	6,240
Period 2f Collateral Costs																					
2f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
2f.3	Subtotal Period 2f Collateral Costs	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
Period 2f Period-Dependent Costs																					
2f.4.1	Insurance	-	-	-	-	-	-	507	51	558	558	-	-	-	-	-	-	-	-	-	-
2f.4.2	Property taxes	-	-	-	-	-	-	81	8	90	90	-	-	-	-	-	-	-	-	-	-
2f.4.3	Health physics supplies	-	910	-	-	-	-	-	228	1,138	1,138	-	-	-	-	-	-	-	-	-	-
2f.4.4	Disposal of DAW generated	-	-	7	3	-	20	-	6	36	36	-	-	-	353	-	-	-	7,050	11	-
2f.4.5	Plant energy budget	-	-	-	-	-	-	258	39	296	296	-	-	-	-	-	-	-	-	-	-
2f.4.6	NRC Fees	-	-	-	-	-	-	427	43	470	470	-	-	-	-	-	-	-	-	-	-
2f.4.7	Corporate Allocations	-	-	-	-	-	-	756	76	832	832	-	-	-	-	-	-	-	-	-	-
2f.4.8	Security Staff Cost	-	-	-	-	-	-	1,906	286	2,192	2,192	-	-	-	-	-	-	-	-	-	23,692
2f.4.9	DOC Staff Cost	-	-	-	-	-	-	6,579	1,032	7,910	7,910	-	-	-	-	-	-	-	-	-	57,408
2f.4.10	Utility Staff Cost	-	-	-	-	-	-	7,882	1,152	8,834	8,834	-	-	-	-	-	-	-	-	-	74,709
2f.4	Subtotal Period 2f Period-Dependent Costs	-	910	7	3	-	20	18,496	2,919	22,365	22,365	-	-	-	353	-	-	-	7,050	11	155,709
2f.0	TOTAL PERIOD 2f COST	-	910	7	3	-	20	29,680	6,029	36,649	36,649	-	-	-	353	-	-	-	7,050	11	161,949
PERIOD 2 TOTALS		11,598	93,785	28,204	14,795	31,248	90,195	360,047	127,920	757,799	689,210	49,619	18,970	256,857	232,117	963	393	2,217	26,685,210	1,171,704	3,064,259

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 3b - Site Restoration																					
Period 3b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
3b.1.1.1	Reactor	-	3,189	-	-	-	-	-	478	3,667	-	-	3,667	-	-	-	-	-	-	27,502	-
3b.1.1.2	Auxiliary	-	2,481	-	-	-	-	-	372	2,853	-	-	2,853	-	-	-	-	-	-	19,024	-
3b.1.1.3	Auxiliary Boiler	-	23	-	-	-	-	-	3	27	-	-	27	-	-	-	-	-	-	248	-
3b.1.1.4	Barge Facility	-	924	-	-	-	-	-	139	1,063	-	-	1,063	-	-	-	-	-	-	4,290	-
3b.1.1.5	Circulating & Service Water Pumphouse	-	218	-	-	-	-	-	33	251	-	-	251	-	-	-	-	-	-	1,996	-
3b.1.1.6	Communication Corridor - Clean	-	892	-	-	-	-	-	134	1,026	-	-	1,026	-	-	-	-	-	-	8,280	-
3b.1.1.7	Communication Corridor - Contaminated	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	184	-
3b.1.1.8	Cooling Tower Concrete	-	433	-	-	-	-	-	65	498	-	-	498	-	-	-	-	-	-	2,332	-
3b.1.1.9	Diesel Generator	-	291	-	-	-	-	-	44	335	-	-	335	-	-	-	-	-	-	2,185	-
3b.1.1.10	Essential Service Water Pumphouse	-	169	-	-	-	-	-	25	194	-	-	194	-	-	-	-	-	-	955	-
3b.1.1.11	Fire Water Pumphouse	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	151	-
3b.1.1.12	Flex Building Storage	-	309	-	-	-	-	-	46	355	-	-	355	-	-	-	-	-	-	1,972	-
3b.1.1.13	Hardened Condensate Storage Tank - HCST	-	195	-	-	-	-	-	29	224	-	-	224	-	-	-	-	-	-	1,870	-
3b.1.1.14	Hot Machine Shop	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	243	-
3b.1.1.15	Intake	-	209	-	-	-	-	-	31	240	-	-	240	-	-	-	-	-	-	1,411	-
3b.1.1.16	Misc. Structures	-	2,147	-	-	-	-	-	322	2,469	-	-	2,469	-	-	-	-	-	-	18,774	-
3b.1.1.17	Miscellaneous Site Foundations	-	186	-	-	-	-	-	28	214	-	-	214	-	-	-	-	-	-	1,011	-
3b.1.1.18	Outage Maintenance	-	128	-	-	-	-	-	19	147	-	-	147	-	-	-	-	-	-	1,570	-
3b.1.1.19	RAM Storage Building	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	624	-
3b.1.1.20	Radioactive and Personnel Tunnel	-	32	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	386	-
3b.1.1.21	Radwaste	-	1,056	-	-	-	-	-	158	1,214	-	-	1,214	-	-	-	-	-	-	8,131	-
3b.1.1.22	Radwaste Drum Storage	-	161	-	-	-	-	-	24	185	-	-	185	-	-	-	-	-	-	1,449	-
3b.1.1.23	Reactor Head Assembly Building	-	81	-	-	-	-	-	12	93	-	-	93	-	-	-	-	-	-	1,108	-
3b.1.1.24	Security Additions	-	1,583	-	-	-	-	-	237	1,820	-	-	1,820	-	-	-	-	-	-	6,051	-
3b.1.1.25	Service	-	422	-	-	-	-	-	63	485	-	-	485	-	-	-	-	-	-	3,485	-
3b.1.1.26	Sludge Pump Station & Lagoon	-	1,582	-	-	-	-	-	237	1,820	-	-	1,820	-	-	-	-	-	-	10,601	-
3b.1.1.27	Steam Generator Replacement Bldgs	-	852	-	-	-	-	-	128	979	-	-	979	-	-	-	-	-	-	6,874	-
3b.1.1.28	Turbine Building	-	3,653	-	-	-	-	-	548	4,201	-	-	4,201	-	-	-	-	-	-	47,075	-
3b.1.1.29	Turbine Pedestal	-	540	-	-	-	-	-	81	620	-	-	620	-	-	-	-	-	-	2,934	-
3b.1.1.30	U.H.S. Cooling Tower	-	330	-	-	-	-	-	49	379	-	-	379	-	-	-	-	-	-	1,814	-
3b.1.1.31	Water Treatment Plant	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	9	-
3b.1.1.32	Fuel Building	-	1,106	-	-	-	-	-	166	1,272	-	-	1,272	-	-	-	-	-	-	8,068	-
3b.1.1	Totals	-	23,316	-	-	-	-	-	3,497	26,813	-	-	26,813	-	-	-	-	-	-	192,587	-
Site Closeout Activities																					
3b.1.2	Remove Rubble	-	1,399	-	-	-	-	-	210	1,608	-	-	1,608	-	-	-	-	-	-	7,233	-
3b.1.3	Grade & landscape site	-	130	-	-	-	-	-	19	149	-	-	149	-	-	-	-	-	-	692	-
3b.1.4	Final report to NRC	-	-	-	-	-	-	249	37	286	286	-	-	-	-	-	-	-	-	-	1,560
3b.1	Subtotal Period 3b Activity Costs	-	24,844	-	-	-	-	249	3,764	28,857	286	-	28,571	-	-	-	-	-	-	200,413	1,560
Period 3b Additional Costs																					
3b.2.1	Concrete Crushing	-	1,379	-	-	-	-	13	209	1,601	-	-	1,601	-	-	-	-	-	-	6,035	-
3b.2.2	Mine Area Backfill	-	5,308	-	-	-	-	-	796	6,104	-	-	6,104	-	-	-	-	-	-	15,960	-
3b.2.3	Cooling Tower Discharge & Intake Pipe Flow Fill	-	4,074	-	-	-	-	-	611	4,685	-	-	4,685	-	-	-	-	-	-	9,568	-
3b.2.4	Cooling Tower Demolition	-	4,779	-	-	-	-	-	717	5,496	-	-	5,496	-	-	-	-	-	-	21,619	-
3b.2.5	Excavation of Underground Services	-	2,833	-	-	-	-	487	423	3,244	-	-	3,244	-	-	-	-	-	-	14,184	-
3b.2.6	Construction Debris	-	-	-	-	-	-	5,080	755	5,785	-	-	5,785	-	-	-	-	-	-	-	-
3b.2.7	Site Restoration ISFSI	-	1,152	-	-	-	-	86	186	1,423	-	-	1,423	-	-	-	-	-	-	9,601	160
3b.2	Subtotal Period 3b Additional Costs	-	19,026	-	-	-	-	5,616	3,696	28,338	-	-	28,338	-	-	-	-	-	-	76,967	160
Period 3b Collateral Costs																					
3b.3.1	Small tool allowance	-	303	-	-	-	-	-	46	349	-	-	349	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	-	303	-	-	-	-	-	46	349	-	-	349	-	-	-	-	-	-	-	-

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 3b Period-Dependent Costs																					
3b.4.1	Insurance	-	-	-	-	-	-	1,008	101	1,109	-	-	1,109	-	-	-	-	-	-	-	-
3b.4.2	Property taxes	-	-	-	-	-	-	162	16	178	-	-	178	-	-	-	-	-	-	-	-
3b.4.3	Heavy equipment rental	-	5,067	-	-	-	-	-	760	5,827	-	-	5,827	-	-	-	-	-	-	-	-
3b.4.4	Plant energy budget	-	-	-	-	-	-	256	38	295	-	-	295	-	-	-	-	-	-	-	-
3b.4.5	Corporate Allocations	-	-	-	-	-	-	1,504	150	1,655	-	-	1,655	-	-	-	-	-	-	-	-
3b.4.6	Security Staff Cost	-	-	-	-	-	-	2,929	439	3,368	-	-	3,368	-	-	-	-	-	-	-	37,543
3b.4.7	DOC Staff Cost	-	-	-	-	-	-	13,311	1,997	15,308	-	-	15,308	-	-	-	-	-	-	-	106,371
3b.4.8	Utility Staff Cost	-	-	-	-	-	-	6,215	932	7,148	-	-	7,148	-	-	-	-	-	-	-	61,007
3b.4	Subtotal Period 3b Period-Dependent Costs	-	5,067	-	-	-	-	25,386	4,434	34,887	-	-	34,887	-	-	-	-	-	-	-	204,920
3b.0	TOTAL PERIOD 3b COST	-	49,240	-	-	-	-	31,251	11,940	92,431	286	-	92,145	-	-	-	-	-	-	277,379	206,640
PERIOD 3 TOTALS		-	49,240	-	-	-	-	31,251	11,940	92,431	286	-	92,145	-	-	-	-	-	-	277,379	206,640
TOTAL COST TO DECOMMISSION		15,562	146,324	26,329	15,120	31,248	93,732	550,454	186,068	1,046,835	864,546	69,200	113,090	286,837	233,370	1,750	393	2,217	26,805,500	1,469,485	4,448,042

TOTAL COST TO DECOMMISSION WITH 18.85% CONTINGENCY:	$1,046,835	thousands of 2020 dollars
TOTAL NRC LICENSE TERMINATION COST IS 82.59% OR:	$864,546	thousands of 2020 dollars
SPENT FUEL MANAGEMENT COST IS 6.61% OR:	$69,200	thousands of 2020 dollars
NON-NUCLEAR DEMOLITION COST IS 10.8% OR:	$113,090	thousands of 2020 dollars
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	235,513	Cubic Feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	2,217	Cubic Feet
TOTAL SCRAP METAL REMOVED:	71,073	Tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,469,485	Man-hours

End Notes:
n/a - indicates that this activity not charged as decommissioning expense
a - indicates that this activity performed by decommissioning staff
0 - indicates that this value is less than 0.5 but is non-zero
A cell containing " - " indicates a zero value

APPENDIX D

DETAILED COST ANALYSIS

SAFSTOR

with

LOW-LEVEL RADIOACTIVE WASTE PROCESSING

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	SAFSTOR site characterization survey	-	-	-	-	-	-	385	115	500	500	-	-	-	-	-	-	-	-	-	-
1a.1.2	Prepare preliminary decommissioning cost	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
1a.1.3	Notification of Cessation of Operations									a											
1a.1.4	Remove fuel & source material									n/a											
1a.1.5	Notification of Permanent Defueling									a											
1a.1.6	Deactivate plant systems & process waste									a											
1a.1.7	Prepare and submit PSDAR	-	-	-	-	-	-	319	48	367	367	-	-	-	-	-	-	-	-	-	2,000
1a.1.8	Review plant dwgs & specs.	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
1a.1.9	Perform detailed rad survey									a											
1a.1.10	Estimate by-product inventory	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	End product description	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.12	Detailed by-product inventory	-	-	-	-	-	-	239	36	275	275	-	-	-	-	-	-	-	-	-	1,500
1a.1.13	Define major work sequence	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.14	Perform SER and EA	-	-	-	-	-	-	494	74	568	568	-	-	-	-	-	-	-	-	-	3,100
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	797	120	917	917	-	-	-	-	-	-	-	-	-	5,000
Activity Specifications																					
1a.1.16.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	784	118	902	902	-	-	-	-	-	-	-	-	-	4,820
1a.1.16.2	Plant systems	-	-	-	-	-	-	664	100	764	764	-	-	-	-	-	-	-	-	-	4,167
1a.1.16.3	Plant structures and buildings	-	-	-	-	-	-	497	75	572	572	-	-	-	-	-	-	-	-	-	5,120
1a.1.16.4	Waste management	-	-	-	-	-	-	319	48	367	367	-	-	-	-	-	-	-	-	-	2,000
1a.1.16.5	Facility and site dormancy	-	-	-	-	-	-	319	48	367	367	-	-	-	-	-	-	-	-	-	2,000
1a.1.16	Total	-	-	-	-	-	-	2,584	388	2,972	2,972	-	-	-	-	-	-	-	-	-	16,207
Detailed Work Procedures																					
1a.1.17.1	Plant systems	-	-	-	-	-	-	189	28	217	217	-	-	-	-	-	-	-	-	-	1,183
1a.1.17.2	Facility closeout & dormancy	-	-	-	-	-	-	191	29	220	220	-	-	-	-	-	-	-	-	-	1,200
1a.1.17	Total	-	-	-	-	-	-	380	57	437	437	-	-	-	-	-	-	-	-	-	2,383
1a.1.18	Procure vacuum drying system	-	-	-	-	-	-	16	2	18	18	-	-	-	-	-	-	-	-	-	100
1a.1.19	Drain/de-energize non-cont. systems									a											
1a.1.20	Drain & dry NSSS									a											
1a.1.21	Drain/de-energize contaminated systems									a											
1a.1.22	Decon/secure contaminated systems									a											
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	6,107	974	7,081	7,081	-	-	-	-	-	-	-	-	-	35,890
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	8,900	1,335	10,235	-	10,235	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	8,900	1,335	10,235	-	10,235	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	3,644	364	4,009	4,009	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	108	11	118	118	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	614	-	-	-	-	-	153	767	767	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	753	-	-	-	-	-	113	866	866	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	12	4	-	35	-	11	62	62	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,708	256	1,959	1,959	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	892	89	981	981	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,556	156	1,711	-	1,711	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	346	52	398	398	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	845	127	971	-	971	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	112	17	129	-	129	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate Allocations	-	-	-	-	-	-	1,000	100	1,100	1,100	-	-	-	-	-	-	-	-	-	-
1a.4.13	Security Staff Cost	-	-	-	-	-	-	16,233	2,435	18,668	18,668	-	-	-	-	-	-	-	-	-	246,315
1a.4.14	Utility Staff Cost	-	-	-	-	-	-	37,599	5,640	43,238	43,238	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,367	12	4	-	35	64,038	9,523	74,978	72,167	2,811	-	-	610	-	-	-	12,190	20	668,555
1a.0	TOTAL PERIOD 1a COST	-	1,367	12	4	-	35	78,045	11,831	92,294	79,248	13,046	-	-	610	-	-	-	12,190	20	704,445

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1b - SAFSTOR Limited DECON Activities																					
Period 1b Direct Decommissioning Activities																					
Decontamination of Site Buildings																					
1b.1.1.1	Reactor	1,443	-	-	-	-	-	-	721	2,164	2,164	-	-	-	-	-	-	-	-	24,102	-
1b.1.1.2	Auxiliary	714	-	-	-	-	-	-	357	1,071	1,071	-	-	-	-	-	-	-	-	12,527	-
1b.1.1.3	Communication Corridor - Contaminated	16	-	-	-	-	-	-	8	24	24	-	-	-	-	-	-	-	-	276	-
1b.1.1.4	Fuel Building	945	-	-	-	-	-	-	473	1,418	1,418	-	-	-	-	-	-	-	-	14,371	-
1b.1.1.5	Hot Machine Shop	20	-	-	-	-	-	-	10	29	29	-	-	-	-	-	-	-	-	344	-
1b.1.1.6	RAM Storage Building	49	-	-	-	-	-	-	25	74	74	-	-	-	-	-	-	-	-	865	-
1b.1.1.7	Radioactive and Personnel Tunnel	6	-	-	-	-	-	-	3	9	9	-	-	-	-	-	-	-	-	102	-
1b.1.1.8	Radwaste	380	-	-	-	-	-	-	190	571	571	-	-	-	-	-	-	-	-	6,671	-
1b.1.1.9	Radwaste Drum Storage	43	-	-	-	-	-	-	21	64	64	-	-	-	-	-	-	-	-	750	-
1b.1.1.10	Reactor Head Assembly Building	40	-	-	-	-	-	-	20	59	59	-	-	-	-	-	-	-	-	691	-
1b.1.1	Totals	3,656	-	-	-	-	-	-	1,828	5,484	5,484	-	-	-	-	-	-	-	-	60,700	-
1b.1	Subtotal Period 1b Activity Costs	3,656	-	-	-	-	-	-	1,828	5,484	5,484	-	-	-	-	-	-	-	-	60,700	-
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	1,055	-	-	-	-	-	-	158	1,213	1,213	-	-	-	-	-	-	-	-	-	-
1b.3.2	Process decommissioning water waste	176	-	112	204	-	536	-	264	1,292	1,292	-	-	-	1,085	-	-	-	65,127	212	-
1b.3.4	Small tool allowance	-	61	-	-	-	-	-	9	70	70	-	-	-	-	-	-	-	-	-	-
1b.3.5	Spent Fuel Capital and Transfer	-	-	-	-	-	-	2,670	401	3,071	-	3,071	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	1,231	61	112	204	-	536	2,670	832	5,646	2,576	3,071	-	-	1,085	-	-	-	65,127	212	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	1,586	-	-	-	-	-	-	397	1,985	1,985	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	819	92	1,010	1,010	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	27	3	30	30	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	501	-	-	-	-	-	125	626	626	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	190	-	-	-	-	-	28	218	218	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	14	5	-	43	-	13	76	76	-	-	-	752	-	-	-	15,043	25	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	429	64	494	494	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	163	16	179	179	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	392	39	431	-	431	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	218	32	245	-	245	-	-	-	-	-	-	-	-	-
1b.4.11	ISFSI Operating Costs	-	-	-	-	-	-	28	4	32	-	32	-	-	-	-	-	-	-	-	-
1b.4.12	Corporate Allocations	-	-	-	-	-	-	252	25	277	277	-	-	-	-	-	-	-	-	-	-
1b.4.13	Security Staff Cost	-	-	-	-	-	-	4,005	601	4,606	4,606	-	-	-	-	-	-	-	-	-	60,774
1b.4.14	Utility Staff Cost	-	-	-	-	-	-	9,477	1,422	10,899	10,899	-	-	-	-	-	-	-	-	-	106,428
1b.4	Subtotal Period 1b Period-Dependent Costs	1,586	691	14	5	-	43	15,905	2,862	21,109	20,400	709	-	-	752	-	-	-	15,043	25	167,202
1b.0	TOTAL PERIOD 1b COST	6,475	752	127	209	-	579	18,575	5,522	32,239	28,460	3,779	-	-	1,838	-	-	-	80,170	60,936	167,202
PERIOD 1c - Preparations for SAFSTOR Dormancy																					
Period 1c Direct Decommissioning Activities																					
1c.1.1	Prepare support equipment for storage	-	407	-	-	-	-	-	61	468	468	-	-	-	-	-	-	-	-	3,000	-
1c.1.2	Install containment pressure equal. lines	-	26	-	-	-	-	-	4	30	30	-	-	-	-	-	-	-	-	700	-
1c.1.3	Interim survey prior to dormancy	-	-	-	-	-	-	733	220	953	953	-	-	-	-	-	-	-	-	13,933	-
1c.1.4	Secure building accesses									a											
1c.1.5	Prepare & submit interim report	-	-	-	-	-	-	93	14	107	107	-	-	-	-	-	-	-	-	-	583
1c.1	Subtotal Period 1c Activity Costs	-	432	-	-	-	-	826	299	1,557	1,557	-	-	-	-	-	-	-	-	17,633	583
Period 1c Additional Costs																					
1c.2.1	Spent Fuel Pool Isolation	-	-	-	-	-	-	12,675	1,901	14,576	14,576	-	-	-	-	-	-	-	-	-	-
1c.2	Subtotal Period 1c Additional Costs	-	-	-	-	-	-	12,675	1,901	14,576	14,576	-	-	-	-	-	-	-	-	-	-
Period 1c Collateral Costs																					
1c.3.1	Process decommissioning water waste	192	-	122	222	-	584	-	287	1,408	1,408	-	-	-	1,183	-	-	-	70,961	231	-
1c.3.3	Small tool allowance	-	2	-	-	-	-	-	0	3	3	-	-	-	-	-	-	-	-	-	-
1c.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	2,670	401	3,071	-	3,071	-	-	-	-	-	-	-	-	-
1c.3	Subtotal Period 1c Collateral Costs	192	2	122	222	-	584	2,670	688	4,481	1,410	3,071	-	-	1,183	-	-	-	70,961	231	-

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 1c Period-Dependent Costs																					
1c.4.1	Insurance	-	-	-	-	-	-	919	92	1,010	1,010	-	-	-	-	-	-	-	-	-	-
1c.4.2	Property taxes	-	-	-	-	-	-	27	3	30	30	-	-	-	-	-	-	-	-	-	-
1c.4.3	Health physics supplies	-	256	-	-	-	-	-	64	320	320	-	-	-	-	-	-	-	-	-	-
1c.4.4	Heavy equipment rental	-	190	-	-	-	-	-	28	218	218	-	-	-	-	-	-	-	-	-	-
1c.4.5	Disposal of DAW generated	-	-	3	1	-	9	-	3	16	16	-	-	-	154	-	-	-	3,073	5	-
1c.4.6	Plant energy budget	-	-	-	-	-	-	429	64	494	494	-	-	-	-	-	-	-	-	-	-
1c.4.7	NRC Fees	-	-	-	-	-	-	163	16	179	179	-	-	-	-	-	-	-	-	-	-
1c.4.8	Emergency Planning Fees	-	-	-	-	-	-	392	39	431	-	431	-	-	-	-	-	-	-	-	-
1c.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	213	32	245	-	245	-	-	-	-	-	-	-	-	-
1c.4.10	ISFSI Operating Costs	-	-	-	-	-	-	28	4	32	-	32	-	-	-	-	-	-	-	-	-
1c.4.11	Corporate Allocations	-	-	-	-	-	-	252	25	277	277	-	-	-	-	-	-	-	-	-	-
1c.4.12	Security Staff Cost	-	-	-	-	-	-	3,999	600	4,599	4,599	-	-	-	-	-	-	-	-	-	60,667
1c.4.13	Utility Staff Cost	-	-	-	-	-	-	9,477	1,422	10,899	10,899	-	-	-	-	-	-	-	-	-	106,428
1c.4	Subtotal Period 1c Period-Dependent Costs	-	446	3	1	-	9	15,900	2,393	18,751	18,043	709	-	-	154	-	-	-	3,073	5	167,125
1c.0	TOTAL PERIOD 1c COST	192	881	125	223	-	593	32,071	5,281	39,366	35,587	3,779	-	-	1,336	-	-	-	74,034	17,869	167,708
PERIOD 1 TOTALS		6,667	3,000	263	437	-	1,207	129,691	22,634	163,899	143,296	20,604	-	-	3,783	-	-	-	166,394	78,825	1,039,355
PERIOD 2a - SAFSTOR Dormancy with Wet Spent Fuel Storage																					
Period 2a Direct Decommissioning Activities																					
2a.1.1	Quarterly Inspection									a											
2a.1.2	Semi-annual environmental survey									a											
2a.1.3	Prepare reports									a											
2a.1.4	Bituminous roof replacement	-	-	-	-	-	-	313	47	360	360	-	-	-	-	-	-	-	-	-	-
2a.1.5	Maintenance supplies	-	-	-	-	-	-	606	151	757	757	-	-	-	-	-	-	-	-	-	-
2a.1	Subtotal Period 2a Activity Costs	-	-	-	-	-	-	919	198	1,117	1,117	-	-	-	-	-	-	-	-	-	-
Period 2a Collateral Costs																					
2a.5.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	34,710	5,207	39,917	-	39,917	-	-	-	-	-	-	-	-	-
2a.5	Subtotal Period 2a Collateral Costs	-	-	-	-	-	-	34,710	5,207	39,917	-	39,917	-	-	-	-	-	-	-	-	-
Period 2a Period-Dependent Costs																					
2a.4.1	Insurance	-	-	-	-	-	-	2,681	268	2,949	2,949	-	-	-	-	-	-	-	-	-	-
2a.4.2	Property taxes	-	-	-	-	-	-	431	43	474	474	-	-	-	-	-	-	-	-	-	-
2a.4.3	Health physics supplies	-	986	-	-	-	-	-	246	1,231	1,231	-	-	-	-	-	-	-	-	-	-
2a.4.4	Disposal of DAW generated	-	-	18	7	-	53	-	15	93	93	-	-	-	920	-	-	-	18,406	30	-
2a.4.5	Plant energy budget	-	-	-	-	-	-	1,363	204	1,567	784	784	-	-	-	-	-	-	-	-	-
2a.4.6	NRC Fees	-	-	-	-	-	-	975	97	1,072	1,072	-	-	-	-	-	-	-	-	-	-
2a.4.7	Emergency Planning Fees	-	-	-	-	-	-	3,896	390	4,285	-	4,285	-	-	-	-	-	-	-	-	-
2a.4.8	Spent Fuel Pool O&M	-	-	-	-	-	-	3,378	507	3,885	-	3,885	-	-	-	-	-	-	-	-	-
2a.4.9	ISFSI Operating Costs	-	-	-	-	-	-	448	67	515	-	515	-	-	-	-	-	-	-	-	-
2a.4.10	Corporate Allocations	-	-	-	-	-	-	4,000	400	4,400	4,400	-	-	-	-	-	-	-	-	-	-
2a.4.11	Security Staff Cost	-	-	-	-	-	-	56,859	8,529	65,388	59,568	5,820	-	-	-	-	-	-	-	-	864,688
2a.4.12	Utility Staff Cost	-	-	-	-	-	-	29,543	4,432	33,975	27,384	6,591	-	-	-	-	-	-	-	-	326,640
2a.4	Subtotal Period 2a Period-Dependent Costs	-	986	18	7	-	53	103,573	15,199	119,834	97,956	21,878	-	-	920	-	-	-	18,406	30	1,193,328
2a.0	TOTAL PERIOD 2a COST	-	986	18	7	-	53	139,202	20,604	160,867	99,072	61,795	-	-	920	-	-	-	18,406	30	1,193,328
PERIOD 2c - SAFSTOR Dormancy without Spent Fuel Storage																					
Period 2c Direct Decommissioning Activities																					
2c.1.1	Quarterly Inspection									a											
2c.1.2	Semi-annual environmental survey									a											
2c.1.3	Prepare reports									a											
2c.1.4	Bituminous roof replacement	-	-	-	-	-	-	3,798	569	4,366	4,366	-	-	-	-	-	-	-	-	-	-
2c.1.5	Maintenance supplies	-	-	-	-	-	-	7,354	1,838	9,192	9,192	-	-	-	-	-	-	-	-	-	-
2c.1	Subtotal Period 2c Activity Costs	-	-	-	-	-	-	11,150	2,408	13,558	13,558	-	-	-	-	-	-	-	-	-	-

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 2c	Period-Dependent Costs																				
2c.4.1	Insurance	-	-	-	-	-	-	19,887	1,989	21,876	21,876	-	-	-	-	-	-	-	-	-	-
2c.4.2	Property taxes	-	-	-	-	-	-	5,226	523	5,749	5,749	-	-	-	-	-	-	-	-	-	-
2c.4.3	Health physics supplies	-	5,455	-	-	-	-	-	1,364	6,819	6,819	-	-	-	-	-	-	-	-	-	-
2c.4.4	Disposal of DAW generated	-	-	94	35	-	284	-	86	499	499	-	-	-	4,942	-	-	-	98,844	161	-
2c.4.5	Plant energy budget	-	-	-	-	-	-	8,271	1,241	9,512	9,512	-	-	-	-	-	-	-	-	-	-
2c.4.6	NRC Fees	-	-	-	-	-	-	9,961	996	10,957	10,957	-	-	-	-	-	-	-	-	-	-
2c.4.7	Security Staff Cost	-	-	-	-	-	-	122,387	18,355	140,722	140,722	-	-	-	-	-	-	-	-	-	1,514,867
2c.4.8	Utility Staff Cost	-	-	-	-	-	-	71,944	10,792	82,735	82,735	-	-	-	-	-	-	-	-	-	883,672
2c.4	Subtotal Period 2c Period-Dependent Costs	-	5,455	94	35	-	284	237,656	35,344	278,869	278,869	-	-	-	4,942	-	-	-	98,844	161	2,398,539
2c.0	TOTAL PERIOD 2c COST	-	5,455	94	35	-	284	248,806	37,752	292,427	292,427	-	-	-	4,942	-	-	-	98,844	161	2,398,539
PERIOD 2 TOTALS		-	6,440	112	42	-	337	388,007	58,356	453,294	391,499	61,795	-	-	5,863	-	-	-	117,251	191	3,691,867
PERIOD 3a - Reactivate Site Following SAFSTOR Dormancy																					
Period 3a	Direct Decommissioning Activities																				
3a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
3a.1.2	Review plant dwgs & specs.	-	-	-	-	-	-	788	110	843	843	-	-	-	-	-	-	-	-	-	4,600
3a.1.3	Perform detailed rad survey									a											
3a.1.4	End product description	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
3a.1.5	Detailed by-product inventory	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
3a.1.6	Define major work sequences	-	-	-	-	-	-	1,196	179	1,375	1,375	-	-	-	-	-	-	-	-	-	7,500
3a.1.7	Perform SER and EA	-	-	-	-	-	-	494	74	568	568	-	-	-	-	-	-	-	-	-	3,100
3a.1.8	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	1,196	179	1,375	1,375	-	-	-	-	-	-	-	-	-	7,500
3a.1.9	Perform Site-Specific Cost Study	-	-	-	-	-	-	797	120	917	917	-	-	-	-	-	-	-	-	-	5,000
3a.1.10	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
3a.1.11.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	1,175	176	1,351	1,216	-	135	-	-	-	-	-	-	-	7,370
3a.1.11.2	Plant systems	-	-	-	-	-	-	664	100	764	688	-	76	-	-	-	-	-	-	-	4,167
3a.1.11.3	Reactor internals	-	-	-	-	-	-	1,132	170	1,302	1,302	-	-	-	-	-	-	-	-	-	7,100
3a.1.11.4	Reactor vessel	-	-	-	-	-	-	1,036	155	1,192	1,192	-	-	-	-	-	-	-	-	-	6,500
3a.1.11.5	Biological shield	-	-	-	-	-	-	80	12	92	92	-	-	-	-	-	-	-	-	-	500
3a.1.11.6	Steam generators	-	-	-	-	-	-	497	75	572	572	-	-	-	-	-	-	-	-	-	3,120
3a.1.11.7	Reinforced concrete	-	-	-	-	-	-	255	38	293	147	-	147	-	-	-	-	-	-	-	1,600
3a.1.11.8	Main Turbine	-	-	-	-	-	-	64	10	73	-	-	73	-	-	-	-	-	-	-	400
3a.1.11.9	Main Condensers	-	-	-	-	-	-	64	10	73	-	-	73	-	-	-	-	-	-	-	400
3a.1.11.10	Plant structures & buildings	-	-	-	-	-	-	497	75	572	286	-	286	-	-	-	-	-	-	-	3,120
3a.1.11.11	Waste management	-	-	-	-	-	-	788	110	843	843	-	-	-	-	-	-	-	-	-	4,600
3a.1.11.12	Facility & site closeout	-	-	-	-	-	-	144	22	165	83	-	83	-	-	-	-	-	-	-	900
3a.1.11	Total	-	-	-	-	-	-	6,342	951	7,294	6,420	-	874	-	-	-	-	-	-	-	39,777
Planning & Site Preparations																					
3a.1.12	Prepare dismantling sequence	-	-	-	-	-	-	383	57	440	440	-	-	-	-	-	-	-	-	-	2,400
3a.1.13	Plant prep. & temp. svces	-	-	-	-	-	-	3,500	525	4,025	4,025	-	-	-	-	-	-	-	-	-	-
3a.1.14	Design water clean-up system	-	-	-	-	-	-	223	33	257	257	-	-	-	-	-	-	-	-	-	1,400
3a.1.15	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,400	360	2,760	2,760	-	-	-	-	-	-	-	-	-	-
3a.1.16	Procure casks/liners & containers	-	-	-	-	-	-	196	29	226	226	-	-	-	-	-	-	-	-	-	1,280
3a.1	Subtotal Period 3a Activity Costs	-	-	-	-	-	-	18,198	2,729	20,924	20,050	-	874	-	-	-	-	-	-	-	77,107
Period 3a	Period-Dependent Costs																				
3a.4.1	Insurance	-	-	-	-	-	-	410	41	451	451	-	-	-	-	-	-	-	-	-	-
3a.4.2	Property taxes	-	-	-	-	-	-	108	11	118	118	-	-	-	-	-	-	-	-	-	-
3a.4.3	Health physics supplies	-	537	-	-	-	-	-	134	671	671	-	-	-	-	-	-	-	-	-	-
3a.4.4	Heavy equipment rental	-	753	-	-	-	-	-	113	866	866	-	-	-	-	-	-	-	-	-	-
3a.4.5	Disposal of DAW generated	-	-	10	4	-	30	-	9	52	52	-	-	-	514	-	-	-	10,287	17	-
3a.4.6	Plant energy budget	-	-	-	-	-	-	1,703	256	1,959	1,959	-	-	-	-	-	-	-	-	-	-
3a.4.7	NRC Fees	-	-	-	-	-	-	335	33	368	368	-	-	-	-	-	-	-	-	-	-
3a.4.8	Corporate Allocations	-	-	-	-	-	-	1,000	100	1,100	1,100	-	-	-	-	-	-	-	-	-	-
3a.4.9	Security Staff Cost	-	-	-	-	-	-	4,188	628	4,816	4,816	-	-	-	-	-	-	-	-	-	68,000
3a.4.10	Utility Staff Cost	-	-	-	-	-	-	23,868	3,505	26,873	26,873	-	-	-	-	-	-	-	-	-	257,920
3a.4	Subtotal Period 3a Period-Dependent Costs	-	1,289	10	4	-	30	31,111	4,830	37,273	37,273	-	-	-	514	-	-	-	10,287	17	322,920
3a.0	TOTAL PERIOD 3a COST	-	1,289	10	4	-	30	49,309	7,559	58,197	57,324	-	874	-	514	-	-	-	10,287	17	400,027

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 3b - Decommissioning Preparations																					
Period 3b Direct Decommissioning Activities																					
Detailed Work Procedures																					
3b.1.1.1	Plant systems	-	-	-	-	-	-	755	113	868	781	-	87	-	-	-	-	-	-	-	4,733
3b.1.1.2	Reactor internals	-	-	-	-	-	-	399	60	458	458	-	-	-	-	-	-	-	-	-	2,500
3b.1.1.3	Remaining buildings	-	-	-	-	-	-	215	32	248	62	-	186	-	-	-	-	-	-	-	1,350
3b.1.1.4	CRD cooling assembly	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.5	CRD housings & ICI tubes	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.6	Incore instrumentation	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.7	Reactor vessel	-	-	-	-	-	-	579	87	666	666	-	-	-	-	-	-	-	-	-	3,630
3b.1.1.8	Facility closeout	-	-	-	-	-	-	191	29	220	110	-	110	-	-	-	-	-	-	-	1,200
3b.1.1.9	Missile shields	-	-	-	-	-	-	72	11	83	83	-	-	-	-	-	-	-	-	-	450
3b.1.1.10	Biological shield	-	-	-	-	-	-	191	29	220	220	-	-	-	-	-	-	-	-	-	1,200
3b.1.1.11	Steam generators	-	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-	-	-	-	4,600
3b.1.1.12	Reinforced concrete	-	-	-	-	-	-	159	24	183	92	-	92	-	-	-	-	-	-	-	1,000
3b.1.1.13	Main Turbine	-	-	-	-	-	-	249	37	286	-	-	286	-	-	-	-	-	-	-	1,560
3b.1.1.14	Main Condensers	-	-	-	-	-	-	249	37	286	-	-	286	-	-	-	-	-	-	-	1,560
3b.1.1.15	Auxiliary building	-	-	-	-	-	-	435	65	501	451	-	50	-	-	-	-	-	-	-	2,730
3b.1.1.16	Reactor building	-	-	-	-	-	-	435	65	501	451	-	50	-	-	-	-	-	-	-	2,730
3b.1.1	Total	-	-	-	-	-	-	5,141	771	5,912	4,766	-	1,146	-	-	-	-	-	-	-	32,243
3b.1	Subtotal Period 3b Activity Costs	-	-	-	-	-	-	5,141	771	5,912	4,766	-	1,146	-	-	-	-	-	-	-	32,243
Period 3b Additional Costs																					
3b.2.1	Site Characterization	-	-	-	-	-	-	3,134	940	4,074	4,074	-	-	-	-	-	-	-	-	19,100	7,852
3b.2	Subtotal Period 3b Additional Costs	-	-	-	-	-	-	3,134	940	4,074	4,074	-	-	-	-	-	-	-	-	19,100	7,852
Period 3b Collateral Costs																					
3b.3.1	Decon equipment	1,055	-	-	-	-	-	-	158	1,213	1,213	-	-	-	-	-	-	-	-	-	-
3b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
3b.3.3	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	1,055	1,200	-	-	-	-	1,636	584	4,475	4,475	-	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Decon supplies	38	-	-	-	-	-	-	10	48	48	-	-	-	-	-	-	-	-	-	-
3b.4.2	Insurance	-	-	-	-	-	-	338	34	372	372	-	-	-	-	-	-	-	-	-	-
3b.4.3	Property taxes	-	-	-	-	-	-	54	5	60	60	-	-	-	-	-	-	-	-	-	-
3b.4.4	Health physics supplies	-	296	-	-	-	-	-	75	373	373	-	-	-	-	-	-	-	-	-	-
3b.4.5	Heavy equipment rental	-	390	-	-	-	-	-	57	436	436	-	-	-	-	-	-	-	-	-	-
3b.4.6	Disposal of DAW generated	-	-	6	2	-	17	-	5	30	30	-	-	-	293	-	-	-	5,866	10	-
3b.4.7	Plant energy budget	-	-	-	-	-	-	859	129	988	988	-	-	-	-	-	-	-	-	-	-
3b.4.8	NRC Fees	-	-	-	-	-	-	169	17	186	186	-	-	-	-	-	-	-	-	-	-
3b.4.9	Corporate Allocations	-	-	-	-	-	-	504	50	555	555	-	-	-	-	-	-	-	-	-	-
3b.4.10	Security Staff Cost	-	-	-	-	-	-	2,111	317	2,428	2,428	-	-	-	-	-	-	-	-	-	32,767
3b.4.11	DOC Staff Cost	-	-	-	-	-	-	6,997	1,050	8,047	8,047	-	-	-	-	-	-	-	-	-	56,719
3b.4.12	Utility Staff Cost	-	-	-	-	-	-	11,780	1,767	13,547	13,547	-	-	-	-	-	-	-	-	-	130,020
3b.4	Subtotal Period 3b Period-Dependent Costs	38	678	6	2	-	17	22,812	3,515	27,068	27,068	-	-	-	293	-	-	-	5,866	10	221,506
3b.0	TOTAL PERIOD 3b COST	1,093	1,878	6	2	-	17	32,723	5,310	41,528	40,352	-	1,146	-	293	-	-	-	5,866	19,110	261,601
PERIOD 3 TOTALS		1,093	3,167	15	6	-	46	52,029	13,369	99,726	97,706	-	2,020	-	808	-	-	-	16,163	19,126	661,628
PERIOD 4a - Large Component Removal																					
Period 4a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
4a.1.1.1	Reactor Coolant Piping	41	200	37	43	185	373	-	201	1,077	1,077	-	-	987	1,023	-	-	-	135,750	3,982	-
4a.1.1.2	Pressurizer Relief Tank	7	26	10	11	52	105	-	47	261	261	-	-	273	289	-	-	-	38,387	502	-
4a.1.1.3	Reactor Coolant Pumps & Motors	23	99	80	224	-	1,440	-	438	2,305	2,305	-	-	-	3,386	-	-	-	816,140	488	40
4a.1.1.4	Pressurizer	-	71	493	186	-	1,590	-	492	2,832	2,832	-	-	-	3,739	-	-	-	241,053	1,346	1,500
4a.1.1.5	Steam Generators	-	6,080	2,633	2,889	3,622	9,589	-	5,157	29,970	29,970	-	-	40,262	22,546	-	-	-	3,349,305	20,507	2,250
4a.1.1.6	Retired Steam Generator Units	-	-	2,633	2,889	3,622	9,589	-	3,637	22,370	22,370	-	-	40,262	22,546	-	-	-	3,349,305	10,600	2,250
4a.1.1.7	CRDMs/ICIs/Service Structure Removal	35	175	229	52	80	592	-	252	1,414	1,414	-	-	753	2,947	-	-	-	141,134	5,231	-
4a.1.1.8	Reactor Vessel Internals	71	6,435	12,666	793	-	10,841	316	13,671	44,697	44,697	-	-	-	3,485	501	393	-	330,577	26,073	1,161
4a.1.1.9	Vessel & Internals GTCC Disposal	-	-	-	-	-	12,538	-	1,881	14,419	14,419	-	-	-	-	-	-	2,217	433,180	-	-
4a.1.1.10	Reactor Vessel	-	8,046	2,099	725	-	6,648	316	10,097	27,870	27,870	-	-	-	15,631	-	-	-	976,056	26,073	1,161
4a.1.1	Totals	177	21,133	20,721	7,819	7,560	53,308	631	35,873	147,217	147,217	-	-	82,616	75,692	501	393	2,217	9,813,947	93,102	8,563

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
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Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Removal of Major Equipment																					
4a.1.2	Main Turbine/Generator	-	540	253	21	892	-	-	297	2,003	2,003	-	-	5,180	-	-	-	-	310,807	8,721	-
4a.1.3	Main Condensers	-	1,536	155	59	1,047	-	-	565	3,362	3,362	-	-	8,106	-	-	-	-	364,767	24,802	-
Cascading Costs from Clean Building Demolition																					
4a.1.4.1	Reactor	-	561	-	-	-	-	-	84	645	645	-	-	-	-	-	-	-	-	4,852	-
4a.1.4.2	Auxiliary	-	276	-	-	-	-	-	41	317	317	-	-	-	-	-	-	-	-	2,113	-
4a.1.4.3	Fuel Building	-	115	-	-	-	-	-	17	132	132	-	-	-	-	-	-	-	-	773	-
4a.1.4.4	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	7	-
4a.1.4.5	Radwaste	-	53	-	-	-	-	-	8	62	62	-	-	-	-	-	-	-	-	387	-
4a.1.4	Totals	-	1,006	-	-	-	-	-	151	1,157	1,157	-	-	-	-	-	-	-	-	8,113	-
Disposal of Plant Systems																					
4a.1.5.1	100 Aux.Bldg Non-System Specific RCA	-	841	15	50	889	-	-	353	2,147	2,147	-	-	7,629	-	-	-	-	309,812	13,471	-
4a.1.5.2	100 Auxiliary Bldg Non-System Specific	-	123	2	5	96	10	-	49	287	287	-	-	624	81	-	-	-	35,464	2,031	-
4a.1.5.3	AB - Main Steam	-	324	-	-	-	-	-	49	373	-	-	373	-	-	-	-	-	-	5,833	-
4a.1.5.4	AB - Main Steam RCA	-	93	4	14	251	-	-	64	427	427	-	-	2,156	-	-	-	-	87,550	1,515	-
4a.1.5.5	AC - Main Turbine	-	320	-	-	-	-	-	48	368	-	-	368	-	-	-	-	-	-	5,541	-
4a.1.5.6	AD - Condensate	-	356	-	-	-	-	-	53	409	-	-	409	-	-	-	-	-	-	6,144	-
4a.1.5.7	AE - Feedwater	-	244	-	-	-	-	-	37	280	-	-	280	-	-	-	-	-	-	4,271	-
4a.1.5.8	AF - Feedwater Heater Extraction	-	299	-	-	-	-	-	45	344	-	-	344	-	-	-	-	-	-	5,352	-
4a.1.5.9	AK - Condensate Demineralizer	-	110	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	1,944	-
4a.1.5.10	AL - Auxiliary Feedwater	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	852	-
4a.1.5.11	AQ - Condensate & Feedwater Chem Addtn	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	468	-
4a.1.5.12	BM - Steam Generator Blowdown	-	129	2	8	135	-	-	54	328	328	-	-	1,157	-	-	-	-	46,998	2,137	-
4a.1.5.13	BM - Steam Generator Blowdown - RCA	-	447	8	27	479	-	-	188	1,149	1,149	-	-	4,109	-	-	-	-	166,857	7,066	-
4a.1.5.14	BN - Borated Refueling Water Storage	-	368	12	41	729	-	-	209	1,359	1,359	-	-	6,255	-	-	-	-	254,024	6,161	-
4a.1.5.15	CA - Steam Seal	-	26	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	455	-
4a.1.5.16	CB - Main Turbine Lube Oil	-	73	-	-	-	-	-	11	84	-	-	84	-	-	-	-	-	-	1,207	-
4a.1.5.17	CC - Generator Hydrogen Seal & CO2	-	12	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	198	-
4a.1.5.18	CD - Generator Seal Oil	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	287	-
4a.1.5.19	CE - Stator Cooling Water	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	241	-
4a.1.5.20	CF - Lube Oil Storage Xfer & Prfication	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	812	-
4a.1.5.21	CG - Condenser Air Removal	-	36	-	-	-	-	-	6	43	-	-	43	-	-	-	-	-	-	657	-
4a.1.5.22	CH - Main Turbine Control Oil	-	75	-	-	-	-	-	11	86	-	-	86	-	-	-	-	-	-	1,219	-
4a.1.5.23	DA - Circulating Water	-	419	-	-	-	-	-	63	482	-	-	482	-	-	-	-	-	-	7,502	-
4a.1.5.24	DB - Cooling Tower Makeup & Blowdown	-	71	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,260	-
4a.1.5.25	DD - Cooling Water Chemical Control Sys	-	63	-	-	-	-	-	9	72	-	-	72	-	-	-	-	-	-	1,084	-
4a.1.5.26	DD - Cooling Wtr Chem Control RCA	-	329	7	23	414	-	-	148	922	922	-	-	3,855	-	-	-	-	144,376	4,951	-
4a.1.5.27	EJ - Residual Heat Removal	-	428	32	62	522	389	-	293	1,716	1,716	-	-	1,481	1,166	-	-	-	256,354	7,147	-
4a.1.5.28	EM - High Pressure Coolant Injection	-	362	4	15	258	-	-	132	771	771	-	-	2,214	-	-	-	-	89,903	5,913	-
4a.1.5.29	EN - Containment Spray	-	262	6	20	353	-	-	122	762	762	-	-	3,026	-	-	-	-	122,374	4,124	-
4a.1.5.30	EP - Accumulator Safety Injection	-	190	4	13	232	-	-	85	524	524	-	-	1,989	-	-	-	-	80,762	3,132	-
4a.1.5.31	FA - Auxiliary Steam Generator	-	28	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	521	-
4a.1.5.32	FB - Auxiliary Steam	-	118	-	-	-	-	-	18	135	-	-	135	-	-	-	-	-	-	2,106	-
4a.1.5.33	FB - Auxiliary Steam RCA	-	99	2	5	95	-	-	40	241	241	-	-	816	-	-	-	-	33,148	1,657	-
4a.1.5.34	FC - Auxiliary Turbines	-	77	-	-	-	-	-	12	88	-	-	88	-	-	-	-	-	-	1,520	-
4a.1.5.35	FE - Auxiliary Steam Chemical Addition	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	105	-
4a.1.5.36	GE - Turbine Building HVAC	-	213	-	-	-	-	-	32	245	-	-	245	-	-	-	-	-	-	3,557	-
4a.1.5.37	GS - Containment Hydrogen Control	-	83	2	5	93	-	-	36	219	219	-	-	801	-	-	-	-	32,539	1,295	-
4a.1.5.38	HE - Boron Recycle	-	551	26	38	403	267	-	273	1,558	1,558	-	-	3,460	794	-	-	-	191,581	8,970	-
4a.1.5.39	HF - Secondary Liquid Waste	-	1,080	53	86	983	533	-	569	3,303	3,303	-	-	8,431	1,588	-	-	-	444,251	17,532	-
4a.1.5.40	JA - Auxiliary Oil & Transfer	-	36	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	690	-
4a.1.5.41	KS - Bulk Chemical Storage	-	110	13	42	762	-	-	148	1,065	1,065	-	-	5,449	-	-	-	-	261,890	1,825	-
4a.1.5.42	LE - Oily Waste	-	215	-	-	-	-	-	33	250	-	-	250	-	-	-	-	-	-	3,965	-
4a.1.5.43	LE - Oily Waste RCA	-	295	4	15	263	-	-	113	681	681	-	-	2,256	-	-	-	-	91,628	4,296	-
4a.1.5.44	Turbine Bldg Non-System Specific	-	913	-	-	-	-	-	137	1,050	-	-	1,050	-	-	-	-	-	-	16,405	-
4a.1.5	Totals	-	9,973	196	460	6,947	1,199	-	3,504	22,280	17,458	-	4,822	59,608	3,579	-	-	-	2,649,944	166,890	-
4a.1.6	Scaffolding in support of decommissioning	-	1,702	26	11	159	36	-	463	2,397	2,397	-	-	1,233	109	-	-	-	62,391	33,584	-
4a.1	Subtotal Period 4a Activity Costs	177	35,880	21,350	8,364	16,606	54,548	631	40,554	178,415	173,593	-	4,822	156,643	79,250	501	393	2,217	13,201,360	336,261	8,363
Period 4a Collateral Costs																					
4a.3.1	Process decommissioning water waste	5	-	8	14	-	38	-	15	79	79	-	-	-	76	-	-	-	4,578	15	-
4a.3.3	Small tool allowance	-	346	-	-	-	-	-	52	398	358	-	40	-	-	-	-	-	-	-	-
4a.3.4	On-site survey and release of 60.87 tons clean metallic waste	-	-	-	-	-	-	96	10	106	106	-	-	-	-	-	-	-	-	-	-
4a.3	Subtotal Period 4a Collateral Costs	5	346	8	14	-	38	96	76	583	543	-	40	-	76	-	-	-	4,578	15	-

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 4a Period-Dependent Costs																					
4a.4.1	Decon supplies	108	-	-	-	-	-	-	27	135	135	-	-	-	-	-	-	-	-	-	-
4a.4.2	Insurance	-	-	-	-	-	-	949	95	1,044	1,044	-	-	-	-	-	-	-	-	-	-
4a.4.3	Property taxes	-	-	-	-	-	-	152	15	168	168	-	-	-	-	-	-	-	-	-	-
4a.4.4	Health physics supplies	-	2,764	-	-	-	-	-	691	3,455	3,455	-	-	-	-	-	-	-	-	-	-
4a.4.5	Heavy equipment rental	-	3,644	-	-	-	-	-	532	4,076	4,076	-	-	-	-	-	-	-	-	-	-
4a.4.6	Disposal of DAW generated	-	-	101	38	-	302	-	91	532	532	-	-	-	5,265	-	-	-	105,293	172	-
4a.4.7	Plant energy budget	-	-	-	-	-	-	2,292	344	2,636	2,636	-	-	-	-	-	-	-	-	-	-
4a.4.8	NRC Fees	-	-	-	-	-	-	686	69	754	754	-	-	-	-	-	-	-	-	-	-
4a.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	602	90	692	692	-	-	-	-	-	-	-	-	-	-
4a.4.10	Corporate Allocations	-	-	-	-	-	-	1,418	142	1,558	1,558	-	-	-	-	-	-	-	-	-	-
4a.4.11	Remedial Actions Surveys	-	-	-	-	-	-	1,458	219	1,676	1,676	-	-	-	-	-	-	-	-	-	-
4a.4.12	Security Staff Cost	-	-	-	-	-	-	5,932	890	6,821	6,821	-	-	-	-	-	-	-	-	-	92,069
4a.4.13	DOC Staff Cost	-	-	-	-	-	-	23,561	3,534	27,095	27,095	-	-	-	-	-	-	-	-	-	203,287
4a.4.14	Utility Staff Cost	-	-	-	-	-	-	33,298	4,996	38,292	38,292	-	-	-	-	-	-	-	-	-	382,274
4a.4	Subtotal Period 4a Period-Dependent Costs	108	6,308	101	38	-	302	70,346	11,733	88,936	88,936	-	-	-	5,265	-	-	-	105,293	172	683,630
4a.0	TOTAL PERIOD 4a COST	290	42.545	21.459	8,418	15,606	54,883	71,073	52,883	267,933	263,072	-	4,881	156,643	84,621	501	393	2,217	13,311,730	335,448	671,992
PERIOD 4b - Site Decontamination																					
Period 4b Direct Decommissioning Activities																					
4b.1.1	Remove spent fuel racks	868	55	276	134	-	2,322	-	1,075	4,727	4,727	-	-	-	6,988	-	-	-	443,960	1,925	-
Disposal of Plant Systems																					
4b.1.2.1	200 Reactor Bldg Non-Systom Specific	-	100	1	4	59	6	-	36	206	206	-	-	502	19	-	-	-	21,590	1,669	-
4b.1.2.2	200 Reactor Bldg Non-System Specific RCA	-	693	9	31	556	-	-	262	1,552	1,552	-	-	4,768	-	-	-	-	193,312	10,425	-
4b.1.2.3	300 Control Bldg Non-System Specific	-	216	4	14	249	-	-	94	577	577	-	-	2,139	-	-	-	-	86,849	3,413	-
4b.1.2.4	300 Control Bldg Non-System Specific Cln	-	1,655	-	-	-	-	-	248	1,901	-	-	1,901	-	-	-	-	-	-	28,076	-
4b.1.2.5	600 Fuel Bldg Non-Specific Systems RCA	-	377	6	21	373	-	-	154	931	931	-	-	3,200	-	-	-	-	129,974	5,859	-
4b.1.2.6	600 Fuel Bldg Non-System Specific	-	53	1	2	37	4	-	20	118	118	-	-	322	12	-	-	-	13,829	850	-
4b.1.2.7	700 Radwaste Bldg Non-Sys Specific RCA	-	1,386	25	83	1,478	-	-	583	3,555	3,555	-	-	12,684	-	-	-	-	515,103	21,919	-
4b.1.2.8	700 Radwaste Bldg Non-System Specific	-	200	3	10	155	17	-	79	463	463	-	-	1,329	50	-	-	-	57,145	3,223	-
4b.1.2.9	AN - Demineralized Wtr Storage & Xfer	-	185	-	-	-	-	-	28	212	-	-	212	-	-	-	-	-	-	3,263	-
4b.1.2.10	AN - Demineralized Wtr Strg & Xfer RCA	-	48	1	2	37	-	-	18	106	106	-	-	314	-	-	-	-	12,759	740	-
4b.1.2.11	AP-HCST/Condensate Stor.& Transfr	-	244	-	-	-	-	-	37	281	-	-	281	-	-	-	-	-	-	4,018	-
4b.1.2.12	BB - Reactor Coolant System	-	370	27	39	301	376	-	240	1,354	1,354	-	-	2,586	1,130	-	-	-	176,949	6,323	-
4b.1.2.13	BG - Chemical & Volume Control	-	1,050	73	104	955	867	-	645	3,694	3,694	-	-	6,192	2,586	-	-	-	498,359	17,275	-
4b.1.2.14	BL - Reactor Makeup Water	-	335	15	25	295	141	-	168	979	979	-	-	2,629	418	-	-	-	129,920	5,494	-
4b.1.2.15	DE - Intake & Water Treatment	-	148	-	-	-	-	-	22	170	-	-	170	-	-	-	-	-	-	2,617	-
4b.1.2.16	DE - Intake & Water Treatment RCA	-	299	24	78	1,390	-	-	297	2,088	2,088	-	-	11,923	-	-	-	-	484,206	5,014	-
4b.1.2.17	EA - Service Water	-	175	-	-	-	-	-	26	201	-	-	201	-	-	-	-	-	-	3,145	-
4b.1.2.18	EA - Service Water RCA	-	54	2	8	145	-	-	37	246	246	-	-	1,248	-	-	-	-	50,893	889	-
4b.1.2.19	EB - Closed Cooling Water	-	71	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,267	-
4b.1.2.20	EC - Fuel Pool Cooling & Cleanup	-	440	8	27	480	-	-	187	1,141	1,141	-	-	4,119	-	-	-	-	167,293	7,163	-
4b.1.2.21	EF - Essential Service Water	-	408	-	-	-	-	-	61	467	-	-	467	-	-	-	-	-	-	7,244	-
4b.1.2.22	EF - Essential Service Water RCA	-	236	11	35	621	-	-	159	1,063	1,063	-	-	5,326	-	-	-	-	216,287	3,862	-
4b.1.2.23	EG - Component Cooling Water RCA	-	298	-	-	-	-	-	45	343	-	-	343	-	-	-	-	-	-	5,335	-
4b.1.2.24	GA - Plant Heating	-	106	-	-	-	-	-	16	122	-	-	122	-	-	-	-	-	-	1,912	-
4b.1.2.25	GA - Plant Heating RCA	-	116	1	4	74	-	-	41	236	236	-	-	638	-	-	-	-	25,924	1,765	-
4b.1.2.26	GA- Plant Heating Fuel Building	-	26	0	1	12	-	-	8	46	46	-	-	107	-	-	-	-	4,351	400	-
4b.1.2.27	GB - Central Chilled Water	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	1,803	-
4b.1.2.28	GB - Central Chilled Water RCA	-	31	0	1	22	-	-	11	66	66	-	-	187	-	-	-	-	7,591	482	-
4b.1.2.29	GD - Essential Serv Wtr Pumphouse HVAC	-	22	-	-	-	-	-	3	26	-	-	26	-	-	-	-	-	-	427	-
4b.1.2.30	GF - Miscellaneous Building HVAC	-	138	4	13	237	-	-	73	465	465	-	-	2,034	-	-	-	-	82,902	2,026	-
4b.1.2.31	GG - Fuel Building HVAC	-	264	8	26	460	-	-	140	896	896	-	-	3,945	-	-	-	-	160,195	4,052	-
4b.1.2.32	GH - Radwaste Building HVAC	-	194	5	17	299	-	-	96	610	610	-	-	2,561	-	-	-	-	104,012	3,004	-
4b.1.2.33	GK - Control Building HVAC	-	206	-	-	-	-	-	31	236	-	-	236	-	-	-	-	-	-	3,959	-
4b.1.2.34	GL - Auxiliary Building HVAC	-	479	10	35	627	-	-	220	1,371	1,371	-	-	5,381	-	-	-	-	218,514	7,364	-
4b.1.2.35	GM - Diesel Generator Building HVAC	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	695	-
4b.1.2.36	GN - Containment Cooling	-	537	16	54	963	-	-	289	1,859	1,859	-	-	6,264	-	-	-	-	335,602	8,405	-
4b.1.2.37	GP - Containment Integrtd Leak Rate Test	-	47	1	4	68	-	-	23	142	142	-	-	580	-	-	-	-	23,570	750	-
4b.1.2.38	GR - Containment Atmospheric Control	-	21	2	7	133	-	-	27	191	191	-	-	1,143	-	-	-	-	46,407	380	-
4b.1.2.39	GT - Containment Purge HVAC	-	125	4	14	255	-	-	72	471	471	-	-	2,185	-	-	-	-	88,746	1,973	-
4b.1.2.40	HA - Gaseous Radwaste	-	393	7	24	431	-	-	167	1,023	1,023	-	-	3,699	-	-	-	-	150,219	6,296	-
4b.1.2.41	HB - Liquid Radwaste	-	955	52	77	858	490	-	506	2,938	2,938	-	-	7,362	1,450	-	-	-	392,564	16,508	-
4b.1.2.42	HC - Solid Radwaste	-	408	24	36	348	288	-	234	1,338	1,338	-	-	2,985	862	-	-	-	176,332	6,652	-
4b.1.2.43	HD - Decontamination	-	113	6	10	115	58	-	62	363	363	-	-	983	171	-	-	-	50,979	1,885	-

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems (continued)																					
4b.1.2.44	JE - Emergency Fuel Oil	-	76	-	-	-	-	-	11	88	-	-	88	-	-	-	-	-	-	1,250	-
4b.1.2.45	KA - Compressed Air	-	239	-	-	-	-	-	35	268	-	-	268	-	-	-	-	-	-	4,167	-
4b.1.2.46	KA - Compressed Air RCA	-	155	2	5	93	-	-	54	308	308	-	-	801	-	-	-	-	32,538	2,339	-
4b.1.2.47	KB - Breathing Air	-	29	-	-	-	-	-	4	34	-	-	34	-	-	-	-	-	-	516	-
4b.1.2.48	KB - Breathing Air RCA	-	24	0	0	8	-	-	7	40	40	-	-	71	-	-	-	-	2,874	402	-
4b.1.2.49	KC - Fire Protection	-	456	-	-	-	-	-	68	524	-	-	524	-	-	-	-	-	-	8,376	-
4b.1.2.50	KC - Fire Protection RCA	-	483	9	29	514	-	-	203	1,237	1,237	-	-	4,411	-	-	-	-	179,151	7,084	-
4b.1.2.51	KC- Fire Protection Fuel Building	-	143	2	5	144	-	-	59	356	356	-	-	1,239	-	-	-	-	50,329	2,115	-
4b.1.2.52	KD - Domestic Water	-	212	-	-	-	-	-	32	244	-	-	244	-	-	-	-	-	-	3,857	-
4b.1.2.53	KD - Domestic Water RCA	-	31	0	2	29	-	-	12	74	74	-	-	247	-	-	-	-	10,039	459	-
4b.1.2.54	KE - Fuel Handling & Storage Rctor vssl	-	21	2	6	103	-	-	22	152	152	-	-	882	-	-	-	-	35,813	332	-
4b.1.2.55	KH - Service Gas (CO2 N2 H2 & O2)	-	67	-	-	-	-	-	10	77	-	-	77	-	-	-	-	-	-	1,229	-
4b.1.2.56	KH - Service Gas (CO2 N2 H2 & O2) RCA	-	303	5	16	284	-	-	121	729	729	-	-	2,433	-	-	-	-	98,813	4,461	-
4b.1.2.57	KJ - Standby Diesel Engine	-	403	-	-	-	-	-	60	463	-	-	463	-	-	-	-	-	-	6,749	-
4b.1.2.58	LA - Sanitary Drains	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	972	-
4b.1.2.59	LA - Sanitary Drains RCA	-	127	3	5	148	-	-	56	342	342	-	-	1,278	-	-	-	-	51,684	1,811	-
4b.1.2.60	LB - Roof Drains	-	72	-	-	-	-	-	11	82	-	-	82	-	-	-	-	-	-	1,276	-
4b.1.2.61	LB - Roof Drains RCA	-	173	4	14	249	-	-	83	524	524	-	-	2,139	-	-	-	-	86,358	2,694	-
4b.1.2.62	LD - Chemical & Detergent Waste	-	131	2	5	93	-	-	48	278	278	-	-	797	-	-	-	-	32,369	2,139	-
4b.1.2.63	LF - Floor & Equipment Drains	-	1,621	32	113	778	1,208	-	849	4,650	4,650	-	-	6,660	3,627	-	-	-	301,387	26,164	-
4b.1.2.64	RM - Process Sampling & Analysis	-	146	2	6	115	-	-	55	325	325	-	-	990	-	-	-	-	40,200	2,450	-
4b.1.2.65	SJ - Nuclear Sampling	-	85	1	4	79	-	-	34	204	204	-	-	677	-	-	-	-	27,501	1,450	-
4b.1.2.66	UB - Services Stores Site Security Bldg	-	217	-	-	-	-	-	33	250	-	-	250	-	-	-	-	-	-	3,815	-
4b.1.2.67	Yard Non-System Specific	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	603	-
4b.1.2	Totals	-	18,650	467	1,025	14,669	3,464	-	7,376	45,641	39,312	-	6,329	125,856	10,326	-	-	-	5,771,424	306,257	-
4b.1.3	Scaffolding in support of decommissioning	-	2,553	39	17	239	54	-	684	3,596	3,596	-	-	1,849	163	-	-	-	93,887	50,421	-
Decontamination of Site Buildings																					
4b.1.4.1	Reactor	1,318	1,904	160	826	699	2,822	-	2,083	9,807	9,807	-	-	5,995	45,300	-	-	-	2,386,838	48,676	-
4b.1.4.2	Auxiliary	667	265	17	73	240	235	-	507	2,004	2,004	-	-	2,058	3,514	-	-	-	250,317	15,255	-
4b.1.4.3	Communication Corridor - Contaminated	13	4	0	1	2	5	-	10	37	37	-	-	17	76	-	-	-	4,296	306	-
4b.1.4.4	Fuel Building	855	870	11	33	315	89	-	721	2,894	2,894	-	-	2,705	954	-	-	-	153,200	27,457	-
4b.1.4.5	Hot Machine Shop	13	7	0	2	-	6	-	13	46	46	-	-	-	94	-	-	-	4,446	421	-
4b.1.4.6	RAM Storage Building	46	9	1	4	2	12	-	29	103	103	-	-	19	195	-	-	-	9,974	920	-
4b.1.4.7	Radioactive and Personnel Tunnel	8	8	0	1	-	3	-	5	22	22	-	-	-	54	-	-	-	2,532	195	-
4b.1.4.8	Radwaste	355	121	8	37	98	122	-	260	1,002	1,002	-	-	844	1,857	-	-	-	122,468	7,915	-
4b.1.4.9	Radwaste Drum Storage	40	12	1	4	8	13	-	28	106	106	-	-	66	208	-	-	-	12,665	850	-
4b.1.4.10	Reactor Head Assembly Building	36	-	-	-	-	-	-	18	54	54	-	-	-	-	-	-	-	-	614	-
4b.1.4.11	Steam Generator Replacement Bldgs	264	-	-	-	-	-	-	132	396	396	-	-	-	-	-	-	-	-	3,855	-
4b.1.4	Totals	3,614	3,200	196	981	1,364	3,307	-	3,805	16,470	16,470	-	-	11,704	52,283	-	-	-	2,951,937	106,295	-
4b.1.5	Prepare/submit License Termination Plan	-	-	-	-	-	-	653	98	751	751	-	-	-	-	-	-	-	-	-	4,096
4b.1.6	Receive NRC approval of termination plan									a											
4b.1	Subtotal Period 4b Activity Costs	4,480	24,458	980	2,156	16,272	9,187	653	13,048	71,164	64,855	-	6,329	139,409	66,780	-	-	-	9,260,607	464,907	4,096
Period 4b Additional Costs																					
4b.2.1	License Termination Survey Planning	-	-	-	-	-	-	1,759	528	2,287	2,287	-	-	-	-	-	-	-	-	-	12,480
4b.2.2	Sanitary Treatment Lagoon	-	6	86	121	-	524	-	159	896	896	-	-	-	4,608	-	-	-	392,140	423	-
4b.2.3	Cooling Tower Asbestos Panel Removal	-	5,989	-	157	-	-	618	1,014	7,772	-	-	7,772	-	-	-	-	-	-	71,419	-
4b.2.4	Operational Equipment	-	-	22	65	644	-	-	138	1,069	1,069	-	-	11,760	-	-	-	-	294,000	32	-
4b.2.5	Retired Reactor Closure Head	-	136	628	1,040	-	1,078	-	522	3,399	3,399	-	-	-	2,764	-	-	-	338,540	3,157	2,000
4b.2.6	License Termination ISFSI	-	591	110	98	-	3,112	3,411	1,830	9,152	9,152	-	-	-	13,299	-	-	-	851,056	17,021	10,896
4b.2	Subtotal Period 4b Additional Costs	-	6,722	841	1,480	844	4,714	5,788	4,191	24,575	16,803	-	7,772	11,760	20,671	-	-	-	1,875,736	92,052	25,376

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes: Class A Cu. Feet	Burial Volumes: Class B Cu. Feet	Burial Volumes: Class C Cu. Feet	Burial Volumes: GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 4b Collateral Costs																					
4b.3.1	Process decommissioning water waste	13	-	22	40	-	106	-	41	222	222	-	-	-	214	-	-	-	12,331	42	-
4b.3.3	Small tool allowance	-	552	-	-	-	-	-	83	635	635	-	-	-	-	-	-	-	-	-	-
4b.3.4	Decommissioning Equipment Disposition	-	-	125	61	775	176	-	182	1,319	1,319	-	-	6,000	529	-	-	-	303,808	147	-
4b.3.5	On-site survey and release of 309.6 tons clean metallic waste	-	-	-	-	-	-	489	49	538	538	-	-	-	-	-	-	-	-	-	-
4b.3	Subtotal Period 4b Collateral Costs	13	552	147	101	775	281	489	355	2,713	2,713	-	-	6,000	743	-	-	-	316,439	189	-
Period 4b Period-Dependent Costs																					
4b.4.1	Decon supplies	1,745	-	-	-	-	-	-	436	2,181	2,181	-	-	-	-	-	-	-	-	-	-
4b.4.2	Insurance	-	-	-	-	-	-	1,546	155	1,701	1,701	-	-	-	-	-	-	-	-	-	-
4b.4.3	Property taxes	-	-	-	-	-	-	248	25	273	273	-	-	-	-	-	-	-	-	-	-
4b.4.4	Health physics supplies	-	4,544	-	-	-	-	-	1,136	5,680	5,680	-	-	-	-	-	-	-	-	-	-
4b.4.5	Heavy equipment rental	-	6,829	-	-	-	-	-	889	6,818	6,818	-	-	-	-	-	-	-	-	-	-
4b.4.6	Disposal of DAW generated	-	-	126	47	-	380	-	115	668	668	-	-	-	6,615	-	-	-	132,302	216	-
4b.4.7	Plant energy budget	-	-	-	-	-	-	2,947	442	3,389	3,389	-	-	-	-	-	-	-	-	-	-
4b.4.8	NRC Fees	-	-	-	-	-	-	1,116	112	1,228	1,228	-	-	-	-	-	-	-	-	-	-
4b.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	980	147	1,127	1,127	-	-	-	-	-	-	-	-	-	-
4b.4.10	Corporate Allocations	-	-	-	-	-	-	2,307	231	2,538	2,538	-	-	-	-	-	-	-	-	-	-
4b.4.11	Remedial Actions Surveys	-	-	-	-	-	-	2,374	356	2,730	2,730	-	-	-	-	-	-	-	-	-	-
4b.4.12	Security Staff Cost	-	-	-	-	-	-	9,860	1,449	11,109	11,109	-	-	-	-	-	-	-	-	-	149,945
4b.4.13	DOC Staff Cost	-	-	-	-	-	-	37,425	5,614	43,039	43,039	-	-	-	-	-	-	-	-	-	321,483
4b.4.14	Utility Staff Cost	-	-	-	-	-	-	51,442	7,716	59,158	59,158	-	-	-	-	-	-	-	-	-	566,193
4b.4	Subtotal Period 4b Period-Dependent Costs	1,745	10,473	126	47	-	380	110,048	18,822	141,640	141,640	-	-	-	6,615	-	-	-	132,302	216	1,037,621
4b.0	TOTAL PERIOD 4b COST	6,237	42,204	2,095	3,784	17,890	14,512	116,972	36,417	240,112	226,011	-	14,101	157,169	97,788	-	-	-	11,585,090	557,363	1,067,093
PERIOD 4f - License Termination																					
Period 4f Direct Decommissioning Activities																					
4f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	163	49	212	212	-	-	-	-	-	-	-	-	-	-
4f.1.2	Terminate license									a											
4f.1	Subtotal Period 4f Activity Costs	-	-	-	-	-	-	163	49	212	212	-	-	-	-	-	-	-	-	-	-
Period 4f Additional Costs																					
4f.2.1	License Termination Survey	-	-	-	-	-	-	9,385	2,815	12,200	12,200	-	-	-	-	-	-	-	-	153,878	6,240
4f.2	Subtotal Period 4f Additional Costs	-	-	-	-	-	-	9,385	2,815	12,200	12,200	-	-	-	-	-	-	-	-	153,878	6,240
Period 4f Collateral Costs																					
4f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
4f.3	Subtotal Period 4f Collateral Costs	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
Period 4f Period-Dependent Costs																					
4f.4.1	Insurance	-	-	-	-	-	-	507	51	558	558	-	-	-	-	-	-	-	-	-	-
4f.4.2	Property taxes	-	-	-	-	-	-	81	8	90	90	-	-	-	-	-	-	-	-	-	-
4f.4.3	Health physics supplies	-	910	-	-	-	-	-	228	1,138	1,138	-	-	-	-	-	-	-	-	-	-
4f.4.4	Disposal of DAW generated	-	-	7	3	-	20	-	6	36	36	-	-	-	353	-	-	-	7,050	11	-
4f.4.5	Plant energy budget	-	-	-	-	-	-	258	39	296	296	-	-	-	-	-	-	-	-	-	-
4f.4.6	NRC Fees	-	-	-	-	-	-	427	43	470	470	-	-	-	-	-	-	-	-	-	-
4f.4.7	Corporate Allocations	-	-	-	-	-	-	756	76	832	832	-	-	-	-	-	-	-	-	-	-
4f.4.8	Security Staff Cost	-	-	-	-	-	-	1,473	221	1,693	1,693	-	-	-	-	-	-	-	-	-	16,574
4f.4.9	DOC Staff Cost	-	-	-	-	-	-	6,879	1,032	7,910	7,910	-	-	-	-	-	-	-	-	-	57,408
4f.4.10	Utility Staff Cost	-	-	-	-	-	-	7,682	1,152	8,834	8,834	-	-	-	-	-	-	-	-	-	74,709
4f.4	Subtotal Period 4f Period-Dependent Costs	-	910	7	3	-	20	18,062	2,854	21,856	21,856	-	-	-	353	-	-	-	7,050	11	150,991
4f.0	TOTAL PERIOD 4f COST	-	910	7	3	-	20	29,247	5,964	36,151	36,151	-	-	-	353	-	-	-	7,050	11	157,231
PERIOD 4 TOTALS		6,527	85,659	23,561	12,203	34,496	69,415	217,292	95,044	544,196	525,233	-	18,962	313,512	182,762	501	393	2,217	24,903,860	1,046,700	1,896,316

Table D
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Low-Level Radioactive Waste Processing
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 5b - Site Restoration																					
Period 5b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
5b.1.1.1	Reactor	-	3,189	-	-	-	-	-	478	3,667	-	-	3,667	-	-	-	-	-	-	27,502	-
5b.1.1.2	Auxiliary	-	2,481	-	-	-	-	-	372	2,853	-	-	2,853	-	-	-	-	-	-	19,024	-
5b.1.1.3	Auxiliary Boiler	-	23	-	-	-	-	-	3	27	-	-	27	-	-	-	-	-	-	248	-
5b.1.1.4	Barge Facility	-	924	-	-	-	-	-	139	1,063	-	-	1,063	-	-	-	-	-	-	4,290	-
5b.1.1.5	Circulating & Service Water Pumphouse	-	218	-	-	-	-	-	33	251	-	-	251	-	-	-	-	-	-	1,996	-
5b.1.1.6	Communication Corridor - Clean	-	892	-	-	-	-	-	134	1,026	-	-	1,026	-	-	-	-	-	-	8,280	-
5b.1.1.7	Communication Corridor - Contaminated	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	184	-
5b.1.1.8	Cooling Tower Concrete	-	433	-	-	-	-	-	65	498	-	-	498	-	-	-	-	-	-	2,332	-
5b.1.1.9	Diesel Generator	-	291	-	-	-	-	-	44	335	-	-	335	-	-	-	-	-	-	2,185	-
5b.1.1.10	Essential Service Water Pumphouse	-	169	-	-	-	-	-	25	194	-	-	194	-	-	-	-	-	-	855	-
5b.1.1.11	Fire Water Pumphouse	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	151	-
5b.1.1.12	Flex Building Storage	-	309	-	-	-	-	-	46	355	-	-	355	-	-	-	-	-	-	1,972	-
5b.1.1.13	Fuel Building	-	1,092	-	-	-	-	-	164	1,256	-	-	1,256	-	-	-	-	-	-	7,874	-
5b.1.1.14	Hardened Condensate Storage Tank - HCST	-	195	-	-	-	-	-	29	224	-	-	224	-	-	-	-	-	-	1,870	-
5b.1.1.15	Hot Machine Shop	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	243	-
5b.1.1.16	Intake	-	209	-	-	-	-	-	31	240	-	-	240	-	-	-	-	-	-	1,411	-
5b.1.1.17	Misc. Structures	-	2,147	-	-	-	-	-	322	2,469	-	-	2,469	-	-	-	-	-	-	18,774	-
5b.1.1.18	Miscellaneous Site Foundations	-	186	-	-	-	-	-	28	214	-	-	214	-	-	-	-	-	-	1,011	-
5b.1.1.19	Outage Maintenance	-	128	-	-	-	-	-	19	147	-	-	147	-	-	-	-	-	-	1,570	-
5b.1.1.20	RAM Storage Building	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	624	-
6b.1.1.21	Radioactive and Personnel Tunnel	-	32	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	386	-
5b.1.1.22	Radwaste	-	1,056	-	-	-	-	-	158	1,214	-	-	1,214	-	-	-	-	-	-	8,111	-
5b.1.1.23	Radwaste Drum Storage	-	161	-	-	-	-	-	24	185	-	-	185	-	-	-	-	-	-	1,449	-
5b.1.1.24	Reactor Head Assembly Building	-	81	-	-	-	-	-	12	93	-	-	93	-	-	-	-	-	-	1,108	-
5b.1.1.25	Security Additions	-	1,583	-	-	-	-	-	237	1,820	-	-	1,820	-	-	-	-	-	-	6,051	-
5b.1.1.26	Service	-	422	-	-	-	-	-	63	485	-	-	485	-	-	-	-	-	-	3,485	-
5b.1.1.27	Sludge Pump Station & Lagoon	-	1,582	-	-	-	-	-	237	1,820	-	-	1,820	-	-	-	-	-	-	10,601	-
5b.1.1.28	Steam Generator Replacement Bldgs	-	852	-	-	-	-	-	128	979	-	-	979	-	-	-	-	-	-	6,874	-
5b.1.1.29	Turbine Building	-	3,653	-	-	-	-	-	548	4,201	-	-	4,201	-	-	-	-	-	-	47,075	-
5b.1.1.30	Turbine Pedestal	-	540	-	-	-	-	-	81	620	-	-	620	-	-	-	-	-	-	2,934	-
5b.1.1.31	U.H.S. Cooling Tower	-	330	-	-	-	-	-	49	379	-	-	379	-	-	-	-	-	-	1,814	-
5b.1.1.32	Water Treatment Plant	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	9	-
5b.1.1	Totals	-	23,301	-	-	-	-	-	3,496	26,797	-	-	26,797	-	-	-	-	-	-	192,393	-
Site Closeout Activities																					
5b.1.2	Remove Rubble	-	1,399	-	-	-	-	-	210	1,608	-	-	1,608	-	-	-	-	-	-	7,233	-
5b.1.3	Grade & landscape site	-	130	-	-	-	-	-	19	149	-	-	149	-	-	-	-	-	-	592	-
5b.1.4	Final report to NRC	-	-	-	-	-	-	249	37	286	286	-	-	-	-	-	-	-	-	-	1,560
5b.1	Subtotal Period 5b Activity Costs	-	24,830	-	-	-	-	249	3,762	28,841	286	-	28,555	-	-	-	-	-	-	200,218	1,560
Period 5b Additional Costs																					
5b.2.1	Concrete Crushing	-	1,379	-	-	-	-	13	209	1,601	-	-	1,601	-	-	-	-	-	-	6,095	-
5b.2.2	Mine Area Backfill	-	5,308	-	-	-	-	-	796	6,104	-	-	6,104	-	-	-	-	-	-	16,960	-
5b.2.3	Cooling Tower Discharge & Intake Pipe Flow Fill	-	4,074	-	-	-	-	-	611	4,685	-	-	4,685	-	-	-	-	-	-	9,568	-
5b.2.4	Cooling Tower Demolition	-	4,779	-	-	-	-	-	717	5,496	-	-	5,496	-	-	-	-	-	-	21,619	-
5b.2.5	Excavation of Underground Services	-	2,833	-	-	-	-	487	423	3,244	-	-	3,244	-	-	-	-	-	-	14,184	-
5b.2.6	Construction Debris	-	-	-	-	-	-	5,080	755	5,785	-	-	5,785	-	-	-	-	-	-	-	-
5b.2.7	Site Restoration ISFSI	-	1,152	-	-	-	-	86	186	1,423	-	-	1,423	-	-	-	-	-	-	9,601	160
5b.2	Subtotal Period 5b Additional Costs	-	19,026	-	-	-	-	5,616	3,696	28,338	-	-	28,338	-	-	-	-	-	-	76,967	160
Period 5b Collateral Costs																					
5b.3.1	Small tool allowance	-	310	-	-	-	-	-	47	357	-	-	357	-	-	-	-	-	-	-	-
5b.3	Subtotal Period 5b Collateral Costs	-	310	-	-	-	-	-	47	357	-	-	357	-	-	-	-	-	-	-	-

Table D
Callaway Energy Center
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Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 5b Period-Dependent Costs																					
5b.4.2	Property taxes	-	-	-	-	-	-	162	16	178	-	-	178	-	-	-	-	-	-	-	-
5b.4.3	Heavy equipment rental	-	5,067	-	-	-	-	-	760	5,827	-	-	5,827	-	-	-	-	-	-	-	-
5b.4.4	Plant energy budget	-	-	-	-	-	-	256	38	295	-	-	295	-	-	-	-	-	-	-	-
5b.4.5	Corporate Allocations	-	-	-	-	-	-	1,504	150	1,655	-	-	1,655	-	-	-	-	-	-	-	-
5b.4.6	Security Staff Cost	-	-	-	-	-	-	2,929	439	3,368	-	-	3,368	-	-	-	-	-	-	-	37,543
5b.4.7	DOC Staff Cost	-	-	-	-	-	-	13,311	1,997	15,308	-	-	15,308	-	-	-	-	-	-	-	106,371
5b.4.8	Utility Staff Cost	-	-	-	-	-	-	6,215	932	7,148	-	-	7,148	-	-	-	-	-	-	-	61,007
5b.4	Subtotal Period 5b Period-Dependent Costs	-	5,067	-	-	-	-	24,378	4,333	33,778	-	-	33,778	-	-	-	-	-	-	-	204,920
5b.0	TOTAL PERIOD 5b COST	-	49,233	-	-	-	-	30,242	11,838	91,313	286	-	91,027	-	-	-	-	-	-	277,185	206,640
PERIOD 5 TOTALS		-	49,233	-	-	-	-	30,242	11,838	91,313	286	-	91,027	-	-	-	-	-	-	277,185	206,640
TOTAL COST TO DECOMMISSION		14,287	147,499	23,951	12,685	34,496	71,004	847,261	201,241	1,352,428	1,158,018	82,400	112,010	313,612	193,215	501	393	2,217	25,203,660	1,422,028	7,395,506

TOTAL COST TO DECOMMISSION WITH 17.48% CONTINGENCY:	$1,352,428	thousands of 2020 dollars
TOTAL NRC LICENSE TERMINATION COST IS 85.63% OR:	$1,158,018	thousands of 2020 dollars
SPENT FUEL MANAGEMENT COST IS 6.09% OR:	$82,400	thousands of 2020 dollars
NON-NUCLEAR DEMOLITION COST IS 8.28% OR:	$112,010	thousands of 2020 dollars
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	194,169	Cubic Feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	2,217	Cubic Feet
TOTAL SCRAP METAL REMOVED:	71,148	Tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,422,028	Man-hours

End Notes:
n/a - indicates that this activity not charged as decommissioning expense
a - indicates that this activity performed by decommissioning staff
0 - indicates that this value is less than 0.5 but is non-zero
A cell containing " - " indicates a zero value

APPENDIX E

DETAILED COST ANALYSIS

DECON

with

DIRECT DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTE

Table E
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,800
1a.1.2	Notification of Cessation of Operations									n											
1a.1.3	Remove fuel & source material									n/a											
1a.1.4	Notification of Permanent Defueling									n											
1a.1.5	Deactivate plant systems & process waste									n											
1a.1.6	Prepare and submit PSDAR	-	-	-	-	-	-	319	48	367	367	-	-	-	-	-	-	-	-	-	2,000
1a.1.7	Review plant dwgs & specs.	-	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-	-	-	-	4,600
1a.1.8	Perform detailed rad survey									n											
1a.1.9	Estimate by-product inventory	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.10	End product description	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	Detailed by-product inventory	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
1a.1.12	Define major work sequence	-	-	-	-	-	-	1,196	179	1,375	1,375	-	-	-	-	-	-	-	-	-	7,500
1a.1.13	Perform SER and EA	-	-	-	-	-	-	494	74	568	568	-	-	-	-	-	-	-	-	-	3,100
1a.1.14	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	1,196	179	1,375	1,375	-	-	-	-	-	-	-	-	-	7,500
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	797	120	917	917	-	-	-	-	-	-	-	-	-	5,000
1a.1.16	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
1a.1.17.1	Plant & temporary facilities	-	-	-	-	-	-	784	118	902	812	-	90	-	-	-	-	-	-	-	4,920
1a.1.17.2	Plant systems	-	-	-	-	-	-	664	100	764	688	-	76	-	-	-	-	-	-	-	4,167
1a.1.17.3	NSSS Decontamination Flush	-	-	-	-	-	-	80	12	92	92	-	-	-	-	-	-	-	-	-	500
1a.1.17.4	Reactor internals	-	-	-	-	-	-	1,152	170	1,302	1,302	-	-	-	-	-	-	-	-	-	7,100
1a.1.17.5	Reactor vessel	-	-	-	-	-	-	1,036	156	1,192	1,192	-	-	-	-	-	-	-	-	-	6,500
1a.1.17.6	Biological shield	-	-	-	-	-	-	80	12	92	92	-	-	-	-	-	-	-	-	-	500
1a.1.17.7	Steam generators	-	-	-	-	-	-	497	75	572	572	-	-	-	-	-	-	-	-	-	3,120
1a.1.17.8	Reinforced concrete	-	-	-	-	-	-	255	38	293	147	-	147	-	-	-	-	-	-	-	1,600
1a.1.17.9	Main Turbine	-	-	-	-	-	-	64	10	73	-	-	73	-	-	-	-	-	-	-	400
1a.1.17.10	Main Condensers	-	-	-	-	-	-	64	10	73	-	-	73	-	-	-	-	-	-	-	400
1a.1.17.11	Plant structures & buildings	-	-	-	-	-	-	497	75	572	286	-	286	-	-	-	-	-	-	-	3,120
1a.1.17.12	Waste management	-	-	-	-	-	-	735	110	843	843	-	-	-	-	-	-	-	-	-	4,600
1a.1.17.13	Facility & site closeout	-	-	-	-	-	-	144	22	166	83	-	83	-	-	-	-	-	-	-	900
1a.1.17	Total	-	-	-	-	-	-	6,031	905	6,936	6,108	-	829	-	-	-	-	-	-	-	37,827
Planning & Site Preparations																					
1a.1.18	Prepare dismantling sequence	-	-	-	-	-	-	383	57	440	440	-	-	-	-	-	-	-	-	-	2,400
1a.1.19	Plant prep. & temp. svces	-	-	-	-	-	-	3,500	525	4,025	4,025	-	-	-	-	-	-	-	-	-	-
1a.1.20	Design water clean-up system	-	-	-	-	-	-	223	33	257	257	-	-	-	-	-	-	-	-	-	1,400
1a.1.21	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,400	360	2,760	2,760	-	-	-	-	-	-	-	-	-	-
1a.1.22	Procure casks/liners & containers	-	-	-	-	-	-	196	29	226	226	-	-	-	-	-	-	-	-	-	1,230
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	18,362	2,754	21,116	20,288	-	829	-	-	-	-	-	-	-	78,157
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	8,900	1,335	10,235	-	10,235	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	8,900	1,335	10,235	-	10,235	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	3,644	364	4,009	4,009	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	106	11	118	118	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	614	-	-	-	-	-	153	767	767	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	753	-	-	-	-	-	113	866	866	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	12	4	-	35	-	11	62	62	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,703	256	1,959	1,959	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	1,137	114	1,251	1,251	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,556	156	1,711	-	1,711	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	346	52	398	398	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	845	127	971	-	971	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	112	17	129	-	129	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate Allocations	-	-	-	-	-	-	1,000	100	1,100	1,100	-	-	-	-	-	-	-	-	-	-
1a.4.13	Security Staff Cost	-	-	-	-	-	-	16,233	2,435	18,668	18,668	-	-	-	-	-	-	-	-	-	246,315
1a.4.14	Utility Staff Cost	-	-	-	-	-	-	37,599	5,640	43,239	43,239	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,367	12	4	-	35	64,283	9,547	75,248	72,437	2,811	-	-	610	-	-	-	12,190	20	668,555
1a.0	TOTAL PERIOD 1a COST	-	1,367	12	4	-	35	91,545	13,637	106,600	92,725	13,046	829	-	610	-	-	-	12,190	20	746,712

Table E
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1b - Decommissioning Preparations																					
Period 1b Direct Decommissioning Activities																					
Detailed Work Procedures																					
1b.1.1.1	Plant systems	-	-	-	-	-	-	755	113	868	781	-	87	-	-	-	-	-	-	-	4,733
1b.1.1.2	NSSS Decontamination Flush	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.3	Reactor internals	-	-	-	-	-	-	399	60	458	458	-	-	-	-	-	-	-	-	-	2,500
1b.1.1.4	Remaining buildings	-	-	-	-	-	-	215	32	248	62	-	186	-	-	-	-	-	-	-	1,350
1b.1.1.5	CRD cooling assembly	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.6	CRD housings & ICI tubes	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.7	Incore instrumentation	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.8	Reactor vessel	-	-	-	-	-	-	579	87	666	666	-	-	-	-	-	-	-	-	-	3,630
1b.1.1.9	Facility closeout	-	-	-	-	-	-	191	29	220	110	-	110	-	-	-	-	-	-	-	1,200
1b.1.1.10	Missile shields	-	-	-	-	-	-	72	11	83	83	-	-	-	-	-	-	-	-	-	450
1b.1.1.11	Biological shield	-	-	-	-	-	-	191	29	220	220	-	-	-	-	-	-	-	-	-	1,200
1b.1.1.12	Steam generators	-	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-	-	-	-	4,600
1b.1.1.13	Reinforced concrete	-	-	-	-	-	-	159	24	183	92	-	92	-	-	-	-	-	-	-	1,000
1b.1.1.14	Main Turbine	-	-	-	-	-	-	249	37	286	-	-	286	-	-	-	-	-	-	-	1,560
1b.1.1.15	Main Condensers	-	-	-	-	-	-	249	37	286	-	-	286	-	-	-	-	-	-	-	1,560
1b.1.1.16	Auxiliary building	-	-	-	-	-	-	435	65	501	451	-	50	-	-	-	-	-	-	-	2,730
1b.1.1.17	Reactor building	-	-	-	-	-	-	435	65	501	451	-	50	-	-	-	-	-	-	-	2,730
1b.1.1	Total	-	-	-	-	-	-	5,301	795	6,096	4,949	-	1,146	-	-	-	-	-	-	-	33,243
1b.1.2	Decon primary loop	740	-	-	-	-	-	-	370	1,110	1,110	-	-	-	-	-	-	-	-	1,067	-
1b.1	Subtotal Period 1b Activity Costs	740	-	-	-	-	-	5,301	1,166	7,206	6,060	-	1,146	-	-	-	-	-	-	1,067	33,243
Period 1b Additional Costs																					
1b.2.1	Spent Fuel Pool Isolation	-	-	-	-	-	-	12,675	1,901	14,576	14,576	-	-	-	-	-	-	-	-	-	-
1b.2.2	Site Characterization	-	-	-	-	-	-	3,134	940	4,074	4,074	-	-	-	-	-	-	-	-	19,100	7,852
1b.2	Subtotal Period 1b Additional Costs	-	-	-	-	-	-	15,809	2,841	18,650	18,650	-	-	-	-	-	-	-	-	19,100	7,852
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	1,055	-	-	-	-	-	-	158	1,213	1,213	-	-	-	-	-	-	-	-	-	-
1b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
1b.3.3	Process decommissioning water waste	46	-	29	53	-	140	-	69	337	337	-	-	-	283	-	-	-	16,989	55	-
1b.3.4	Process decommissioning chemical flush waste	2	-	78	261	-	3,842	-	883	4,566	4,566	-	-	-	-	788	-	-	83,917	147	-
1b.3.5	Small tool allowance	-	3	-	-	-	-	-	0	3	3	-	-	-	-	-	-	-	-	-	-
1b.3.6	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-
1b.3.7	Decon rig	2,133	-	-	-	-	-	-	320	2,453	2,453	-	-	-	-	-	-	-	-	-	-
1b.3.8	Spent Fuel Capital and Transfer	-	-	-	-	-	-	4,450	668	5,118	-	5,118	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	3,236	1,203	107	314	-	3,981	6,086	2,324	16,952	11,834	5,118	-	-	283	788	-	-	100,906	203	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	38	-	-	-	-	-	-	10	48	48	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	1,837	184	2,021	2,021	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	54	5	60	60	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	347	-	-	-	-	-	87	434	434	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	360	-	-	-	-	-	57	436	436	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	7	8	-	21	-	6	36	36	-	-	-	360	-	-	-	7,197	12	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	1,717	258	1,975	1,975	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	328	33	359	359	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	784	78	863	-	863	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	426	64	490	-	490	-	-	-	-	-	-	-	-	-
1b.4.11	ISFSI Operating Costs	-	-	-	-	-	-	58	8	65	-	65	-	-	-	-	-	-	-	-	-
1b.4.12	Corporate Allocations	-	-	-	-	-	-	504	50	555	555	-	-	-	-	-	-	-	-	-	-
1b.4.13	Security Staff Cost	-	-	-	-	-	-	8,004	1,201	9,205	9,205	-	-	-	-	-	-	-	-	-	121,471
1b.4.14	DOC Staff Cost	-	-	-	-	-	-	7,649	1,147	8,797	8,797	-	-	-	-	-	-	-	-	-	63,961
1b.4.15	Utility Staff Cost	-	-	-	-	-	-	19,056	2,858	21,915	21,915	-	-	-	-	-	-	-	-	-	213,904
1b.4	Subtotal Period 1b Period-Dependent Costs	38	727	7	8	-	21	40,415	6,047	47,257	45,840	1,417	-	-	360	-	-	-	7,197	12	399,337
1b.0	TOTAL PERIOD 1b COST	4,014	1,929	114	317	-	3,502	67,611	12,377	90,065	82,384	6,535	1,146	-	643	788	-	-	108,103	20,381	440,432
PERIOD 1 TOTALS		4,014	3,296	126	321	-	3,537	159,156	26,213	196,664	175,108	19,581	1,975	-	1,253	788	-	-	120,293	20,401	1,187,143

Table E
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial7 Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 2a - Large Component Removal																					
Period 2a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
2a.1.1.1	Reactor Coolant Piping	218	220	37	71	-	746	-	365	1,658	1,658	-	-	-	2,046	-	-	-	142,726	6,863	-
2a.1.1.2	Pressurizer Relief Tank	37	31	10	20	-	211	-	83	392	392	-	-	-	578	-	-	-	40,338	1,077	-
2a.1.1.3	Reactor Coolant Pumps & Motors	111	112	151	240	-	1,440	-	496	2,549	2,549	-	-	-	3,356	-	-	-	816,140	744	60
2a.1.1.4	Pressurizer	-	71	706	199	-	1,590	-	516	3,082	3,082	-	-	-	3,739	-	-	-	293,734	1,666	1,875
2a.1.1.5	Steam Generators	-	6,080	3,732	2,944	-	15,726	-	6,266	34,748	34,748	-	-	-	63,478	-	-	-	3,570,150	23,227	3,500
2a.1.1.6	Retired Steam Generator Units	-	-	2,733	2,888	-	15,534	-	4,590	25,746	25,746	-	-	-	62,808	-	-	-	3,349,305	10,800	2,250
2a.1.1.7	CRDMs/ICIs/Service Structure Removal	188	196	233	74	-	761	-	387	1,818	1,818	-	-	-	3,851	-	-	-	145,494	7,976	-
2a.1.1.8	Reactor Vessel Internals	165	7,167	13,655	1,352	-	14,987	416	16,780	54,482	54,482	-	-	-	1,878	963	393	-	329,968	34,307	1,531
2a.1.1.9	Vessel & Internals GTCC Disposal	-	-	-	-	-	12,538	-	1,881	14,419	14,419	-	-	-	-	-	-	2,217	433,150	-	-
2a.1.1.10	Reactor Vessel	132	8,777	3,058	1,137	-	5,740	416	10,680	29,890	29,890	-	-	-	13,554	-	-	-	972,356	34,307	1,531
2a.1.1	Totals	648	22,857	24,315	8,905	-	69,273	832	41,652	166,782	166,782	-	-	-	155,348	963	393	2,217	10,093,570	120,966	10,746
Removal of Major Equipment																					
2a.1.2	Main Turbine/Generator	-	612	2,674	453	-	17,199	-	4,788	25,726	25,726	-	-	-	54,809	-	-	-	3,481,857	9,888	-
2a.1.3	Main Condensers	-	1,718	1,301	1,282	-	21,372	-	6,086	31,704	31,704	-	-	-	64,324	-	-	-	4,086,853	27,762	-
Cascading Costs from Clean Building Demolition																					
2a.1.4.1	Reactor	-	561	-	-	-	-	-	84	645	645	-	-	-	-	-	-	-	-	4,832	-
2a.1.4.2	Auxiliary	-	276	-	-	-	-	-	41	317	317	-	-	-	-	-	-	-	-	2,113	-
2a.1.4.3	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	7	-
2a.1.4.4	Radwaste	-	53	-	-	-	-	-	8	62	62	-	-	-	-	-	-	-	-	387	-
2a.1.4.5	Fuel Building	-	117	-	-	-	-	-	17	134	134	-	-	-	-	-	-	-	-	795	-
2a.1.4	Totals	-	1,007	-	-	-	-	-	151	1,158	1,158	-	-	-	-	-	-	-	-	8,134	-
Disposal of Plant Systems																					
2a.1.5.1	100 Aux.Bldg Non-System Specific RCA	-	841	102	105	-	1,815	-	690	3,552	3,552	-	-	-	5,468	-	-	-	347,071	13,677	-
2a.1.5.2	100 Auxiliary Bldg Non-System Specific	-	137	11	12	-	208	-	89	455	455	-	-	-	621	-	-	-	39,480	2,291	-
2a.1.5.3	AB - Main Steam	-	324	-	-	-	-	-	49	373	-	-	373	-	-	-	-	-	-	6,833	-
2a.1.5.4	AB - Main Steam RCA	-	93	32	30	-	516	-	160	831	831	-	-	-	1,647	-	-	-	98,672	1,680	-
2a.1.5.5	AC - Main Turbine	-	320	-	-	-	-	-	48	368	-	-	368	-	-	-	-	-	-	5,641	-
2a.1.5.6	AD - Condensate	-	355	-	-	-	-	-	53	409	-	-	409	-	-	-	-	-	-	6,144	-
2a.1.5.7	AE - Feedwater	-	244	-	-	-	-	-	37	280	-	-	280	-	-	-	-	-	-	4,271	-
2a.1.5.8	AF - Feedwater Heater Extraction	-	299	-	-	-	-	-	45	344	-	-	344	-	-	-	-	-	-	5,362	-
2a.1.5.9	AK - Condensate Demineralizer	-	110	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	1,944	-
2a.1.5.10	AL - Auxiliary Feedwater	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	852	-
2a.1.5.11	AQ - Condensate & Feedwater Chem Addtn	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	468	-
2a.1.5.12	BM - Steam Generator Blowdown	-	143	19	16	-	279	-	110	566	566	-	-	-	832	-	-	-	53,260	2,415	-
2a.1.5.13	BM - Steam Generator Blowdown - RCA	-	447	72	57	-	996	-	377	1,949	1,949	-	-	-	2,963	-	-	-	190,396	7,221	-
2a.1.5.14	BN - Borated Refueling Water Storage	-	412	93	85	-	1,492	-	498	2,580	2,580	-	-	-	4,482	-	-	-	285,246	7,044	-
2a.1.5.15	CA - Steam Seal	-	26	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	455	-
2a.1.5.16	CB - Main Turbine Lube Oil	-	73	-	-	-	-	-	11	84	-	-	84	-	-	-	-	-	-	1,207	-
2a.1.5.17	CC - Generator Hydrogen Seal & CO2	-	12	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	198	-
2a.1.5.18	CD - Generator Seal Oil	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	287	-
2a.1.5.19	CE - Stator Cooling Water	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	241	-
2a.1.5.20	CF - Lube Oil Storage Xfer & Prfication	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	812	-
2a.1.5.21	CG - Condenser Air Removal	-	38	-	-	-	-	-	6	43	-	-	43	-	-	-	-	-	-	657	-
2a.1.5.22	CH - Main Turbine Control Oil	-	75	-	-	-	-	-	11	86	-	-	86	-	-	-	-	-	-	1,298	-
2a.1.5.23	DA - Circulating Water	-	419	-	-	-	-	-	63	482	-	-	482	-	-	-	-	-	-	7,502	-
2a.1.5.24	DB - Cooling Tower Makeup & Blowdown	-	71	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,260	-
2a.1.5.25	DD - Cooling Water Chemical Control Sys	-	63	-	-	-	-	-	9	72	-	-	72	-	-	-	-	-	-	1,084	-
2a.1.5.26	DD - Cooling Wtr Chem Control RCA	-	329	67	50	-	866	-	313	1,624	1,624	-	-	-	2,869	-	-	-	165,513	5,095	-
2a.1.5.27	EJ - Residual Heat Removal	-	478	90	84	-	1,464	-	506	2,619	2,619	-	-	-	4,385	-	-	-	280,003	8,105	-
2a.1.5.28	EM - High Pressure Coolant Injection	-	398	40	31	-	539	-	243	1,251	1,251	-	-	-	1,599	-	-	-	103,347	6,672	-
2a.1.5.29	EN - Containment Spray	-	262	51	42	-	731	-	260	1,346	1,346	-	-	-	2,179	-	-	-	139,742	4,242	-
2a.1.5.30	EP - Accumulator Safety Injection	-	209	35	28	-	481	-	160	933	933	-	-	-	1,483	-	-	-	91,944	3,516	-
2a.1.5.31	FA - Auxiliary Steam Generator	-	28	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	621	-
2a.1.5.32	FB - Auxiliary Steam	-	116	-	-	-	-	-	18	135	-	-	135	-	-	-	-	-	-	2,106	-
2a.1.5.33	FB - Auxiliary Steam RCA	-	99	15	11	-	198	-	78	401	401	-	-	-	689	-	-	-	37,925	1,568	-
2a.1.5.34	FC - Auxiliary Turbines	-	77	-	-	-	-	-	12	88	-	-	88	-	-	-	-	-	-	1,220	-
2a.1.5.35	FE - Auxiliary Steam Chemical Addition	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	105	-
2a.1.5.36	GE - Turbine Building HVAC	-	218	-	-	-	-	-	32	245	-	-	245	-	-	-	-	-	-	3,957	-
2a.1.5.37	GS - Containment Hydrogen Control	-	82	13	11	-	193	-	74	383	383	-	-	-	577	-	-	-	36,925	1,574	-
2a.1.5.38	HE - Boron Recycle	461	606	76	63	-	1,098	-	674	2,977	2,977	-	-	-	3,280	-	-	-	209,922	16,718	-

Table E
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes: Class A Cu. Feet	Burial Volumes: Class B Cu. Feet	Burial Volumes: Class C Cu. Feet	Burial Volumes: GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems (continued)																					
2a.1.5.39	HF - Secondary Liquid Waste	849	1,193	171	147	-	2,555	-	1,401	6,317	6,317	-	-	-	7,644	-	-	-	488,595	32,027	-
2a.1.5.40	JA - Auxiliary Oil & Transfer	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	990	-
2a.1.5.41	KS - Bulk Chemical Storage	-	110	89	89	-	1,536	-	434	2,257	2,257	-	-	-	4,620	-	-	-	293,686	2,002	-
2a.1.5.42	LE - Oily Waste	-	218	-	-	-	-	-	33	250	-	-	250	-	-	-	-	-	-	3,865	-
2a.1.5.43	LE - Oily Waste RCA	-	285	36	31	-	548	-	215	1,111	1,111	-	-	-	1,623	-	-	-	103,828	4,372	-
2a.1.5.44	Turbine Bldg Non-System Specific	-	913	-	-	-	-	-	137	1,050	-	-	1,050	-	-	-	-	-	-	15,405	-
2a.1.5	Totals	1,311	10,320	1,011	884	-	15,509	-	6,929	35,974	31,152	-	4,822	-	46,409	-	-	-	2,985,355	193,518	-
2a.1.6	Scaffolding in support of decommissioning	-	1,856	22	21	-	361	-	560	2,819	2,819	-	-	-	1,057	-	-	-	69,064	36,741	-
2a.1	Subtotal Period 2a Activity Costs	2,158	38,165	29,323	11,506	-	123,714	832	60,466	266,165	261,343	-	4,822	-	321,977	963	393	2,217	20,696,500	397,006	10,746
Period 2a Collateral Costs																					
2a.3.1	Process decommissioning water waste	198	-	128	283	-	614	-	300	1,474	1,474	-	-	-	1,248	-	-	-	74,579	242	-
2a.3.2	Process decommissioning chemical flush waste	1	-	41	136	-	360	-	115	653	653	-	-	-	410	-	-	-	43,711	77	-
2a.3.3	Small tool allowance	-	419	-	-	-	-	-	63	482	434	-	48	-	-	-	-	-	-	-	-
2a.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	14,240	2,136	16,376	-	16,376	-	-	-	-	-	-	-	-	-
2a.3.5	On-site survey and release of 60.57 tons clean metallic waste	-	-	-	-	-	-	96	10	106	106	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	199	419	169	370	-	974	14,336	2,624	19,091	2,666	16,376	48	-	1,658	-	-	-	118,289	319	-
Period 2a Period-Dependent Costs																					
2a.4.1	Decon supplies	137	-	-	-	-	-	-	34	171	171	-	-	-	-	-	-	-	-	-	-
2a.4.2	Insurance	-	-	-	-	-	-	1,203	120	1,323	1,323	-	-	-	-	-	-	-	-	-	-
2a.4.3	Property taxes	-	-	-	-	-	-	193	19	212	212	-	-	-	-	-	-	-	-	-	-
2a.4.4	Health physics supplies	-	3,887	-	-	-	-	-	547	4,234	4,234	-	-	-	-	-	-	-	-	-	-
2a.4.5	Heavy equipment rental	-	4,490	-	-	-	-	-	674	5,164	5,164	-	-	-	-	-	-	-	-	-	-
2a.4.6	Disposal of DAW generated	-	-	126	47	-	378	-	114	666	666	-	-	-	6,591	-	-	-	131,817	215	-
2a.4.7	Plant energy budget	-	-	-	-	-	-	2,804	436	3,340	3,340	-	-	-	-	-	-	-	-	-	-
2a.4.8	NRC Fees	-	-	-	-	-	-	1,060	106	1,166	1,166	-	-	-	-	-	-	-	-	-	-
2a.4.9	Emergency Planning Fees	-	-	-	-	-	-	1,748	175	1,922	-	1,922	-	-	-	-	-	-	-	-	-
2a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,515	227	1,743	-	1,743	-	-	-	-	-	-	-	-	-
2a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	201	30	231	-	231	-	-	-	-	-	-	-	-	-
2a.4.12	Corporate Allocations	-	-	-	-	-	-	1,795	179	1,974	1,974	-	-	-	-	-	-	-	-	-	-
2a.4.13	Remedial Actions Surveys	-	-	-	-	-	-	1,847	277	2,124	2,124	-	-	-	-	-	-	-	-	-	-
2a.4.14	Security Staff Cost	-	-	-	-	-	-	25,509	3,826	29,335	29,335	-	-	-	-	-	-	-	-	-	387,925
2a.4.15	DOC Staff Cost	-	-	-	-	-	-	5,000	750	5,750	5,750	-	-	-	-	-	-	-	-	-	283,678
2a.4.16	Utility Staff Cost	-	-	-	-	-	-	48,059	7,209	55,268	55,268	-	-	-	-	-	-	-	-	-	528,163
2a.4	Subtotal Period 2a Period-Dependent Costs	137	7,877	126	47	-	378	119,368	19,274	147,207	143,311	3,896	-	-	6,591	-	-	-	131,817	215	1,199,766
2a.0	TOTAL PERIOD 2a COST	2,495	46,462	29,618	11,923	-	125,065	134,536	82,364	432,463	407,320	20,272	4,870	-	330,221	963	393	2,217	20,946,600	397,543	1,210,513
PERIOD 2b - Site Decontamination																					
Period 2b Direct Decommissioning Activities																					
Disposal of Plant Systems																					
2b.1.1.1	200 Reactor Bldg Non-System Specific	-	110	7	7	-	126	-	61	311	311	-	-	-	378	-	-	-	24,042	1,765	-
2b.1.1.2	200 Reactor Bldg Non-System Specific RCA	-	693	64	66	-	1,134	-	473	2,430	2,430	-	-	-	3,414	-	-	-	216,897	10,564	-
2b.1.1.3	300 Control Bldg Non-System Specific	-	216	29	29	-	509	-	188	971	971	-	-	-	1,532	-	-	-	97,284	3,471	-
2b.1.1.4	300 Control Bldg Non-System Specific Cln	-	1,853	-	-	-	-	-	248	1,901	-	-	1,901	-	-	-	-	-	-	29,076	-
2b.1.1.5	700 Radwaste Bldg Non-Sys Specific RCA	-	1,386	170	174	-	3,018	-	1,144	5,891	5,891	-	-	-	9,083	-	-	-	577,051	22,261	-
2b.1.1.6	700 Radwaste Bldg Non-System Specific	-	221	18	19	-	333	-	143	734	734	-	-	-	1,002	-	-	-	63,835	3,667	-
2b.1.1.7	AN - Demineralized Wtr Storage & Xfer	-	185	-	-	-	-	-	28	212	-	-	212	-	-	-	-	-	-	3,383	-
2b.1.1.8	AN - Demineralized Wtr Strg & Xfer RCA	-	48	6	6	-	77	-	33	168	168	-	-	-	227	-	-	-	14,650	753	-
2b.1.1.9	AP -HCST/Condensate Stor.& Transfr	-	244	-	-	-	-	-	37	281	-	-	281	-	-	-	-	-	-	4,018	-
2b.1.1.10	BB - Reactor Coolant System	-	410	63	57	-	996	-	366	1,893	1,893	-	-	-	2,957	-	-	-	190,474	7,115	-
2b.1.1.11	BG - Chemical & Volume Control	925	1,157	186	164	-	2,886	-	1,304	6,773	6,773	-	-	-	8,476	-	-	-	542,341	28,366	-
2b.1.1.12	BL - Reactor Makeup Water	-	369	51	43	-	747	-	291	1,501	1,501	-	-	-	2,234	-	-	-	142,818	6,176	-
2b.1.1.13	DE - Intake & Water Treatment	-	148	-	-	-	-	-	22	170	-	-	170	-	-	-	-	-	-	2,517	-
2b.1.1.14	DE - Intake & Water Treatment RCA	-	299	165	164	-	2,843	-	827	4,298	4,298	-	-	-	8,646	-	-	-	543,623	6,351	-
2b.1.1.15	EA - Service Water	-	175	-	-	-	-	-	26	201	-	-	201	-	-	-	-	-	-	3,145	-
2b.1.1.16	EA - Service Water RCA	-	54	18	17	-	298	-	92	479	479	-	-	-	895	-	-	-	57,005	876	-
2b.1.1.17	RB - Closed Cooling Water	-	71	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,267	-
2b.1.1.18	EF - Essential Service Water	-	406	-	-	-	-	-	61	467	-	-	467	-	-	-	-	-	-	7,244	-
2b.1.1.19	EF - Essential Service Water RCA	-	238	76	73	-	1,272	-	396	2,056	2,056	-	-	-	3,820	-	-	-	243,301	4,018	-
2b.1.1.20	EG - Component Cooling Water RCA	-	298	-	-	-	-	-	45	343	-	-	343	-	-	-	-	-	-	5,385	-
2b.1.1.21	GA - Plant Heating	-	106	-	-	-	-	-	16	122	-	-	122	-	-	-	-	-	-	1,912	-

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Disposal of Plant Systems (continued)																					
2b.1.1.22	GA - Plant Heating RCA	-	115	14	9	-	157	-	71	366	366	-	-	-	463	-	-	-	30,040	1,795	-
2b.1.1.23	GB - Central Chilled Water	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	1,803	-
2b.1.1.24	GB - Central Chilled Water RCA	-	31	4	3	-	48	-	20	104	104	-	-	-	136	-	-	-	8,778	490	-
2b.1.1.25	GG - Essential Serv Wtr Pumphouse HVAC	-	22	-	-	-	-	-	3	26	-	-	26	-	-	-	-	-	-	427	-
2b.1.1.26	GF - Miscellaneous Building HVAC	-	138	27	29	-	484	-	162	840	840	-	-	-	1,457	-	-	-	92,568	2,081	-
2b.1.1.27	GH - Radwaste Building HVAC	-	215	33	35	-	610	-	215	1,108	1,108	-	-	-	1,834	-	-	-	116,589	3,602	-
2b.1.1.28	GK - Control Building HVAC	-	205	-	-	-	-	-	31	236	-	-	236	-	-	-	-	-	-	3,959	-
2b.1.1.29	GL - Auxiliary Building HVAC	-	530	71	74	-	1,281	-	471	2,427	2,427	-	-	-	3,855	-	-	-	245,020	8,590	-
2b.1.1.30	GM - Diesel Generator Building HVAC	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	695	-
2b.1.1.31	GN - Containment Cooling	-	594	111	114	-	1,971	-	669	3,459	3,459	-	-	-	5,923	-	-	-	376,780	9,749	-
2b.1.1.32	GP - Containment Integrated Leak Rate Test	-	47	9	8	-	139	-	49	252	252	-	-	-	417	-	-	-	26,823	788	-
2b.1.1.33	GR - Containment Atmospheric Control	-	24	15	16	-	272	-	78	404	404	-	-	-	818	-	-	-	51,989	413	-
2b.1.1.34	GT - Containment Purge HVAC	-	139	29	30	-	520	-	172	890	890	-	-	-	1,566	-	-	-	99,513	2,297	-
2b.1.1.35	HA - Gaseous Radwaste	-	431	93	52	-	893	-	345	1,764	1,764	-	-	-	2,954	-	-	-	170,799	7,097	-
2b.1.1.36	HB - Liquid Radwaste	925	1,050	168	180	-	2,254	-	1,824	5,839	5,839	-	-	-	6,735	-	-	-	430,985	31,019	-
2b.1.1.37	HC - Solid Radwaste	-	449	65	68	-	1,004	-	378	1,954	1,954	-	-	-	3,006	-	-	-	192,060	7,483	-
2b.1.1.38	HD - Decontamination	-	125	19	17	-	293	-	109	563	563	-	-	-	877	-	-	-	56,053	2,072	-
2b.1.1.39	JE - Emergency Fuel Oil	-	76	-	-	-	-	-	11	88	-	-	88	-	-	-	-	-	-	1,260	-
2b.1.1.40	KA - Compressed Air	-	233	-	-	-	-	-	35	268	-	-	268	-	-	-	-	-	-	4,187	-
2b.1.1.41	KA - Compressed Air RCA	-	155	18	11	-	198	-	92	475	475	-	-	-	683	-	-	-	37,947	2,380	-
2b.1.1.42	KB - Breathing Air	-	29	-	-	-	-	-	4	34	-	-	34	-	-	-	-	-	-	516	-
2b.1.1.43	KB - Breathing Air RCA	-	24	2	1	-	18	-	11	55	55	-	-	-	52	-	-	-	3,401	406	-
2b.1.1.44	KC - Fire Protection	-	456	-	-	-	-	-	68	524	-	-	524	-	-	-	-	-	-	8,376	-
2b.1.1.45	KC - Fire Protection RCA	-	483	84	62	-	1,075	-	407	2,111	2,111	-	-	-	3,189	-	-	-	205,825	7,245	-
2b.1.1.46	KD - Domestic Water	-	212	-	-	-	-	-	32	244	-	-	244	-	-	-	-	-	-	3,857	-
2b.1.1.47	KD - Domestic Water RCA	-	31	4	3	-	60	-	24	123	123	-	-	-	178	-	-	-	11,485	468	-
2b.1.1.48	KE - Fuel Handling & Storage Rctor vsel	-	23	11	12	-	210	-	61	317	317	-	-	-	632	-	-	-	40,119	388	-
2b.1.1.49	KH - Service Gas (CO2 N2 H2 & O2)	-	67	-	-	-	-	-	10	77	-	-	77	-	-	-	-	-	-	1,226	-
2b.1.1.50	KH - Service Gas (CO2 N2 H2 & O2) RCA	-	303	44	34	-	591	-	233	1,205	1,205	-	-	-	1,756	-	-	-	112,949	4,575	-
2b.1.1.51	KJ - Standby Diesel Engine	-	403	-	-	-	-	-	60	463	-	-	463	-	-	-	-	-	-	6,748	-
2b.1.1.52	LA - Sanitary Drains	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	972	-
2b.1.1.53	LA - Sanitary Drains RCA	-	127	20	13	-	306	-	119	585	585	-	-	-	916	-	-	-	59,593	1,854	-
2b.1.1.54	LB - Roof Drains	-	72	-	-	-	-	-	11	82	-	-	82	-	-	-	-	-	-	1,276	-
2b.1.1.55	LB - Roof Drains RCA	-	173	31	29	-	511	-	179	923	923	-	-	-	1,534	-	-	-	97,740	2,757	-
2b.1.1.56	LD - Chemical & Detergent Waste	79	144	18	11	-	193	-	127	567	567	-	-	-	574	-	-	-	36,840	3,503	-
2b.1.1.57	LF - Floor & Equipment Drains	-	1,735	175	162	-	2,812	-	1,181	6,125	6,125	-	-	-	8,419	-	-	-	537,847	29,417	-
2b.1.1.58	RM - Process Sampling & Analysis	-	164	19	14	-	242	-	106	545	545	-	-	-	737	-	-	-	46,849	2,762	-
2b.1.1.59	SJ - Nuclear Sampling	-	95	18	10	-	166	-	68	352	352	-	-	-	491	-	-	-	31,744	1,632	-
2b.1.1.60	UB - Service Stems Site Security Bldg	-	217	-	-	-	-	-	33	250	-	-	250	-	-	-	-	-	-	3,815	-
2b.1.1.61	Yard Non-System Specific	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	603	-
2b.1.1	Totals	1,930	18,100	1,902	1,759	-	30,498	-	13,018	67,207	60,878	-	6,329	-	91,385	-	-	-	5,831,320	326,556	-
2b.1.2	Scaffolding in support of decommissioning	-	2,320	27	25	-	452	-	699	3,524	3,524	-	-	-	1,359	-	-	-	88,330	45,926	-
Decontamination of Site Buildings																					
2b.1.3.1	Reactor	1,464	2,225	256	897	-	9,648	-	3,861	18,353	18,353	-	-	-	61,873	-	-	-	2,713,720	56,041	-
2b.1.3.2	Auxiliary	759	443	58	160	-	936	-	752	3,098	3,098	-	-	-	8,629	-	-	-	422,631	19,470	-
2b.1.3.3	Communication Corridor - Contaminated	17	7	1	3	-	13	-	14	55	55	-	-	-	164	-	-	-	7,995	395	-
2b.1.3.4	Hot Machine Shop	21	16	1	3	-	11	-	18	70	70	-	-	-	188	-	-	-	8,892	597	-
2b.1.3.5	RAM Storage Building	52	18	2	7	-	23	-	39	146	146	-	-	-	415	-	-	-	19,255	1,162	-
2b.1.3.6	Radioactive and Personnel Tunnel	7	14	0	2	-	6	-	9	39	39	-	-	-	106	-	-	-	5,022	325	-
2b.1.3.7	Radwaste	404	213	25	75	-	434	-	378	1,531	1,531	-	-	-	4,322	-	-	-	212,823	10,019	-
2b.1.3.8	Radwaste Drum Storage	45	22	2	8	-	42	-	40	159	159	-	-	-	460	-	-	-	22,567	1,094	-
2b.1.3.9	Reactor Head Assembly Building	40	-	-	-	-	-	-	20	59	59	-	-	-	-	-	-	-	-	691	-
2b.1.3.10	Steam Generator Replacement Bldgs	295	-	-	-	-	-	-	148	444	444	-	-	-	-	-	-	-	-	4,368	-
2b.1.3	Totals	3,105	2,959	346	1,148	-	11,120	-	5,279	23,954	23,954	-	-	-	76,157	-	-	-	3,412,845	94,163	-
2b.1.4	Prepare/submit License Termination Plan	-	-	-	-	-	-	653	98	751	751	-	-	-	-	-	-	-	-	-	4,066
2b.1.5	Receive NRC approval of termination plan									a											
2b.1	Subtotal Period 2b Activity Costs	5,034	23,379	2,276	2,931	-	42,069	653	19,094	95,436	89,107	-	6,329	-	168,901	-	-	-	9,330,495	466,645	4,066

Table E
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 2b Additional Costs																					
2b.2.1	Sanitary Treatment Lagoon	-	6	86	121	-	524	-	159	896	896	-	-	-	4,606	-	-	-	392,140	423	-
2b.2.2	Cooling Tower Asbestos Panel Removal	-	5,989	-	157	-	-	613	1,014	7,772	-	-	7,772	-	-	-	-	-	-	71,419	-
2b.2.3	Operational Equipment	-	-	22	121	-	1,538	-	405	2,085	2,085	-	-	-	11,760	-	-	-	294,000	32	-
2b.2.4	Retired Reactor Closure Head	-	136	623	1,040	-	1,078	-	522	3,399	3,399	-	-	-	2,764	-	-	-	338,540	3,167	2,000
2b.2	Subtotal Period 2b Additional Costs	-	6,131	731	1,439	-	3,139	613	2,099	14,152	6,380	-	7,772	-	19,132	-	-	-	1,024,680	76,031	2,000
Period 2b Collateral Costs																					
2b.3.1	Process decommissioning water waste	173	-	115	210	-	551	-	268	1,317	1,317	-	-	-	1,117	-	-	-	66,992	218	-
2b.3.2	Process decommissioning chemical flush waste	3	-	133	444	-	1,173	-	375	2,128	2,128	-	-	-	1,338	-	-	-	142,540	250	-
2b.3.3	Small tool allowance	-	528	-	-	-	-	-	79	607	607	-	-	-	-	-	-	-	-	-	-
2b.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	21,380	3,204	24,584	-	24,584	-	-	-	-	-	-	-	-	-
2b.3.5	On-site survey and release of 209.6 tons clean metallic waste	-	-	-	-	-	-	489	49	538	538	-	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	177	528	248	654	-	1,724	21,849	3,974	29,164	4,590	24,584	-	-	2,454	-	-	-	209,532	468	-
Period 2b Period-Dependent Costs																					
2b.4.1	Decon supplies	1,687	-	-	-	-	-	-	422	2,109	2,109	-	-	-	-	-	-	-	-	-	-
2b.4.2	Insurance	-	-	-	-	-	-	1,477	148	1,624	1,624	-	-	-	-	-	-	-	-	-	-
2b.4.3	Property taxes	-	-	-	-	-	-	237	24	261	261	-	-	-	-	-	-	-	-	-	-
2b.4.4	Health physics supplies	-	4,447	-	-	-	-	-	1,112	5,559	5,559	-	-	-	-	-	-	-	-	-	-
2b.4.5	Heavy equipment rental	-	5,861	-	-	-	-	-	649	6,510	6,510	-	-	-	-	-	-	-	-	-	-
2b.4.6	Disposal of DAW generated	-	-	126	47	-	377	-	114	664	664	-	-	-	6,571	-	-	-	131,421	214	-
2b.4.7	Plant energy budget	-	-	-	-	-	-	2,814	422	3,236	3,236	-	-	-	-	-	-	-	-	-	-
2b.4.8	NRC Fees	-	-	-	-	-	-	1,301	130	1,431	1,431	-	-	-	-	-	-	-	-	-	-
2b.4.9	Emergency Planning Fees	-	-	-	-	-	-	2,145	215	2,360	-	2,360	-	-	-	-	-	-	-	-	-
2b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,860	279	2,139	-	2,139	-	-	-	-	-	-	-	-	-
2b.4.11	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	468	70	538	538	-	-	-	-	-	-	-	-	-	-
2b.4.12	ISFSI Operating Costs	-	-	-	-	-	-	247	37	284	-	284	-	-	-	-	-	-	-	-	-
2b.4.13	Corporate Allocations	-	-	-	-	-	-	2,203	220	2,423	2,423	-	-	-	-	-	-	-	-	-	-
2b.4.14	Remedial Actions Surveys	-	-	-	-	-	-	2,267	340	2,607	2,607	-	-	-	-	-	-	-	-	-	-
2b.4.15	Security Staff Cost	-	-	-	-	-	-	31,311	4,697	36,008	36,008	-	-	-	-	-	-	-	-	-	476,171
2b.4.16	DOC Staff Cost	-	-	-	-	-	-	39,440	5,916	45,356	45,356	-	-	-	-	-	-	-	-	-	334,464
2b.4.17	Utility Staff Cost	-	-	-	-	-	-	56,665	8,500	65,165	65,165	-	-	-	-	-	-	-	-	-	620,820
2b.4	Subtotal Period 2b Period-Dependent Costs	1,687	10,109	126	47	-	377	142,435	23,494	178,275	173,493	4,783	-	-	6,571	-	-	-	131,421	214	1,431,455
2b.0	TOTAL PERIOD 2b COST	6,899	40,146	3,380	5,070	-	47,210	165,550	48,662	317,017	278,570	29,847	14,101	-	197,058	-	-	-	10,696,130	542,358	1,437,551
PERIOD 2d - Decontamination Following Wet Fuel Storage																					
Period 2d Direct Decommissioning Activities																					
2d.1.1	Remove spent fuel racks	955	55	276	134	-	2,822	-	1,120	4,862	4,862	-	-	-	6,988	-	-	-	443,980	1,925	-
Disposal of Plant Systems																					
2d.1.2.1	600 Fuel Bldg Non-Specific Systems RCA	-	377	43	44	-	762	-	296	1,521	1,521	-	-	-	2,292	-	-	-	145,605	6,946	-
2d.1.2.2	600 Fuel Bldg Non-System Specific	-	59	4	5	-	81	-	36	184	184	-	-	-	242	-	-	-	15,399	957	-
2d.1.2.3	EC - Fuel Pool Cooling & Cleanup	-	486	65	57	-	993	-	386	1,986	1,986	-	-	-	2,986	-	-	-	188,813	8,118	-
2d.1.2.4	GA- Plant Heating Fuel Building	-	27	2	2	-	25	-	14	71	71	-	-	-	78	-	-	-	5,037	421	-
2d.1.2.5	GG - Fuel Building HVAC	-	292	51	54	-	939	-	321	1,657	1,657	-	-	-	2,825	-	-	-	179,529	4,745	-
2d.1.2.6	KC- Fire Protection Fuel Building	-	143	23	17	-	302	-	116	602	602	-	-	-	896	-	-	-	57,756	2,166	-
2d.1.2	Totals	-	1,382	189	179	-	3,102	-	1,167	6,019	6,019	-	-	-	9,298	-	-	-	593,141	22,383	-
Decontamination of Site Buildings																					
2d.1.3.1	Fuel Building	958	1,026	73	72	-	817	-	958	3,903	3,903	-	-	-	3,849	-	-	-	218,838	31,668	-
2d.1.3	Totals	958	1,026	73	72	-	817	-	958	3,903	3,903	-	-	-	3,849	-	-	-	218,838	31,668	-
2d.1.4	Scaffolding in support of decommissioning	-	464	5	5	-	90	-	140	705	705	-	-	-	272	-	-	-	17,266	9,185	-
2d.1	Subtotal Period 2d Activity Costs	1,913	2,927	544	393	-	6,331	-	3,264	15,489	15,489	-	-	-	20,407	-	-	-	1,273,206	65,161	-
Period 2d Additional Costs																					
2d.2.1	License Termination Survey Planning	-	-	-	-	-	-	1,759	528	2,287	2,287	-	-	-	-	-	-	-	-	-	12,480
2d.2.2	License Termination ISFSI	-	591	110	98	-	3,112	3,411	1,830	9,152	9,152	-	-	-	13,299	-	-	-	861,066	17,021	10,896
2d.2	Subtotal Period 2d Additional Costs	-	591	110	98	-	3,112	5,170	2,358	11,439	11,439	-	-	-	13,299	-	-	-	861,066	17,021	23,376

Table E
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes: Class A Cu. Feet	Burial Volumes: Class B Cu. Feet	Burial Volumes: Class C Cu. Feet	Burial Volumes: GTCC Cu. Feet	Burial7 Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 2d Collateral Costs																					
2d.3.1	Process decommissioning water waste	93	-	62	113	-	297	-	144	708	708	-	-	-	601	-	-	-	36,070	117	-
2d.3.2	Process decommissioning chemical flush waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2d.3.3	Small tool allowance	-	89	-	-	-	-	-	13	103	103	-	-	-	-	-	-	-	-	-	-
2d.3.4	Decommissioning Equipment Disposition	-	-	107	101	-	1,758	-	465	2,431	2,431	-	-	-	5,290	-	-	-	336,079	147	-
2d.3	Subtotal Period 2d Collateral Costs	93	89	169	214	-	2,055	-	622	3,242	3,242	-	-	-	5,891	-	-	-	372,149	264	-
Period 2d Period-Dependent Costs																					
2d.4.1	Decon supplies	247	-	-	-	-	-	-	62	309	309	-	-	-	-	-	-	-	-	-	-
2d.4.2	Insurance	-	-	-	-	-	-	446	45	491	491	-	-	-	-	-	-	-	-	-	-
2d.4.3	Property taxes	-	-	-	-	-	-	72	7	79	79	-	-	-	-	-	-	-	-	-	-
2d.4.4	Health physics supplies	-	839	-	-	-	-	-	210	1,049	1,049	-	-	-	-	-	-	-	-	-	-
2d.4.5	Heavy equipment rental	-	1,711	-	-	-	-	-	257	1,968	1,968	-	-	-	-	-	-	-	-	-	-
2d.4.6	Disposal of DAW generated	-	-	40	15	-	119	-	36	210	210	-	-	-	2,081	-	-	-	41,624	68	-
2d.4.7	Plant energy budget	-	-	-	-	-	-	454	68	522	522	-	-	-	-	-	-	-	-	-	-
2d.4.8	NRC Fees	-	-	-	-	-	-	375	37	412	412	-	-	-	-	-	-	-	-	-	-
2d.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	283	42	325	325	-	-	-	-	-	-	-	-	-	-
2d.4.10	Corporate Allocations	-	-	-	-	-	-	666	67	732	732	-	-	-	-	-	-	-	-	-	-
2d.4.11	Remedial Actions Surveys	-	-	-	-	-	-	685	103	788	788	-	-	-	-	-	-	-	-	-	-
2d.4.12	Security Staff Cost	-	-	-	-	-	-	1,678	252	1,930	1,930	-	-	-	-	-	-	-	-	-	20,772
2d.4.13	DOC Staff Cost	-	-	-	-	-	-	8,173	1,226	9,399	9,399	-	-	-	-	-	-	-	-	-	69,238
2d.4.14	Utility Staff Cost	-	-	-	-	-	-	12,280	1,842	14,122	14,122	-	-	-	-	-	-	-	-	-	130,861
2d.4	Subtotal Period 2d Period-Dependent Costs	247	2,550	40	15	-	119	25,111	4,253	32,336	32,336	-	-	-	2,081	-	-	-	41,624	68	220,870
2d.0	TOTAL PERIOD 2d COST	2,253	6,157	883	718	-	11,618	30,281	10,618	62,506	62,506	-	-	-	41,678	-	-	-	2,538,034	82,514	244,246
PERIOD 2f - License Termination																					
Period 2f Direct Decommissioning Activities																					
2f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	168	49	212	212	-	-	-	-	-	-	-	-	-	-
2f.1.2	Terminate license									a											
2f.1	Subtotal Period 2f Activity Costs	-	-	-	-	-	-	168	49	212	212	-	-	-	-	-	-	-	-	-	-
Period 2f Additional Costs																					
2f.2.1	License Termination Survey	-	-	-	-	-	-	9,385	2,815	12,200	12,200	-	-	-	-	-	-	-	-	153,878	6,240
2f.2	Subtotal Period 2f Additional Costs	-	-	-	-	-	-	9,385	2,815	12,200	12,200	-	-	-	-	-	-	-	-	153,878	6,240
Period 2f Collateral Costs																					
2f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
2f.3	Subtotal Period 2f Collateral Costs	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
Period 2f Period-Dependent Costs																					
2f.4.1	Insurance	-	-	-	-	-	-	507	51	558	558	-	-	-	-	-	-	-	-	-	-
2f.4.2	Property taxes	-	-	-	-	-	-	81	8	90	90	-	-	-	-	-	-	-	-	-	-
2f.4.3	Health physics supplies	-	910	-	-	-	-	-	228	1,138	1,138	-	-	-	-	-	-	-	-	-	-
2f.4.4	Disposal of DAW generated	-	-	7	3	-	20	-	6	36	36	-	-	-	353	-	-	-	7,050	11	-
2f.4.5	Plant energy budget	-	-	-	-	-	-	258	39	298	298	-	-	-	-	-	-	-	-	-	-
2f.4.6	NRC Fees	-	-	-	-	-	-	427	43	470	470	-	-	-	-	-	-	-	-	-	-
2f.4.7	Corporate Allocations	-	-	-	-	-	-	756	76	832	832	-	-	-	-	-	-	-	-	-	-
2f.4.8	Security Staff Cost	-	-	-	-	-	-	1,906	286	2,192	2,192	-	-	-	-	-	-	-	-	-	23,692
2f.4.9	DOC Staff Cost	-	-	-	-	-	-	6,879	1,032	7,910	7,910	-	-	-	-	-	-	-	-	-	57,408
2f.4.10	Utility Staff Cost	-	-	-	-	-	-	7,882	1,152	8,834	8,834	-	-	-	-	-	-	-	-	-	74,709
2f.4	Subtotal Period 2f Period-Dependent Costs	-	910	7	3	-	20	18,496	2,919	22,355	22,355	-	-	-	353	-	-	-	7,050	11	155,709
2f.0	TOTAL PERIOD 2f COST	-	910	7	3	-	20	29,680	6,029	36,649	36,649	-	-	-	353	-	-	-	7,050	153,889	161,949
PERIOD 2 TOTALS		11,647	93,676	33,868	17,711	-	184,013	360,047	147,673	848,635	780,045	49,619	18,971	-	569,310	963	393	2,217	34,187,820	1,176,304	3,054,259

Table E
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 3b - Site Restoration																					
Period 3b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
3b.1.1.1	Reactor	-	3,189	-	-	-	-	-	478	3,667	-	-	3,667	-	-	-	-	-	-	27,502	-
3b.1.1.2	Auxiliary	-	2,481	-	-	-	-	-	372	2,853	-	-	2,853	-	-	-	-	-	-	19,024	-
3b.1.1.3	Auxiliary Boiler	-	23	-	-	-	-	-	3	27	-	-	27	-	-	-	-	-	-	248	-
3b.1.1.4	Barge Facility	-	924	-	-	-	-	-	139	1,063	-	-	1,063	-	-	-	-	-	-	4,290	-
3b.1.1.5	Circulating & Service Water Pumphouse	-	218	-	-	-	-	-	33	251	-	-	251	-	-	-	-	-	-	1,996	-
3b.1.1.6	Communication Corridor - Clean	-	892	-	-	-	-	-	134	1,025	-	-	1,025	-	-	-	-	-	-	8,280	-
3b.1.1.7	Communication Corridor - Contaminated	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	184	-
3b.1.1.8	Cooling Tower Concrete	-	433	-	-	-	-	-	65	498	-	-	498	-	-	-	-	-	-	2,332	-
3b.1.1.9	Diesel Generator	-	291	-	-	-	-	-	44	335	-	-	335	-	-	-	-	-	-	2,165	-
3b.1.1.10	Essential Service Water Pumphouse	-	169	-	-	-	-	-	25	194	-	-	194	-	-	-	-	-	-	955	-
3b.1.1.11	Fire Water Pumphouse	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	151	-
3b.1.1.12	Flex Building Storage	-	309	-	-	-	-	-	46	355	-	-	355	-	-	-	-	-	-	1,972	-
3b.1.1.13	Hardened Condensate Storage Tank - HCST	-	195	-	-	-	-	-	29	224	-	-	224	-	-	-	-	-	-	1,870	-
3b.1.1.14	Hot Machine Shop	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	243	-
3b.1.1.15	Intake	-	209	-	-	-	-	-	31	240	-	-	240	-	-	-	-	-	-	1,411	-
3b.1.1.16	Misc. Structures	-	2,147	-	-	-	-	-	322	2,469	-	-	2,469	-	-	-	-	-	-	18,774	-
3b.1.1.17	Miscellaneous Site Foundations	-	186	-	-	-	-	-	28	214	-	-	214	-	-	-	-	-	-	1,011	-
3b.1.1.18	Outage Maintenance	-	128	-	-	-	-	-	19	147	-	-	147	-	-	-	-	-	-	1,570	-
3b.1.1.19	RAM Storage Building	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	624	-
3b.1.1.20	Radioactive and Personnel Tunnel	-	32	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	386	-
3b.1.1.21	Radwaste	-	1,056	-	-	-	-	-	158	1,214	-	-	1,214	-	-	-	-	-	-	8,111	-
3b.1.1.22	Radwaste Drum Storage	-	161	-	-	-	-	-	24	185	-	-	185	-	-	-	-	-	-	1,449	-
3b.1.1.23	Reactor Head Assembly Building	-	81	-	-	-	-	-	12	93	-	-	93	-	-	-	-	-	-	1,108	-
3b.1.1.24	Security Additions	-	1,583	-	-	-	-	-	237	1,820	-	-	1,820	-	-	-	-	-	-	6,051	-
3b.1.1.25	Service	-	422	-	-	-	-	-	63	485	-	-	485	-	-	-	-	-	-	3,485	-
3b.1.1.26	Sludge Pump Station & Lagoon	-	1,582	-	-	-	-	-	237	1,820	-	-	1,820	-	-	-	-	-	-	10,601	-
3b.1.1.27	Steam Generator Replacement Bldgs	-	852	-	-	-	-	-	128	979	-	-	979	-	-	-	-	-	-	6,874	-
3b.1.1.28	Turbine Building	-	3,653	-	-	-	-	-	548	4,201	-	-	4,201	-	-	-	-	-	-	47,075	-
3b.1.1.29	Turbine Pedestal	-	540	-	-	-	-	-	81	620	-	-	620	-	-	-	-	-	-	2,934	-
3b.1.1.30	U.H.S. Cooling Tower	-	330	-	-	-	-	-	49	379	-	-	379	-	-	-	-	-	-	1,814	-
3b.1.1.31	Water Treatment Plant	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	9	-
3b.1.1.32	Fuel Building	-	1,106	-	-	-	-	-	166	1,272	-	-	1,272	-	-	-	-	-	-	8,068	-
3b.1.1	Totals	-	23,816	-	-	-	-	-	3,497	26,813	-	-	26,813	-	-	-	-	-	-	192,587	-
Site Closeout Activities																					
3b.1.2	Remove Rubble	-	1,399	-	-	-	-	-	210	1,608	-	-	1,608	-	-	-	-	-	-	7,233	-
3b.1.3	Grade & landscape site	-	130	-	-	-	-	-	19	149	-	-	149	-	-	-	-	-	-	692	-
3b.1.4	Final report to NRC	-	-	-	-	-	-	249	37	286	286	-	-	-	-	-	-	-	-	-	1,560
3b.1	Subtotal Period 3b Activity Costs	-	24,844	-	-	-	-	249	3,764	28,857	286	-	28,571	-	-	-	-	-	-	200,413	1,560
Period 3b Additional Costs																					
3b.2.1	Concrete Crushing	-	1,379	-	-	-	-	13	209	1,601	-	-	1,601	-	-	-	-	-	-	6,035	-
3b.2.2	Mine Area Backfill	-	5,306	-	-	-	-	-	796	6,104	-	-	6,104	-	-	-	-	-	-	16,960	-
3b.2.3	Cooling Tower Discharge & Intake Pipe Flow Fill	-	4,074	-	-	-	-	-	611	4,685	-	-	4,685	-	-	-	-	-	-	9,568	-
3b.2.4	Cooling Tower Demolition	-	4,779	-	-	-	-	-	717	5,496	-	-	5,496	-	-	-	-	-	-	21,619	-
3b.2.5	Excavation of Underground Services	-	2,833	-	-	-	-	487	423	3,244	-	-	3,244	-	-	-	-	-	-	14,184	-
3b.2.6	Construction Debris	-	-	-	-	-	-	5,080	755	5,785	-	-	5,785	-	-	-	-	-	-	-	-
3b.2.7	Site Restoration ISFSI	-	1,152	-	-	-	-	86	186	1,423	-	-	1,423	-	-	-	-	-	-	8,601	160
3b.2	Subtotal Period 3b Additional Costs	-	19,026	-	-	-	-	5,616	3,696	28,338	-	-	28,338	-	-	-	-	-	-	76,967	160
Period 3b Collateral Costs																					
3b.3.1	Small tool allowance	-	311	-	-	-	-	-	47	357	-	-	357	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	-	311	-	-	-	-	-	47	357	-	-	357	-	-	-	-	-	-	-	-

Table E
Callaway Plant
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes: Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 3b Period-Dependent Costs																					
3b.4.1	Insurance	-	-	-	-	-	-	1,008	101	1,109	-	-	1,109	-	-	-	-	-	-	-	-
3b.4.2	Property taxes	-	-	-	-	-	-	162	16	178	-	-	178	-	-	-	-	-	-	-	-
3b.4.3	Heavy equipment rental	-	5,067	-	-	-	-	-	760	5,827	-	-	5,827	-	-	-	-	-	-	-	-
3b.4.4	Plant energy budget	-	-	-	-	-	-	256	38	295	-	-	295	-	-	-	-	-	-	-	-
3b.4.5	Corporate Allocations	-	-	-	-	-	-	1,504	150	1,655	-	-	1,655	-	-	-	-	-	-	-	-
3b.4.6	Security Staff Cost	-	-	-	-	-	-	2,929	439	3,368	-	-	3,368	-	-	-	-	-	-	-	37,543
3b.4.7	DOC Staff Cost	-	-	-	-	-	-	13,311	1,997	15,308	-	-	15,308	-	-	-	-	-	-	-	106,371
3b.4.8	Utility Staff Cost	-	-	-	-	-	-	6,215	932	7,148	-	-	7,148	-	-	-	-	-	-	-	61,007
3b.4	Subtotal Period 3b Period-Dependent Costs	-	5,067	-	-	-	-	25,386	4,434	34,887	-	-	34,887	-	-	-	-	-	-	-	204,920
3b.0	TOTAL PERIOD 3b COST	-	49,248	-	-	-	-	31,251	11,941	92,439	286	-	92,153	-	-	-	-	-	-	277,379	206,640
PERIOD 3 TOTALS		-	49,248	-	-	-	-	31,251	11,941	92,439	286	-	92,153	-	-	-	-	-	-	277,379	206,640
TOTAL COST TO DECOMMISSION		15,661	146,219	33,994	18,033	-	187,550	550,454	185,827	1,137,738	955,439	69,200	113,099	-	570,563	1,750	393	2,217	34,308,110	1,474,055	4,448,042

TOTAL COST TO DECOMMISSION WITH 19.52% CONTINGENCY:	$1,137,738	thousands of 2020 dollars
TOTAL NRC LICENSE TERMINATION COST IS 83.98% OR:	$955,439	thousands of 2020 dollars
SPENT FUEL MANAGEMENT COST IS 6.08% OR:	$69,200	thousands of 2020 dollars
NON-NUCLEAR DEMOLITION COST IS 9.94% OR:	$113,099	thousands of 2020 dollars
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	572,706	Cubic Feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	2,217	Cubic Feet
TOTAL SCRAP METAL REMOVED:	69,040	Tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,474,055	Man-hours

End Notes:
n/a - indicates that this activity not charged as decommissioning expense
a - indicates that this activity performed by decommissioning staff
0 - indicates that this value is less than 0.5 but is non-zero
A cell containing " - " indicates a zero value

APPENDIX F

DETAILED COST ANALYSIS

SAFSTOR

with

DIRECT DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTE

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	SAFSTOR site characterization survey	-	-	-	-	-	-	385	115	500	500	-	-	-	-	-	-	-	-	-	-
1a.1.2	Prepare preliminary decommissioning cost	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,900
1a.1.3	Notification of Cessation of Operations									a											
1a.1.4	Remove fuel & source material									n/a											
1a.1.5	Notification of Permanent Defueling									a											
1a.1.6	Deactivate plant systems & process waste									a											
1a.1.7	Prepare and submit PSDAR	-	-	-	-	-	-	319	48	367	367	-	-	-	-	-	-	-	-	-	2,000
1a.1.8	Review plant dwgs & specs.	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
1a.1.9	Perform detailed rad survey									a											
1a.1.10	Estimate by-product inventory	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	End product description	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.12	Detailed by-product inventory	-	-	-	-	-	-	239	36	275	275	-	-	-	-	-	-	-	-	-	1,500
1a.1.13	Define major work sequence	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
1a.1.14	Perform SER and EA	-	-	-	-	-	-	494	74	568	568	-	-	-	-	-	-	-	-	-	3,100
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	797	120	917	917	-	-	-	-	-	-	-	-	-	5,000
Activity Specifications																					
1a.1.16.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	784	118	902	902	-	-	-	-	-	-	-	-	-	4,820
1a.1.16.2	Plant systems	-	-	-	-	-	-	664	100	764	764	-	-	-	-	-	-	-	-	-	4,167
1a.1.16.3	Plant structures and buildings	-	-	-	-	-	-	497	75	572	572	-	-	-	-	-	-	-	-	-	3,120
1a.1.16.4	Waste management	-	-	-	-	-	-	319	48	367	367	-	-	-	-	-	-	-	-	-	2,000
1a.1.16.5	Facility and site dormancy	-	-	-	-	-	-	319	48	367	367	-	-	-	-	-	-	-	-	-	2,000
1a.1.16	Total	-	-	-	-	-	-	2,584	388	2,972	2,972	-	-	-	-	-	-	-	-	-	16,207
Detailed Work Procedures																					
1a.1.17.1	Plant systems	-	-	-	-	-	-	189	28	217	217	-	-	-	-	-	-	-	-	-	1,183
1a.1.17.2	Facility closeout & dormancy	-	-	-	-	-	-	191	29	220	220	-	-	-	-	-	-	-	-	-	1,200
1a.1.17	Total	-	-	-	-	-	-	380	57	437	437	-	-	-	-	-	-	-	-	-	2,383
1a.1.18	Procure vacuum drying system	-	-	-	-	-	-	16	2	18	18	-	-	-	-	-	-	-	-	-	100
1a.1.19	Drain/de-energize non-cont. systems									a											
1a.1.20	Drain & dry NSSS									a											
1a.1.21	Drain/de-energize contaminated systems									a											
1a.1.22	Decon/secure contaminated systems									a											
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	6,107	974	7,081	7,081	-	-	-	-	-	-	-	-	-	35,890
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	8,900	1,335	10,235	-	10,235	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	8,900	1,335	10,235	-	10,235	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	3,644	364	4,009	4,009	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	108	11	118	118	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	614	-	-	-	-	-	153	767	767	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	753	-	-	-	-	-	113	866	866	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	12	4	-	35	-	11	62	62	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,703	256	1,959	1,959	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	862	99	961	961	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,556	156	1,711	-	1,711	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	346	52	398	398	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	845	127	971	-	971	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	112	17	129	-	129	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate Allocations	-	-	-	-	-	-	1,000	100	1,100	1,100	-	-	-	-	-	-	-	-	-	-
1a.4.13	Security Staff Cost	-	-	-	-	-	-	16,238	2,435	18,668	18,668	-	-	-	-	-	-	-	-	-	246,315
1a.4.14	Utility Staff Cost	-	-	-	-	-	-	37,599	5,640	43,239	43,239	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,367	12	4	-	35	64,038	9,523	74,978	72,167	2,811	-	-	610	-	-	-	12,190	20	668,555
1a.0	TOTAL PERIOD 1a COST	-	1,367	12	4	-	35	78,045	11,831	92,294	79,248	13,046	-	-	610	-	-	-	12,190	20	704,445

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 1b - SAFSTOR Limited DECON Activities																					
Period 1b Direct Decommissioning Activities																					
Decontamination of Site Buildings																					
1b.1.1.1	Reactor	1,443	-	-	-	-	-	-	721	2,164	2,164	-	-	-	-	-	-	-	-	24,102	-
1b.1.1.2	Auxiliary	714	-	-	-	-	-	-	357	1,071	1,071	-	-	-	-	-	-	-	-	12,527	-
1b.1.1.3	Communication Corridor - Contaminated	16	-	-	-	-	-	-	8	24	24	-	-	-	-	-	-	-	-	276	-
1b.1.1.4	Fuel Building	945	-	-	-	-	-	-	473	1,418	1,418	-	-	-	-	-	-	-	-	14,371	-
1b.1.1.5	Hot Machine Shop	20	-	-	-	-	-	-	10	29	29	-	-	-	-	-	-	-	-	344	-
1b.1.1.6	RAM Storage Building	49	-	-	-	-	-	-	25	74	74	-	-	-	-	-	-	-	-	865	-
1b.1.1.7	Radioactive and Personnel Tunnel	6	-	-	-	-	-	-	3	9	9	-	-	-	-	-	-	-	-	102	-
1b.1.1.8	Radwaste	380	-	-	-	-	-	-	190	571	571	-	-	-	-	-	-	-	-	6,671	-
1b.1.1.9	Radwaste Drum Storage	43	-	-	-	-	-	-	21	64	64	-	-	-	-	-	-	-	-	760	-
1b.1.1.10	Reactor Head Assembly Building	40	-	-	-	-	-	-	20	59	59	-	-	-	-	-	-	-	-	691	-
1b.1.1	Totals	3,656	-	-	-	-	-	-	1,828	5,484	5,484	-	-	-	-	-	-	-	-	60,700	-
1b.1	Subtotal Period 1b Activity Costs	3,656	-	-	-	-	-	-	1,828	5,484	5,484	-	-	-	-	-	-	-	-	60,700	-
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	1,055	-	-	-	-	-	-	158	1,213	1,213	-	-	-	-	-	-	-	-	-	-
1b.3.2	Process decommissioning water waste	176	-	112	204	-	536	-	264	1,292	1,292	-	-	-	1,085	-	-	-	65,127	212	-
1b.3.4	Small tool allowance	-	61	-	-	-	-	-	9	70	70	-	-	-	-	-	-	-	-	-	-
1b.3.5	Spent Fuel Capital and Transfer	-	-	-	-	-	-	2,670	401	3,071	-	3,071	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	1,231	61	112	204	-	536	2,670	832	5,646	2,576	3,071	-	-	1,085	-	-	-	65,127	212	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	1,588	-	-	-	-	-	-	397	1,985	1,985	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	919	92	1,010	1,010	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	27	3	30	30	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	501	-	-	-	-	-	125	626	626	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	190	-	-	-	-	-	28	218	218	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	14	5	-	43	-	13	76	76	-	-	-	752	-	-	-	15,043	25	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	429	64	494	494	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	163	16	179	179	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	392	39	431	-	431	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	218	32	246	-	246	-	-	-	-	-	-	-	-	-
1b.4.11	ISFSI Operating Costs	-	-	-	-	-	-	28	4	32	-	32	-	-	-	-	-	-	-	-	-
1b.4.12	Corporate Allocations	-	-	-	-	-	-	252	25	277	277	-	-	-	-	-	-	-	-	-	-
1b.4.13	Security Staff Cost	-	-	-	-	-	-	4,006	601	4,606	4,606	-	-	-	-	-	-	-	-	-	60,774
1b.4.14	Utility Staff Cost	-	-	-	-	-	-	9,477	1,422	10,899	10,899	-	-	-	-	-	-	-	-	-	106,428
1b.4	Subtotal Period 1b Period-Dependent Costs	1,588	691	14	5	-	43	15,905	2,862	21,109	20,400	709	-	-	752	-	-	-	15,043	25	167,202
1b.0	TOTAL PERIOD 1b COST	6,475	752	127	209	-	579	18,575	5,522	32,239	28,460	3,779	-	-	1,838	-	-	-	80,170	60,936	167,202
PERIOD 1c - Preparations for SAFSTOR Dormancy																					
Period 1c Direct Decommissioning Activities																					
1c.1.1	Prepare support equipment for storage	-	407	-	-	-	-	-	61	468	468	-	-	-	-	-	-	-	-	3,000	-
1c.1.2	Install containment pressure equal. lines	-	26	-	-	-	-	-	4	30	30	-	-	-	-	-	-	-	-	700	-
1c.1.3	Interim survey prior to dormancy	-	-	-	-	-	-	733	220	953	953	-	-	-	-	-	-	-	-	13,953	-
1c.1.4	Secure building accesses									a											
1c.1.5	Prepare & submit interim report	-	-	-	-	-	-	93	14	107	107	-	-	-	-	-	-	-	-	-	583
1c.1	Subtotal Period 1c Activity Costs	-	432	-	-	-	-	826	299	1,557	1,557	-	-	-	-	-	-	-	-	17,653	583
Period 1c Additional Costs																					
1c.2.1	Spent Fuel Pool Isolation	-	-	-	-	-	-	12,675	1,901	14,576	14,576	-	-	-	-	-	-	-	-	-	-
1c.2	Subtotal Period 1c Additional Costs	-	-	-	-	-	-	12,675	1,901	14,576	14,576	-	-	-	-	-	-	-	-	-	-
Period 1c Collateral Costs																					
1c.3.1	Process decommissioning water waste	192	-	122	222	-	584	-	287	1,408	1,408	-	-	-	1,183	-	-	-	70,961	231	-
1c.3.3	Small tool allowance	-	2	-	-	-	-	-	0	3	3	-	-	-	-	-	-	-	-	-	-
1c.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	2,670	401	3,071	-	3,071	-	-	-	-	-	-	-	-	-
1c.3	Subtotal Period 1c Collateral Costs	192	2	122	222	-	584	2,670	688	4,481	1,410	3,071	-	-	1,183	-	-	-	70,961	231	-

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 1c Period-Dependent Costs																					
1c.4.1	Insurance	-	-	-	-	-	-	919	92	1,010	1,010	-	-	-	-	-	-	-	-	-	-
1c.4.2	Property taxes	-	-	-	-	-	-	27	3	30	30	-	-	-	-	-	-	-	-	-	-
1c.4.3	Health physics supplies	-	256	-	-	-	-	-	64	320	320	-	-	-	-	-	-	-	-	-	-
1c.4.4	Heavy equipment rental	-	190	-	-	-	-	-	28	218	218	-	-	-	-	-	-	-	-	-	-
1c.4.5	Disposal of DAW generated	-	-	3	1	-	9	-	3	16	16	-	-	-	154	-	-	-	3,078	5	-
1c.4.6	Plant energy budget	-	-	-	-	-	-	429	64	494	494	-	-	-	-	-	-	-	-	-	-
1c.4.7	NRC Fees	-	-	-	-	-	-	163	16	179	179	-	-	-	-	-	-	-	-	-	-
1c.4.8	Emergency Planning Fees	-	-	-	-	-	-	392	39	431	-	431	-	-	-	-	-	-	-	-	-
1c.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	213	32	245	-	245	-	-	-	-	-	-	-	-	-
1c.4.10	ISFSI Operating Costs	-	-	-	-	-	-	28	4	32	-	32	-	-	-	-	-	-	-	-	-
1c.4.11	Corporate Allocations	-	-	-	-	-	-	252	25	277	277	-	-	-	-	-	-	-	-	-	-
1c.4.12	Security Staff Cost	-	-	-	-	-	-	3,999	600	4,599	4,599	-	-	-	-	-	-	-	-	-	60,697
1c.4.13	Utility Staff Cost	-	-	-	-	-	-	9,477	1,422	10,899	10,899	-	-	-	-	-	-	-	-	-	106,428
1c.4	Subtotal Period 1c Period-Dependent Costs	-	446	3	1	-	9	15,900	2,393	18,751	18,043	709	-	-	154	-	-	-	3,078	5	167,125
1c.0	TOTAL PERIOD 1c COST	192	881	125	223	-	593	32,071	5,281	39,366	35,587	3,779	-	-	1,336	-	-	-	74,034	17,869	167,708
PERIOD 1 TOTALS		6,667	3,000	263	437	-	1,207	129,691	22,634	163,899	143,295	20,604	-	-	3,783	-	-	-	166,394	78,825	1,039,355
PERIOD 2a - SAFSTOR Dormancy with Wet Spent Fuel Storage																					
Period 2a Direct Decommissioning Activities																					
2a.1.1	Quarterly Inspection									a											
2a.1.2	Semi-annual environmental survey									a											
2a.1.3	Prepare reports									a											
2a.1.4	Bituminous roof replacement	-	-	-	-	-	-	313	47	360	360	-	-	-	-	-	-	-	-	-	-
2a.1.5	Maintenance supplies	-	-	-	-	-	-	606	151	757	757	-	-	-	-	-	-	-	-	-	-
2a.1	Subtotal Period 2a Activity Costs	-	-	-	-	-	-	919	198	1,117	1,117	-	-	-	-	-	-	-	-	-	-
Period 2a Collateral Costs																					
2a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	34,710	5,207	39,917	-	39,917	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	-	-	-	-	-	-	34,710	5,207	39,917	-	39,917	-	-	-	-	-	-	-	-	-
Period 2a Period-Dependent Costs																					
2a.4.1	Insurance	-	-	-	-	-	-	2,581	368	2,949	2,949	-	-	-	-	-	-	-	-	-	-
2a.4.2	Property taxes	-	-	-	-	-	-	481	43	474	-	-	-	-	-	-	-	-	-	-	-
2a.4.3	Health physics supplies	-	986	-	-	-	-	-	246	1,231	1,231	-	-	-	-	-	-	-	-	-	-
2a.4.4	Disposal of DAW generated	-	-	18	7	-	53	-	16	93	93	-	-	-	920	-	-	-	18,406	30	-
2a.4.5	Plant energy budget	-	-	-	-	-	-	1,363	204	1,567	784	-	-	-	-	-	-	-	-	-	-
2a.4.6	NRC Fees	-	-	-	-	-	-	975	97	1,072	1,072	-	-	-	-	-	-	-	-	-	-
2a.4.7	Emergency Planning Fees	-	-	-	-	-	-	3,896	390	4,285	-	4,285	-	-	-	-	-	-	-	-	-
2a.4.8	Spent Fuel Pool O&M	-	-	-	-	-	-	3,378	507	3,885	-	3,885	-	-	-	-	-	-	-	-	-
2a.4.9	ISFSI Operating Costs	-	-	-	-	-	-	448	67	515	-	515	-	-	-	-	-	-	-	-	-
2a.4.10	Corporate Allocations	-	-	-	-	-	-	4,000	400	4,400	4,400	-	-	-	-	-	-	-	-	-	-
2a.4.11	Security Staff Cost	-	-	-	-	-	-	56,859	8,529	65,388	59,568	5,820	-	-	-	-	-	-	-	-	864,688
2a.4.12	Utility Staff Cost	-	-	-	-	-	-	29,543	4,432	33,975	27,384	6,591	-	-	-	-	-	-	-	-	328,640
2a.4	Subtotal Period 2a Period-Dependent Costs	-	986	18	7	-	53	103,673	15,199	119,834	97,956	21,879	-	-	920	-	-	-	18,406	30	1,193,328
2a.0	TOTAL PERIOD 2a COST	-	986	18	7	-	53	139,302	20,604	160,867	99,072	61,795	-	-	920	-	-	-	18,406	30	1,193,328
PERIOD 2c - SAFSTOR Dormancy without Spent Fuel Storage																					
Period 2c Direct Decommissioning Activities																					
2c.1.1	Quarterly Inspection									a											
2c.1.2	Semi-annual environmental survey									a											
2c.1.3	Prepare reports									a											
2c.1.4	Bituminous roof replacement	-	-	-	-	-	-	3,796	589	4,386	4,386	-	-	-	-	-	-	-	-	-	-
2c.1.5	Maintenance supplies	-	-	-	-	-	-	7,354	1,838	9,192	9,192	-	-	-	-	-	-	-	-	-	-
2c.1	Subtotal Period 2c Activity Costs	-	-	-	-	-	-	11,150	2,408	13,558	13,558	-	-	-	-	-	-	-	-	-	-

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 2c Period-Dependent Costs																					
2c.4.1	Insurance	-	-	-	-	-	-	19,887	1,989	21,876	21,876	-	-	-	-	-	-	-	-	-	-
2c.4.2	Property taxes	-	-	-	-	-	-	5,226	523	5,749	5,749	-	-	-	-	-	-	-	-	-	-
2c.4.3	Health physics supplies	-	5,455	-	-	-	-	-	1,364	6,819	6,819	-	-	-	-	-	-	-	-	-	-
2c.4.4	Disposal of DAW generated	-	-	94	35	-	284	-	86	499	499	-	-	-	4,942	-	-	-	98,844	161	-
2c.4.5	Plant energy budget	-	-	-	-	-	-	8,271	1,241	9,512	9,512	-	-	-	-	-	-	-	-	-	-
2c.4.6	NRC Fees	-	-	-	-	-	-	9,961	996	10,957	10,957	-	-	-	-	-	-	-	-	-	-
2c.4.7	Security Staff Cost	-	-	-	-	-	-	122,367	18,355	140,722	140,722	-	-	-	-	-	-	-	-	-	1,514,867
2c.4.8	Utility Staff Cost	-	-	-	-	-	-	71,944	10,792	82,736	82,735	-	-	-	-	-	-	-	-	-	883,672
2c.4	Subtotal Period 2c Period-Dependent Costs	-	5,455	94	35	-	284	237,656	35,344	278,869	278,869	-	-	-	4,942	-	-	-	98,844	161	2,398,539
2c.0	TOTAL PERIOD 2c COST	-	5,455	94	35	-	284	248,806	37,782	292,427	292,427	-	-	-	4,942	-	-	-	98,844	161	2,398,539
PERIOD 2 TOTALS		-	6,440	112	42	-	337	388,007	58,356	453,294	391,499	61,795	-	-	5,863	-	-	-	117,251	191	3,691,867
PERIOD 3a - Reactivate Site Following SAFSTOR Dormancy																					
Period 3a Direct Decommissioning Activities																					
3a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
3a.1.2	Review plant dwgs & specs.	-	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-	-	-	-	4,600
3a.1.3	Perform detailed rad survey									a											
3a.1.4	End product description	-	-	-	-	-	-	159	24	183	185	-	-	-	-	-	-	-	-	-	1,000
3a.1.5	Detailed by-product inventory	-	-	-	-	-	-	207	31	238	238	-	-	-	-	-	-	-	-	-	1,300
3a.1.6	Define major work sequence	-	-	-	-	-	-	1,196	179	1,375	1,375	-	-	-	-	-	-	-	-	-	7,500
3a.1.7	Perform SER and EA	-	-	-	-	-	-	494	74	568	568	-	-	-	-	-	-	-	-	-	3,100
3a.1.8	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	1,196	179	1,375	1,375	-	-	-	-	-	-	-	-	-	7,500
3a.1.9	Perform Site-Specific Cost Study	-	-	-	-	-	-	797	120	917	917	-	-	-	-	-	-	-	-	-	5,000
3a.1.10	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
3a.1.11.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	1,175	176	1,351	1,216	-	135	-	-	-	-	-	-	-	7,370
3a.1.11.2	Plant systems	-	-	-	-	-	-	684	100	784	688	-	76	-	-	-	-	-	-	-	4,167
3a.1.11.3	Reactor internals	-	-	-	-	-	-	1,132	170	1,302	1,302	-	-	-	-	-	-	-	-	-	7,100
3a.1.11.4	Reactor vessel	-	-	-	-	-	-	1,036	155	1,192	1,192	-	-	-	-	-	-	-	-	-	6,500
3a.1.11.5	Biological shield	-	-	-	-	-	-	80	12	92	92	-	-	-	-	-	-	-	-	-	500
3a.1.11.6	Steam generators	-	-	-	-	-	-	497	75	572	572	-	-	-	-	-	-	-	-	-	3,120
3a.1.11.7	Reinforced concrete	-	-	-	-	-	-	255	38	293	147	-	147	-	-	-	-	-	-	-	1,600
3a.1.11.8	Main Turbine	-	-	-	-	-	-	64	10	73	-	-	73	-	-	-	-	-	-	-	400
3a.1.11.9	Main Condensers	-	-	-	-	-	-	64	10	73	-	-	73	-	-	-	-	-	-	-	400
3a.1.11.10	Plant structures & buildings	-	-	-	-	-	-	497	75	572	286	-	286	-	-	-	-	-	-	-	3,120
3a.1.11.11	Waste management	-	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-	-	-	-	4,600
3a.1.11.12	Facility & site closeout	-	-	-	-	-	-	144	22	165	83	-	83	-	-	-	-	-	-	-	900
3a.1.11	Total	-	-	-	-	-	-	6,342	951	7,294	6,420	-	874	-	-	-	-	-	-	-	39,777
Planning & Site Preparations																					
3a.1.12	Prepare dismantling sequence	-	-	-	-	-	-	383	57	440	440	-	-	-	-	-	-	-	-	-	2,400
3a.1.13	Plant prep. & temp. svces	-	-	-	-	-	-	3,500	525	4,025	4,025	-	-	-	-	-	-	-	-	-	-
3a.1.14	Design water clean-up system	-	-	-	-	-	-	223	33	257	257	-	-	-	-	-	-	-	-	-	1,400
3a.1.15	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,400	360	2,760	2,760	-	-	-	-	-	-	-	-	-	-
3a.1.16	Procure casks/liners & containers	-	-	-	-	-	-	196	29	226	226	-	-	-	-	-	-	-	-	-	1,230
3a.1	Subtotal Period 3a Activity Costs	-	-	-	-	-	-	16,195	2,729	20,924	20,050	-	874	-	-	-	-	-	-	-	77,107
Period 3a Period-Dependent Costs																					
3a.4.1	Insurance	-	-	-	-	-	-	410	41	451	451	-	-	-	-	-	-	-	-	-	-
3a.4.2	Property taxes	-	-	-	-	-	-	108	11	118	118	-	-	-	-	-	-	-	-	-	-
3a.4.3	Health physics supplies	-	537	-	-	-	-	-	134	671	671	-	-	-	-	-	-	-	-	-	-
3a.4.4	Heavy equipment rental	-	753	-	-	-	-	-	113	866	866	-	-	-	-	-	-	-	-	-	-
3a.4.5	Disposal of DAW generated	-	-	10	4	-	30	-	9	52	52	-	-	-	514	-	-	-	10,287	17	-
3a.4.6	Plant energy budget	-	-	-	-	-	-	1,703	256	1,959	1,959	-	-	-	-	-	-	-	-	-	-
3a.4.7	NRC Fees	-	-	-	-	-	-	335	33	368	368	-	-	-	-	-	-	-	-	-	-
3a.4.8	Corporate Allocations	-	-	-	-	-	-	1,000	100	1,100	1,100	-	-	-	-	-	-	-	-	-	-
3a.4.9	Security Staff Cost	-	-	-	-	-	-	4,188	628	4,816	4,816	-	-	-	-	-	-	-	-	-	55,000
3a.4.10	Utility Staff Cost	-	-	-	-	-	-	23,868	3,505	26,873	26,873	-	-	-	-	-	-	-	-	-	257,920
3a.4	Subtotal Period 3a Period-Dependent Costs	-	1,289	10	4	-	30	31,111	4,850	37,273	37,273	-	-	-	514	-	-	-	10,287	17	322,920
3a.0	TOTAL PERIOD 3a COST	-	1,289	10	4	-	30	46,306	7,559	58,197	57,324	-	874	-	514	-	-	-	10,287	17	400,027

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 3b - Decommissioning Preparations																					
Period 3b Direct Decommissioning Activities																					
Detailed Work Procedures																					
3b.1.1.1	Plant systems	-	-	-	-	-	-	755	113	868	781	-	87	-	-	-	-	-	-	-	4,733
3b.1.1.2	Reactor internals	-	-	-	-	-	-	389	60	448	448	-	-	-	-	-	-	-	-	-	2,500
3b.1.1.3	Remaining buildings	-	-	-	-	-	-	215	32	248	62	-	186	-	-	-	-	-	-	-	1,350
3b.1.1.4	CRD cooling assembly	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.5	CRD housings & ICI tubes	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.6	Incore instrumentation	-	-	-	-	-	-	159	24	183	183	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.7	Reactor vessel	-	-	-	-	-	-	579	87	666	666	-	-	-	-	-	-	-	-	-	3,650
3b.1.1.8	Facility closeout	-	-	-	-	-	-	191	29	220	110	-	110	-	-	-	-	-	-	-	1,200
3b.1.1.9	Missile shields	-	-	-	-	-	-	72	11	83	83	-	-	-	-	-	-	-	-	-	450
3b.1.1.10	Biological shield	-	-	-	-	-	-	191	29	220	220	-	-	-	-	-	-	-	-	-	1,200
3b.1.1.11	Steam generators	-	-	-	-	-	-	733	110	843	843	-	-	-	-	-	-	-	-	-	4,600
3b.1.1.12	Reinforced concrete	-	-	-	-	-	-	159	24	183	92	-	92	-	-	-	-	-	-	-	1,000
3b.1.1.13	Main Turbine	-	-	-	-	-	-	249	37	286	-	-	286	-	-	-	-	-	-	-	1,560
3b.1.1.14	Main Condensers	-	-	-	-	-	-	249	37	286	-	-	286	-	-	-	-	-	-	-	1,560
3b.1.1.15	Auxiliary building	-	-	-	-	-	-	435	65	501	451	-	50	-	-	-	-	-	-	-	2,730
3b.1.1.16	Reactor building	-	-	-	-	-	-	435	65	501	451	-	50	-	-	-	-	-	-	-	2,730
3b.1.1	Total	-	-	-	-	-	-	5,141	771	5,912	4,766	-	1,146	-	-	-	-	-	-	-	32,243
3b.1	Subtotal Period 3b Activity Costs	-	-	-	-	-	-	5,141	771	5,912	4,766	-	1,146	-	-	-	-	-	-	-	32,243
Period 3b Additional Costs																					
3b.2.1	Site Characterization	-	-	-	-	-	-	3,134	940	4,074	4,074	-	-	-	-	-	-	-	-	19,100	7,852
3b.2	Subtotal Period 3b Additional Costs	-	-	-	-	-	-	3,134	940	4,074	4,074	-	-	-	-	-	-	-	-	19,100	7,852
Period 3b Collateral Costs																					
3b.3.1	Decon equipment	1,055	-	-	-	-	-	-	158	1,213	1,213	-	-	-	-	-	-	-	-	-	-
3b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
3b.3.3	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	1,055	1,200	-	-	-	-	1,636	584	4,475	4,475	-	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Decon supplies	38	-	-	-	-	-	-	10	48	48	-	-	-	-	-	-	-	-	-	-
3b.4.2	Insurance	-	-	-	-	-	-	336	34	372	372	-	-	-	-	-	-	-	-	-	-
3b.4.3	Property taxes	-	-	-	-	-	-	54	5	60	60	-	-	-	-	-	-	-	-	-	-
3b.4.4	Health physics supplies	-	295	-	-	-	-	-	75	373	373	-	-	-	-	-	-	-	-	-	-
3b.4.5	Heavy equipment rental	-	380	-	-	-	-	-	57	436	436	-	-	-	-	-	-	-	-	-	-
3b.4.6	Disposal of DAW generated	-	-	6	2	-	17	-	5	30	30	-	-	-	293	-	-	-	5,866	10	-
3b.4.7	Plant energy budget	-	-	-	-	-	-	559	129	988	988	-	-	-	-	-	-	-	-	-	-
3b.4.8	NRC Fees	-	-	-	-	-	-	169	17	186	186	-	-	-	-	-	-	-	-	-	-
3b.4.9	Corporate Allocations	-	-	-	-	-	-	504	50	555	555	-	-	-	-	-	-	-	-	-	-
3b.4.10	Security Staff Cost	-	-	-	-	-	-	2,111	317	2,428	2,428	-	-	-	-	-	-	-	-	-	32,767
3b.4.11	DOC Staff Cost	-	-	-	-	-	-	6,997	1,050	8,047	8,047	-	-	-	-	-	-	-	-	-	58,719
3b.4.12	Utility Staff Cost	-	-	-	-	-	-	11,780	1,767	13,547	13,547	-	-	-	-	-	-	-	-	-	130,020
3b.4	Subtotal Period 3b Period-Dependent Costs	38	678	6	2	-	17	22,812	3,515	27,068	27,068	-	-	-	293	-	-	-	5,866	10	221,506
3b.0	TOTAL PERIOD 3b COST	1,093	1,878	6	2	-	17	32,723	5,310	41,528	40,382	-	1,146	-	293	-	-	-	5,866	19,110	261,601
PERIOD 3 TOTALS		1,093	3,167	15	5	-	46	52,029	13,369	99,726	97,706	-	2,020	-	808	-	-	-	16,163	19,126	661,628
PERIOD 4a - Large Component Removal																					
Period 4a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
4a.1.1.1	Reactor Coolant Piping	41	200	37	52	-	746	-	269	1,345	1,345	-	-	-	2,046	-	-	-	142,726	3,982	-
4a.1.1.2	Pressurizer Relief Tank	7	26	10	15	-	211	-	66	337	337	-	-	-	578	-	-	-	40,358	603	-
4a.1.1.3	Reactor Coolant Pumps & Motors	23	99	80	224	-	1,440	-	438	2,305	2,305	-	-	-	3,386	-	-	-	816,140	488	40
4a.1.1.4	Pressurizer	-	71	493	186	-	1,590	-	492	2,832	2,832	-	-	-	3,739	-	-	-	241,053	1,346	1,500
4a.1.1.5	Steam Generators	-	6,080	2,633	2,889	-	15,728	-	6,148	33,476	33,476	-	-	-	62,808	-	-	-	3,570,150	20,507	2,250
4a.1.1.6	Retired Steam Generator Units	-	-	2,633	2,889	-	15,534	-	4,580	25,636	25,636	-	-	-	62,808	-	-	-	3,349,305	10,500	2,250
4a.1.1.7	CRDMs/ICIs/Service Structure Removal	35	175	233	55	-	781	-	283	1,541	1,541	-	-	-	3,881	-	-	-	145,494	5,232	-
4a.1.1.8	Reactor Vessel Internals	71	6,435	12,666	793	-	10,841	316	13,671	44,697	44,697	-	-	-	3,485	501	393	-	330,577	26,073	1,161
4a.1.1.9	Vessel & Internals GTCC Disposal	-	-	-	-	-	12,538	-	1,881	14,419	14,419	-	-	-	-	-	-	2,217	433,180	-	-
4a.1.1.10	Reactor Vessel	-	8,046	2,099	725	-	6,648	316	10,087	27,870	27,870	-	-	-	15,681	-	-	-	976,098	26,073	1,161
4a.1.1	Totals	177	21,133	20,725	7,831	-	66,036	831	37,925	154,459	154,459	-	-	-	158,361	501	393	2,217	10,048,100	93,104	8,363

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Removal of Major Equipment																					
4a.1.2	Main Turbine/Generator	-	540	2,674	453	-	17,199	-	4,770	25,637	25,637	-	-	-	54,809	-	-	-	3,481,857	6,721	-
4a.1.3	Main Condensers	-	1,536	1,301	1,232	-	21,372	-	6,042	31,482	31,482	-	-	-	64,324	-	-	-	4,086,359	24,802	-
Cascading Costs from Clean Building Demolition																					
4a.1.4.1	Reactor	-	561	-	-	-	-	-	84	645	645	-	-	-	-	-	-	-	-	4,822	-
4a.1.4.2	Auxiliary	-	276	-	-	-	-	-	41	317	317	-	-	-	-	-	-	-	-	2,113	-
4a.1.4.3	Fuel Building	-	115	-	-	-	-	-	17	132	132	-	-	-	-	-	-	-	-	773	-
4a.1.4.4	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	7	-
4a.1.4.5	Radwaste	-	53	-	-	-	-	-	8	62	62	-	-	-	-	-	-	-	-	387	-
4a.1.4	Totals	-	1,006	-	-	-	-	-	151	1,157	1,157	-	-	-	-	-	-	-	-	8,113	-
Disposal of Plant Systems																					
4a.1.5.1	100 Aux.Bldg Non-System Specific RCA	-	841	102	105	-	1,815	-	690	3,552	3,552	-	-	-	5,463	-	-	-	347,071	13,677	-
4a.1.5.2	100 Auxiliary Bldg Non-System Specific	-	123	11	12	-	206	-	85	438	438	-	-	-	621	-	-	-	39,480	2,047	-
4a.1.5.3	AB - Main Steam	-	324	-	-	-	-	-	49	373	-	-	373	-	-	-	-	-	-	5,833	-
4a.1.5.4	AB - Main Steam RCA	-	93	32	30	-	516	-	160	831	831	-	-	-	1,547	-	-	-	98,672	1,550	-
4a.1.5.5	AC - Main Turbine	-	320	-	-	-	-	-	48	368	-	-	368	-	-	-	-	-	-	5,641	-
4a.1.5.6	AD - Condensate	-	355	-	-	-	-	-	53	409	-	-	409	-	-	-	-	-	-	6,144	-
4a.1.5.7	AE - Feedwater	-	244	-	-	-	-	-	37	280	-	-	280	-	-	-	-	-	-	4,271	-
4a.1.5.8	AF - Feedwater Heater Extraction	-	299	-	-	-	-	-	45	344	-	-	344	-	-	-	-	-	-	5,352	-
4a.1.5.9	AK - Condensate Demineralizer	-	110	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	1,944	-
4a.1.5.10	AL - Auxiliary Feedwater	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	852	-
4a.1.5.11	AQ - Condensate & Feedwater Chem Addtn	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	468	-
4a.1.5.12	BM - Steam Generator Blowdown	-	129	19	18	-	279	-	106	549	549	-	-	-	832	-	-	-	53,280	2,184	-
4a.1.5.13	BM - Steam Generator Blowdown - RCA	-	447	72	57	-	996	-	377	1,949	1,949	-	-	-	2,963	-	-	-	190,396	7,221	-
4a.1.5.14	BN - Borated Refueling Water Storage	-	368	93	88	-	1,492	-	487	2,526	2,526	-	-	-	4,482	-	-	-	285,246	6,282	-
4a.1.5.15	CA - Steam Seal	-	26	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	455	-
4a.1.5.16	CB - Main Turbine Lube Oil	-	73	-	-	-	-	-	11	84	-	-	84	-	-	-	-	-	-	1,307	-
4a.1.5.17	CC - Generator Hydrogen Seal & CO2	-	12	-	-	-	-	-	2	13	-	-	18	-	-	-	-	-	-	198	-
4a.1.5.18	CD - Generator Seal Oil	-	17	-	-	-	-	-	2	18	-	-	19	-	-	-	-	-	-	287	-
4a.1.5.19	CE - Stator Cooling Water	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	241	-
4a.1.5.20	CF - Lube Oil Storage Xfer & Prfication	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	812	-
4a.1.5.21	CG - Condenser Air Removal	-	38	-	-	-	-	-	6	43	-	-	43	-	-	-	-	-	-	657	-
4a.1.5.22	CH - Main Turbine Control Oil	-	76	-	-	-	-	-	11	86	-	-	86	-	-	-	-	-	-	1,219	-
4a.1.5.23	DA - Circulating Water	-	419	-	-	-	-	-	63	482	-	-	482	-	-	-	-	-	-	7,502	-
4a.1.5.24	DB - Cooling Tower Makeup & Blowdown	-	71	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,280	-
4a.1.5.25	DD - Cooling Water Chemical Control Sys	-	63	-	-	-	-	-	9	72	-	-	72	-	-	-	-	-	-	1,064	-
4a.1.5.26	DD - Cooling Wtr Chem Control RCA	-	329	67	50	-	866	-	313	1,624	1,624	-	-	-	2,569	-	-	-	165,813	5,095	-
4a.1.5.27	EJ - Residual Heat Removal	-	428	90	84	-	1,464	-	496	2,562	2,562	-	-	-	4,385	-	-	-	280,003	7,249	-
4a.1.5.28	EM - High Pressure Coolant Injection	-	362	40	31	-	539	-	234	1,206	1,206	-	-	-	1,699	-	-	-	103,047	5,976	-
4a.1.5.29	EN - Containment Spray	-	282	51	42	-	731	-	280	1,346	1,346	-	-	-	2,179	-	-	-	139,742	4,242	-
4a.1.5.30	EP - Accumulator Safety Injection	-	190	35	28	-	481	-	175	909	909	-	-	-	1,433	-	-	-	91,944	3,163	-
4a.1.5.31	FA - Auxiliary Steam Generator	-	26	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	521	-
4a.1.5.32	FB - Auxiliary Steam	-	116	-	-	-	-	-	18	135	-	-	135	-	-	-	-	-	-	2,106	-
4a.1.5.33	FB - Auxiliary Steam RCA	-	99	15	11	-	198	-	78	401	401	-	-	-	589	-	-	-	37,925	1,569	-
4a.1.5.34	FC - Auxiliary Turbines	-	77	-	-	-	-	-	12	88	-	-	88	-	-	-	-	-	-	1,320	-
4a.1.5.35	FE - Auxiliary Steam Chemical Additâm	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	105	-
4a.1.5.36	GE - Turbine Building HVAC	-	213	-	-	-	-	-	32	245	-	-	245	-	-	-	-	-	-	3,957	-
4a.1.5.37	GS - Containment Hydrogen Control	-	83	13	11	-	193	-	72	372	372	-	-	-	577	-	-	-	36,925	1,415	-
4a.1.5.38	HE - Boron Recycle	-	551	76	63	-	1,098	-	429	2,217	2,217	-	-	-	3,280	-	-	-	209,922	9,046	-
4a.1.5.39	HF - Secondary Liquid Waste	-	1,080	171	147	-	2,555	-	948	4,902	4,902	-	-	-	7,644	-	-	-	488,595	18,015	-
4a.1.5.40	JA - Auxiliary Oil & Transfer	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	690	-
4a.1.5.41	KS - Bulk Chemical Storage	-	110	89	89	-	1,536	-	434	2,257	2,257	-	-	-	4,620	-	-	-	293,686	2,002	-
4a.1.5.42	LE - Oily Waste	-	218	-	-	-	-	-	33	250	-	-	250	-	-	-	-	-	-	3,865	-
4a.1.5.43	LE - Oily Waste RCA	-	226	36	31	-	543	-	215	1,111	1,111	-	-	-	1,623	-	-	-	103,828	4,372	-
4a.1.5.44	Turbine Bldg Non-System Specific	-	913	-	-	-	-	-	137	1,050	-	-	1,050	-	-	-	-	-	-	15,405	-
4a.1.5	Totals	-	9,978	1,011	894	-	18,509	-	8,186	38,578	28,752	-	4,822	-	46,409	-	-	-	2,965,365	168,513	-
4a.1.6	Scaffolding in support of decommissioning	-	1,702	22	21	-	361	-	521	2,627	2,627	-	-	-	1,087	-	-	-	69,064	33,634	-
4a.1	Subtotal Period 4a Activity Costs	177	35,880	25,784	10,432	-	120,477	631	55,595	248,936	244,114	-	4,822	-	324,990	501	393	2,217	20,660,790	536,886	8,363

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes: Class A Cu. Feet	Burial Volumes: Class B Cu. Feet	Burial Volumes: Class C Cu. Feet	Burial Volumes: GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 4a Collateral Costs																					
4a.3.1	Process decommissioning water waste	5	-	8	14	-	38	-	15	79	79	-	-	-	76	-	-	-	4,582	15	-
4a.5.3	Small tool allowance	-	346	-	-	-	-	-	52	398	358	-	40	-	-	-	-	-	-	-	-
4a.5.4	On-site survey and release of 60.87 tons clean metallic waste	-	-	-	-	-	-	96	10	106	106	-	-	-	-	-	-	-	-	-	-
4a.3	Subtotal Period 4a Collateral Costs	5	346	8	14	-	38	96	76	583	543	-	40	-	76	-	-	-	4,582	15	-
Period 4a Period-Dependent Costs																					
4a.4.1	Decon supplies	108	-	-	-	-	-	-	27	135	135	-	-	-	-	-	-	-	-	-	-
4a.4.2	Insurance	-	-	-	-	-	-	949	95	1,044	1,044	-	-	-	-	-	-	-	-	-	-
4a.4.3	Property taxes	-	-	-	-	-	-	152	15	168	168	-	-	-	-	-	-	-	-	-	-
4a.4.4	Health physics supplies	-	2,773	-	-	-	-	-	693	3,466	3,466	-	-	-	-	-	-	-	-	-	-
4a.4.5	Heavy equipment rental	-	3,644	-	-	-	-	-	532	4,076	4,076	-	-	-	-	-	-	-	-	-	-
4a.4.6	Disposal of DAW generated	-	-	101	38	-	302	-	91	532	532	-	-	-	5,265	-	-	-	105,292	172	-
4a.4.7	Plant energy budget	-	-	-	-	-	-	2,292	344	2,636	2,636	-	-	-	-	-	-	-	-	-	-
4a.4.8	NRC Fees	-	-	-	-	-	-	686	69	754	754	-	-	-	-	-	-	-	-	-	-
4a.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	602	90	692	692	-	-	-	-	-	-	-	-	-	-
4a.4.10	Corporate Allocations	-	-	-	-	-	-	1,416	142	1,558	1,558	-	-	-	-	-	-	-	-	-	-
4a.4.11	Remedial Actions Surveys	-	-	-	-	-	-	1,458	219	1,676	1,676	-	-	-	-	-	-	-	-	-	-
4a.4.12	Security Staff Cost	-	-	-	-	-	-	5,932	890	6,821	6,821	-	-	-	-	-	-	-	-	-	92,069
4a.4.13	DOC Staff Cost	-	-	-	-	-	-	23,561	3,534	27,095	27,095	-	-	-	-	-	-	-	-	-	293,287
4a.4.14	Utility Staff Cost	-	-	-	-	-	-	33,292	4,995	38,292	38,292	-	-	-	-	-	-	-	-	-	368,274
4a.4	Subtotal Period 4a Period-Dependent Costs	108	6,418	101	38	-	302	70,346	11,735	88,947	88,947	-	-	-	5,265	-	-	-	105,292	172	663,630
4a.0	TOTAL PERIOD 4a COST	290	42,554	25,842	10,484	-	120,817	71,073	67,406	338,466	333,604	-	4,861	-	330,351	501	383	2,217	20,760,600	337,073	671,992
PERIOD 4b - Site Decontamination																					
Period 4b Direct Decommissioning Activities																					
4b.1.1	Remove spent fuel racks	866	55	276	134	-	2,322	-	1,076	4,727	4,727	-	-	-	6,958	-	-	-	443,960	1,925	-
Disposal of Plant Systems																					
4b.1.2.1	200 Reactor Bldg Non-System Specific	-	100	7	7	-	126	-	58	298	298	-	-	-	378	-	-	-	24,042	1,579	-
4b.1.2.2	200 Reactor Bldg Non-System Specific RCA	-	693	64	65	-	1,134	-	473	2,430	2,430	-	-	-	3,414	-	-	-	216,897	10,554	-
4b.1.2.3	300 Control Bldg Non-System Specific	-	216	29	29	-	509	-	188	971	971	-	-	-	1,532	-	-	-	97,294	3,471	-
4b.1.2.4	300 Control Bldg Non-System Specific Cln	-	1,663	-	-	-	-	-	248	1,901	-	-	1,901	-	-	-	-	-	-	29,076	-
4b.1.2.5	600 Fuel Bldg Non-Specific Systems RCA	-	377	48	44	-	762	-	296	1,521	1,521	-	-	-	2,292	-	-	-	145,905	6,946	-
4b.1.2.6	600 Fuel Bldg Non-System Specific	-	53	4	5	-	81	-	35	177	177	-	-	-	242	-	-	-	15,399	556	-
4b.1.2.7	700 Radwaste Bldg Non-Sys Specific RCA	-	1,386	170	174	-	3,018	-	1,144	5,891	5,891	-	-	-	9,053	-	-	-	577,061	22,261	-
4b.1.2.8	700 Radwaste Bldg Non-System Specific	-	200	18	19	-	333	-	138	707	707	-	-	-	1,002	-	-	-	63,835	3,278	-
4b.1.2.9	AN - Demineralized Wtr Storage & Xfer	-	186	-	-	-	-	-	28	212	-	-	212	-	-	-	-	-	-	3,283	-
4b.1.2.10	AN - Demineralized Wtr Strg & Xfer RCA	-	48	6	4	-	77	-	33	168	168	-	-	-	227	-	-	-	14,350	753	-
4b.1.2.11	AP-HCST/Condensate Stor.& Transfr	-	244	-	-	-	-	-	37	281	-	-	281	-	-	-	-	-	-	4,018	-
4b.1.2.12	BB - Reactor Coolant System	-	370	63	57	-	996	-	356	1,843	1,843	-	-	-	2,987	-	-	-	190,474	6,379	-
4b.1.2.13	BG - Chemical & Volume Control	-	1,050	186	164	-	2,836	-	1,015	5,251	5,251	-	-	-	8,476	-	-	-	542,341	17,466	-
4b.1.2.14	BL - Reactor Makeup Water	-	335	51	43	-	747	-	282	1,458	1,458	-	-	-	2,284	-	-	-	142,818	5,547	-
4b.1.2.15	DE - Intake & Water Treatment	-	148	-	-	-	-	-	22	170	-	-	170	-	-	-	-	-	-	2,617	-
4b.1.2.16	DE - Intake & Water Treatmeat RCA	-	299	165	164	-	2,843	-	827	4,298	4,298	-	-	-	5,646	-	-	-	543,623	5,351	-
4b.1.2.17	EA - Service Water	-	176	-	-	-	-	-	26	201	-	-	201	-	-	-	-	-	-	3,145	-
4b.1.2.18	EA - Service Water RCA	-	54	18	17	-	298	-	92	479	479	-	-	-	896	-	-	-	57,005	876	-
4b.1.2.19	EB - Closed Cooling Water	-	71	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,267	-
4b.1.2.20	EC - Fuel Pool Cooling & Cleanup	-	440	65	57	-	998	-	373	1,928	1,928	-	-	-	2,965	-	-	-	189,813	7,264	-
4b.1.2.21	EF - Essential Service Water	-	406	-	-	-	-	-	61	467	-	-	467	-	-	-	-	-	-	7,244	-
4b.1.2.22	EF - Essential Service Water RCA	-	238	76	73	-	1,272	-	396	2,056	2,056	-	-	-	3,820	-	-	-	243,301	4,018	-
4b.1.2.23	EG - Component Cooling Water RCA	-	298	-	-	-	-	-	45	343	-	-	343	-	-	-	-	-	-	5,395	-
4b.1.2.24	GA - Plant Heating	-	108	-	-	-	-	-	16	122	-	-	122	-	-	-	-	-	-	1,912	-
4b.1.2.25	GA - Plant Heating RCA	-	115	14	9	-	157	-	71	366	366	-	-	-	463	-	-	-	30,040	1,785	-
4b.1.2.26	GA- Plant Heating Fuel Building	-	25	2	2	-	26	-	13	68	68	-	-	-	78	-	-	-	5,037	404	-
4b.1.2.27	GB - Central Chilled Water	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	1,803	-
4b.1.2.28	GB - Central Chilled Water RCA	-	31	4	3	-	46	-	20	104	104	-	-	-	136	-	-	-	8,778	490	-
4b.1.2.29	GD - Essential Serv Wtr Pumphouse HVAC	-	22	-	-	-	-	-	3	26	-	-	26	-	-	-	-	-	-	427	-
4b.1.2.30	GF - Miscellaneous Building HVAC	-	138	27	28	-	484	-	162	840	840	-	-	-	1,457	-	-	-	92,453	2,081	-
4b.1.2.31	GG - Fuel Building HVAC	-	264	51	54	-	939	-	314	1,622	1,622	-	-	-	2,825	-	-	-	178,529	4,129	-
4b.1.2.32	GH - Radwaste Building HVAC	-	194	33	35	-	610	-	209	1,081	1,081	-	-	-	1,884	-	-	-	116,869	3,054	-
4b.1.2.33	GK - Control Building HVAC	-	205	-	-	-	-	-	31	236	-	-	236	-	-	-	-	-	-	3,959	-
4b.1.2.34	GL - Auxiliary Building HVAC	-	479	71	74	-	1,281	-	458	2,363	2,363	-	-	-	3,855	-	-	-	245,020	7,470	-
4b.1.2.35	GM - Diesel Generator Building HVAC	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	695	-
4b.1.2.36	GN - Containment Cooling	-	557	111	114	-	1,971	-	655	3,388	3,388	-	-	-	5,923	-	-	-	376,780	8,572	-
4b.1.2.37	GP - Containment Intgratd Leak Rate Test	-	47	9	8	-	139	-	49	252	252	-	-	-	417	-	-	-	26,523	768	-

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems (continued)																					
4b.1.2.38	GR - Containment Atmospheric Control	-	21	15	16	-	272	-	77	401	401	-	-	-	818	-	-	-	51,989	372	-
4b.1.2.39	GT - Containment Purge HVAC	-	125	29	30	-	520	-	169	873	873	-	-	-	1,566	-	-	-	98,513	2,016	-
4b.1.2.40	HA - Gaseous Radwaste	-	393	63	52	-	893	-	336	1,737	1,737	-	-	-	2,864	-	-	-	170,799	6,388	-
4b.1.2.41	HB - Liquid Radwaste	-	956	156	130	-	2,254	-	887	4,332	4,332	-	-	-	6,735	-	-	-	430,985	15,962	-
4b.1.2.42	HC - Solid Radwaste	-	408	65	58	-	1,004	-	368	1,903	1,903	-	-	-	3,006	-	-	-	192,060	6,719	-
4b.1.2.43	HD - Decontamination	-	113	19	17	-	293	-	106	548	548	-	-	-	877	-	-	-	56,063	1,855	-
4b.1.2.44	JE - Emergency Fuel Oil	-	76	-	-	-	-	-	11	88	-	-	88	-	-	-	-	-	-	1,260	-
4b.1.2.45	KA - Compressed Air	-	233	-	-	-	-	-	35	268	-	-	268	-	-	-	-	-	-	4,187	-
4b.1.2.46	KA - Compressed Air RCA	-	155	18	11	-	198	-	92	475	475	-	-	-	583	-	-	-	37,947	2,360	-
4b.1.2.47	KB - Breathing Air	-	29	-	-	-	-	-	4	34	-	-	34	-	-	-	-	-	-	516	-
4b.1.2.48	KB - Breathing Air RCA	-	24	2	1	-	18	-	11	55	55	-	-	-	52	-	-	-	3,401	406	-
4b.1.2.49	KC - Fire Protection	-	456	-	-	-	-	-	68	524	-	-	524	-	-	-	-	-	-	8,376	-
4b.1.2.50	KC - Fire Protection RCA	-	483	84	62	-	1,075	-	407	2,111	2,111	-	-	-	3,189	-	-	-	205,626	7,245	-
4b.1.2.51	KC- Fire Protection Fuel Building	-	143	23	17	-	302	-	116	602	602	-	-	-	896	-	-	-	57,758	2,166	-
4b.1.2.52	KD - Domestic Water	-	212	-	-	-	-	-	32	244	-	-	244	-	-	-	-	-	-	3,837	-
4b.1.2.53	KD - Domestic Water RCA	-	31	4	3	-	60	-	24	123	123	-	-	-	178	-	-	-	11,465	468	-
4b.1.2.54	KE - Fuel Handling & Storage Rctor vsel	-	21	11	12	-	210	-	61	314	314	-	-	-	632	-	-	-	40,119	349	-
4b.1.2.55	KH - Service Gas (CO2 N2 H2 & O2)	-	67	-	-	-	-	-	10	77	-	-	77	-	-	-	-	-	-	1,228	-
4b.1.2.56	KH - Service Gas (CO2 N2 H2 & O2) RCA	-	303	44	34	-	591	-	283	1,205	1,205	-	-	-	1,756	-	-	-	112,949	4,575	-
4b.1.2.57	KJ - Standby Diesel Engine	-	403	-	-	-	-	-	60	463	-	-	463	-	-	-	-	-	-	6,749	-
4b.1.2.58	LA - Sanitary Drains	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	972	-
4b.1.2.59	LA - Sanitary Drains RCA	-	127	20	18	-	306	-	113	585	585	-	-	-	916	-	-	-	58,593	1,854	-
4b.1.2.60	LB - Roof Drains	-	72	-	-	-	-	-	11	82	-	-	82	-	-	-	-	-	-	1,276	-
4b.1.2.61	LB - Roof Drains RCA	-	173	31	29	-	511	-	179	923	923	-	-	-	1,534	-	-	-	97,740	2,757	-
4b.1.2.62	LD - Chemical & Detergent Waste	-	131	13	11	-	193	-	84	432	432	-	-	-	674	-	-	-	36,840	2,159	-
4b.1.2.63	LF - Floor & Equipment Drains	-	1,631	175	162	-	2,812	-	1,150	5,920	5,920	-	-	-	8,419	-	-	-	537,847	26,325	-
4b.1.2.64	RM - Process Sampling & Analysis	-	146	19	14	-	242	-	101	523	523	-	-	-	727	-	-	-	46,949	2,481	-
4b.1.2.65	SJ - Nuclear Sampling	-	85	13	10	-	166	-	66	339	339	-	-	-	491	-	-	-	31,744	1,451	-
4b.1.2.66	UB - Services Stores Site Security Bldg	-	217	-	-	-	-	-	33	250	-	-	250	-	-	-	-	-	-	3,815	-
4b.1.2.67	Yard Non-System Specific	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	603	-
4b.1.2	Totals	-	18,850	2,091	1,937	-	33,600	-	13,012	69,290	62,961	-	6,329	-	100,683	-	-	-	6,424,481	309,491	-
4b.1.3	Scaffolding in support of decommissioning	-	2,553	33	31	-	542	-	782	3,941	3,941	-	-	-	1,631	-	-	-	103,596	50,451	-
Decontamination of Site Buildings																					
4b.1.4.1	Reactor	1,313	1,904	252	875	-	4,266	-	2,356	10,967	10,967	-	-	-	49,719	-	-	-	2,410,534	46,711	-
4b.1.4.2	Auxiliary	667	265	47	90	-	727	-	600	2,397	2,397	-	-	-	5,204	-	-	-	260,859	15,387	-
4b.1.4.3	Communication Corridor - Contaminated	15	4	1	2	-	9	-	11	40	40	-	-	-	88	-	-	-	4,277	307	-
4b.1.4.4	Fuel Building	855	870	70	56	-	763	-	851	3,467	3,467	-	-	-	2,969	-	-	-	177,276	27,561	-
4b.1.4.5	Hot Machine Shop	18	7	0	2	-	6	-	13	46	46	-	-	-	94	-	-	-	4,446	421	-
4b.1.4.6	RAM Storage Building	46	9	1	4	-	17	-	30	106	106	-	-	-	221	-	-	-	10,993	920	-
4b.1.4.7	Radioactive and Personnel Tunnel	6	6	0	1	-	3	-	5	22	22	-	-	-	54	-	-	-	2,532	195	-
4b.1.4.8	Radwaste	355	121	20	44	-	323	-	297	1,161	1,161	-	-	-	2,498	-	-	-	126,675	7,830	-
4b.1.4.9	Radwaste Drum Storage	40	12	2	5	-	29	-	31	118	118	-	-	-	256	-	-	-	12,889	851	-
4b.1.4.10	Reactor Head Assembly Building	38	-	-	-	-	-	-	18	54	54	-	-	-	-	-	-	-	-	614	-
4b.1.4.11	Steam Generator Replacement Bldgs	264	-	-	-	-	-	-	132	396	396	-	-	-	-	-	-	-	-	8,885	-
4b.1.4	Totals	3,614	3,200	394	1,078	-	6,143	-	4,344	18,773	18,773	-	-	-	61,102	-	-	-	3,018,682	106,582	-
4b.1.5	Prepare/submit License Termination Plan	-	-	-	-	-	-	653	98	751	751	-	-	-	-	-	-	-	-	-	4,096
4b.1.6	Receive NRC approval of termination plan									a											
4b.1	Subtotal Period 4b Activity Costs	4,480	24,456	2,794	3,181	-	42,807	653	19,310	97,483	91,154	-	6,329	-	170,406	-	-	-	9,990,698	468,448	4,096
Period 4b Additional Costs																					
4b.2.1	License Termination Survey Planning	-	-	-	-	-	-	1,769	528	2,297	2,297	-	-	-	-	-	-	-	-	-	12,480
4b.2.2	Sanitary Treatment Lagoon	-	6	86	121	-	524	-	159	896	896	-	-	-	4,608	-	-	-	392,140	423	-
4b.2.3	Cooling Tower Asbestos Panel Removal	-	5,989	-	157	-	-	613	1,014	7,772	-	-	7,772	-	-	-	-	-	-	71,419	-
4b.2.4	Operational Equipment	-	-	22	121	-	1,538	-	406	2,065	2,065	-	-	-	11,760	-	-	-	294,000	32	-
4b.2.5	Retired Reactor Closure Head	-	136	623	1,040	-	1,078	-	522	3,399	3,399	-	-	-	2,764	-	-	-	338,540	3,157	2,000
4b.2.6	License Termination ISFSI	-	591	110	98	-	3,112	3,411	1,830	9,152	9,152	-	-	-	13,299	-	-	-	851,056	17,021	10,896
4b.2	Subtotal Period 4b Additional Costs	-	6,722	841	1,536	-	6,252	5,783	4,458	25,591	17,819	-	7,772	-	32,431	-	-	-	1,875,736	92,052	25,376

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes: Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 4b Collateral Costs																					
4b.3.1	Process decommissioning water waste	13	-	22	40	-	106	-	41	222	222	-	-	-	214	-	-	-	12,340	42	-
4b.3.3	Small tool allowance	-	552	-	-	-	-	-	83	635	635	-	-	-	-	-	-	-	-	-	-
4b.3.4	Decommissioning Equipment Disposition	-	-	107	101	-	1,758	-	465	2,431	2,431	-	-	-	5,290	-	-	-	336,079	147	-
4b.3.5	On-site survey and release of 309.6 tons clean metallic waste	-	-	-	-	-	-	489	49	538	538	-	-	-	-	-	-	-	-	-	-
4b.3	Subtotal Period 4b Collateral Costs	13	552	129	142	-	1,863	489	638	3,826	3,826	-	-	-	5,504	-	-	-	348,419	189	-
Period 4b Period-Dependent Costs																					
4b.4.1	Decon supplies	1,745	-	-	-	-	-	-	436	2,181	2,181	-	-	-	-	-	-	-	-	-	-
4b.4.2	Insurance	-	-	-	-	-	-	1,546	155	1,701	1,701	-	-	-	-	-	-	-	-	-	-
4b.4.3	Property taxes	-	-	-	-	-	-	248	25	273	273	-	-	-	-	-	-	-	-	-	-
4b.4.4	Health physics supplies	-	4,564	-	-	-	-	-	1,141	5,705	5,705	-	-	-	-	-	-	-	-	-	-
4b.4.5	Heavy equipment rental	-	5,929	-	-	-	-	-	889	6,818	6,818	-	-	-	-	-	-	-	-	-	-
4b.4.6	Disposal of DAW generated	-	-	126	47	-	380	-	115	668	668	-	-	-	6,615	-	-	-	132,302	216	-
4b.4.7	Plant energy budget	-	-	-	-	-	-	2,647	442	3,089	3,089	-	-	-	-	-	-	-	-	-	-
4b.4.8	NRC Fees	-	-	-	-	-	-	1,116	112	1,228	1,228	-	-	-	-	-	-	-	-	-	-
4b.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	880	147	1,127	1,127	-	-	-	-	-	-	-	-	-	-
4b.4.10	Corporate Allocations	-	-	-	-	-	-	2,307	231	2,538	2,538	-	-	-	-	-	-	-	-	-	-
4b.4.11	Remedial Actions Surveys	-	-	-	-	-	-	2,374	356	2,730	2,730	-	-	-	-	-	-	-	-	-	-
4b.4.12	Security Staff Cost	-	-	-	-	-	-	9,860	1,449	11,109	11,109	-	-	-	-	-	-	-	-	-	146,945
4b.4.13	DOC Staff Cost	-	-	-	-	-	-	37,428	5,614	43,039	43,039	-	-	-	-	-	-	-	-	-	321,483
4b.4.14	Utility Staff Cost	-	-	-	-	-	-	51,442	7,716	59,158	59,158	-	-	-	-	-	-	-	-	-	568,193
4b.4	Subtotal Period 4b Period-Dependent Costs	1,745	10,493	126	47	-	380	110,046	18,827	141,665	141,665	-	-	-	6,615	-	-	-	132,302	216	1,037,621
4b.0	TOTAL PERIOD 4b COST	6,237	42,224	3,891	4,905	-	51,102	116,972	43,233	268,564	254,463	-	14,101	-	214,955	-	-	-	12,347,860	560,904	1,067,093
PERIOD 4f - License Termination																					
Period 4f Direct Decommissioning Activities																					
4f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	163	49	212	212	-	-	-	-	-	-	-	-	-	-
4f.1.2	Terminate license									a											
4f.1	Subtotal Period 4f Activity Costs	-	-	-	-	-	-	163	49	212	212	-	-	-	-	-	-	-	-	-	-
Period 4f Additional Costs																					
4f.2.1	License Termination Survey	-	-	-	-	-	-	9,385	2,815	12,200	12,200	-	-	-	-	-	-	-	-	153,878	6,240
4f.2	Subtotal Period 4f Additional Costs	-	-	-	-	-	-	9,385	2,815	12,200	12,200	-	-	-	-	-	-	-	-	153,878	6,240
Period 4f Collateral Costs																					
4f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
4f.3	Subtotal Period 4f Collateral Costs	-	-	-	-	-	-	1,636	245	1,882	1,882	-	-	-	-	-	-	-	-	-	-
Period 4f Period-Dependent Costs																					
4f.4.1	Insurance	-	-	-	-	-	-	507	51	558	558	-	-	-	-	-	-	-	-	-	-
4f.4.2	Property taxes	-	-	-	-	-	-	81	8	90	90	-	-	-	-	-	-	-	-	-	-
4f.4.3	Health physics supplies	-	910	-	-	-	-	-	228	1,138	1,138	-	-	-	-	-	-	-	-	-	-
4f.4.4	Disposal of DAW generated	-	-	7	3	-	20	-	6	36	36	-	-	-	353	-	-	-	7,050	11	-
4f.4.5	Plant energy budget	-	-	-	-	-	-	258	39	296	296	-	-	-	-	-	-	-	-	-	-
4f.4.6	NRC Fees	-	-	-	-	-	-	427	43	470	470	-	-	-	-	-	-	-	-	-	-
4f.4.7	Corporate Allocations	-	-	-	-	-	-	756	76	832	832	-	-	-	-	-	-	-	-	-	-
4f.4.8	Security Staff Cost	-	-	-	-	-	-	1,473	221	1,693	1,693	-	-	-	-	-	-	-	-	-	18,874
4f.4.9	DOC Staff Cost	-	-	-	-	-	-	6,879	1,032	7,910	7,910	-	-	-	-	-	-	-	-	-	57,408
4f.4.10	Utility Staff Cost	-	-	-	-	-	-	7,882	1,152	8,834	8,834	-	-	-	-	-	-	-	-	-	74,709
4f.4	Subtotal Period 4f Period-Dependent Costs	-	910	7	3	-	20	18,062	2,854	21,856	21,856	-	-	-	353	-	-	-	7,050	11	150,991
4f.0	TOTAL PERIOD 4f COST	-	910	7	3	-	20	29,247	5,964	36,151	36,151	-	-	-	353	-	-	-	7,050	153,889	157,231
PERIOD 4 TOTALS		6,527	86,688	29,739	15,392	-	171,939	217,292	116,604	643,181	624,218	-	15,962	-	545,638	501	393	2,217	33,115,310	1,051,867	1,886,316

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 5b - Site Restoration																					
Period 5b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
5b.1.1.1	Reactor	-	3,189	-	-	-	-	-	478	3,667	-	-	3,667	-	-	-	-	-	-	27,502	-
5b.1.1.2	Auxiliary	-	2,481	-	-	-	-	-	372	2,853	-	-	2,853	-	-	-	-	-	-	19,024	-
5b.1.1.3	Auxiliary Boiler	-	23	-	-	-	-	-	3	27	-	-	27	-	-	-	-	-	-	248	-
5b.1.1.4	Barge Facility	-	924	-	-	-	-	-	139	1,063	-	-	1,063	-	-	-	-	-	-	4,290	-
5b.1.1.5	Circulating & Service Water Pumphouse	-	218	-	-	-	-	-	33	251	-	-	251	-	-	-	-	-	-	1,996	-
5b.1.1.6	Communication Corridor - Clean	-	892	-	-	-	-	-	134	1,025	-	-	1,025	-	-	-	-	-	-	8,280	-
5b.1.1.7	Communication Corridor - Contaminated	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	184	-
5b.1.1.8	Cooling Tower Concrete	-	433	-	-	-	-	-	65	498	-	-	498	-	-	-	-	-	-	2,332	-
5b.1.1.9	Diesel Generator	-	291	-	-	-	-	-	44	335	-	-	335	-	-	-	-	-	-	2,165	-
5b.1.1.10	Essential Service Water Pumphouse	-	169	-	-	-	-	-	25	194	-	-	194	-	-	-	-	-	-	955	-
5b.1.1.11	Fire Water Pumphouse	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	151	-
5b.1.1.12	Flex Building Storage	-	309	-	-	-	-	-	46	355	-	-	355	-	-	-	-	-	-	1,972	-
5b.1.1.13	Fuel Building	-	1,092	-	-	-	-	-	164	1,256	-	-	1,256	-	-	-	-	-	-	7,874	-
5b.1.1.14	Hardened Condensate Storage Tank - HCST	-	195	-	-	-	-	-	29	224	-	-	224	-	-	-	-	-	-	1,870	-
5b.1.1.15	Hot Machine Shop	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	243	-
5b.1.1.16	Intake	-	209	-	-	-	-	-	31	240	-	-	240	-	-	-	-	-	-	1,411	-
5b.1.1.17	Misc. Structures	-	2,147	-	-	-	-	-	322	2,469	-	-	2,469	-	-	-	-	-	-	18,774	-
5b.1.1.18	Miscellaneous Site Foundations	-	186	-	-	-	-	-	28	214	-	-	214	-	-	-	-	-	-	1,011	-
5b.1.1.19	Outage Maintenance	-	128	-	-	-	-	-	19	147	-	-	147	-	-	-	-	-	-	1,570	-
5b.1.1.20	RAM Storage Building	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	624	-
5b.1.1.21	Radioactive and Personnel Tunnel	-	32	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	386	-
5b.1.1.22	Radwaste	-	1,056	-	-	-	-	-	158	1,214	-	-	1,214	-	-	-	-	-	-	8,111	-
5b.1.1.23	Radwaste Drum Storage	-	161	-	-	-	-	-	24	185	-	-	185	-	-	-	-	-	-	1,449	-
5b.1.1.24	Reactor Head Assembly Building	-	81	-	-	-	-	-	12	93	-	-	93	-	-	-	-	-	-	1,108	-
5b.1.1.25	Security Additions	-	1,583	-	-	-	-	-	237	1,820	-	-	1,820	-	-	-	-	-	-	6,051	-
5b.1.1.26	Service	-	422	-	-	-	-	-	63	485	-	-	485	-	-	-	-	-	-	3,485	-
5b.1.1.27	Sludge Pump Station & Lagoon	-	1,582	-	-	-	-	-	237	1,820	-	-	1,820	-	-	-	-	-	-	10,601	-
5b.1.1.28	Steam Generator Replacement Bldgs	-	852	-	-	-	-	-	128	979	-	-	979	-	-	-	-	-	-	6,874	-
5b.1.1.29	Turbine Building	-	3,653	-	-	-	-	-	548	4,201	-	-	4,201	-	-	-	-	-	-	47,075	-
5b.1.1.30	Turbine Pedestal	-	540	-	-	-	-	-	81	620	-	-	620	-	-	-	-	-	-	2,934	-
5b.1.1.31	U.H.S. Cooling Tower	-	330	-	-	-	-	-	49	379	-	-	379	-	-	-	-	-	-	1,814	-
5b.1.1.32	Water Treatment Plant	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	9	-
5b.1.1	Totals	-	23,301	-	-	-	-	-	3,496	26,797	-	-	26,797	-	-	-	-	-	-	192,393	-
Site Closeout Activities																					
5b.1.2	Remove Rubble	-	1,390	-	-	-	-	-	210	1,608	-	-	1,608	-	-	-	-	-	-	7,233	-
5b.1.3	Grade & landscape site	-	130	-	-	-	-	-	19	149	-	-	149	-	-	-	-	-	-	692	-
5b.1.4	Final report to NRC	-	-	-	-	-	-	249	37	286	286	-	-	-	-	-	-	-	-	-	1,560
5b.1	Subtotal Period 5b Activity Costs	-	24,830	-	-	-	-	249	3,762	28,841	286	-	28,555	-	-	-	-	-	-	200,318	1,560
Period 5b Additional Costs																					
5b.2.1	Concrete Crushing	-	1,379	-	-	-	-	13	209	1,601	-	-	1,601	-	-	-	-	-	-	6,035	-
5b.2.2	Mine Area Backfill	-	5,308	-	-	-	-	-	796	6,104	-	-	6,104	-	-	-	-	-	-	16,960	-
5b.2.3	Cooling Tower Discharge & Intake Pipe Flow Fill	-	4,074	-	-	-	-	-	611	4,685	-	-	4,685	-	-	-	-	-	-	9,588	-
5b.2.4	Cooling Tower Demolition	-	4,779	-	-	-	-	-	717	5,496	-	-	5,496	-	-	-	-	-	-	21,619	-
5b.2.5	Excavation of Underground Services	-	2,833	-	-	-	-	487	423	3,244	-	-	3,244	-	-	-	-	-	-	14,184	-
5b.2.6	Construction Debris	-	-	-	-	-	-	5,080	755	5,785	-	-	5,785	-	-	-	-	-	-	-	-
5b.2.7	Site Restoration ISFSI	-	1,152	-	-	-	-	86	186	1,423	-	-	1,423	-	-	-	-	-	-	9,601	160
5b.2	Subtotal Period 5b Additional Costs	-	19,026	-	-	-	-	5,616	3,696	28,338	-	-	28,338	-	-	-	-	-	-	76,967	160
Period 5b Collateral Costs																					
5b.3.1	Small tool allowance	-	310	-	-	-	-	-	47	357	-	-	357	-	-	-	-	-	-	-	-
5b.3	Subtotal Period 5b Collateral Costs	-	310	-	-	-	-	-	47	357	-	-	357	-	-	-	-	-	-	-	-

Table F
Callaway Energy Center
SAFSTOR Decommissioning Cost Estimate with Direct Disposal of Low-Level Radioactive Waste
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 5b Period-Dependent Costs																					
5b.4.2	Property taxes	-	-	-	-	-	-	162	16	178	-	-	178	-	-	-	-	-	-	-	-
5b.4.3	Heavy equipment rental	-	5,087	-	-	-	-	-	760	5,827	-	-	5,827	-	-	-	-	-	-	-	-
5b.4.4	Plant energy budget	-	-	-	-	-	-	256	38	295	-	-	295	-	-	-	-	-	-	-	-
5b.4.5	Corporate Allocations	-	-	-	-	-	-	1,504	150	1,655	-	-	1,655	-	-	-	-	-	-	-	-
5b.4.6	Security Staff Cost	-	-	-	-	-	-	2,929	439	3,368	-	-	3,368	-	-	-	-	-	-	-	37,543
5b.4.7	DOC Staff Cost	-	-	-	-	-	-	13,311	1,997	15,308	-	-	15,308	-	-	-	-	-	-	-	106,371
5b.4.8	Utility Staff Cost	-	-	-	-	-	-	6,215	932	7,148	-	-	7,148	-	-	-	-	-	-	-	61,007
5b.4	Subtotal Period 5b Period-Dependent Costs	-	5,087	-	-	-	-	24,378	4,333	33,778	-	-	33,778	-	-	-	-	-	-	-	204,920
5b.0	TOTAL PERIOD 5b COST	-	49,233	-	-	-	-	30,242	11,838	91,313	286	-	91,027	-	-	-	-	-	-	277,185	206,640
PERIOD 5 TOTALS		-	49,233	-	-	-	-	30,242	11,838	91,313	286	-	91,027	-	-	-	-	-	-	277,185	206,640
TOTAL COST TO DECOMMISSION		14,287	147,529	80,130	15,876	-	173,529	847,261	222,801	1,451,413	1,257,004	82,400	112,010	-	556,092	501	393	2,217	33,415,100	1,427,194	7,395,806

TOTAL COST TO DECOMMISSION WITH 18.13% CONTINGENCY:	$1,451,413	thousands of 2020 dollars
TOTAL NRC LICENSE TERMINATION COST IS 86.61% OR:	$1,257,004	thousands of 2020 dollars
SPENT FUEL MANAGEMENT COST IS 5.68% OR:	$82,400	thousands of 2020 dollars
NON-NUCLEAR DEMOLITION COST IS 7.72% OR:	$112,010	thousands of 2020 dollars
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	556,985	Cubic Feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	2,217	Cubic Feet
TOTAL SCRAP METAL REMOVED:	69,004	Tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,427,194	Man-hours

End Notes:
n/a - indicates that this activity not charged as decommissioning expense
a - indicates that this activity performed by decommissioning staff
0 - indicates that this value is less than 0.5 but is non-zero
A cell containing " - " indicates a zero value

APPENDIX G

DETAILED COST ANALYSIS

ISFSI DECOMMISSIONING AND DEMOLITION

TABLE G-1
SIGNIFICANT QUANTITIES AND PHYSICAL DIMENSIONS

ISFSI Pad

Item	Length (feet)	Width (feet)	Depth (feet)	Residual Radioactivity
ISFSI Pad	157.5	143.5	2.5	No

ISFSI HI-STORM UMAX

Item	Value	Notes (all dimensions are nominal)
Cavity Enclosure Container Inside Height	181	inches
Cavity Enclosure Container Inside Diameter	86	inches
Quantity (total)	48	Spent Fuel (43) + GTCC (5)
Quantity (with residual radioactivity)	6	Equivalent to the number of VVMs used to store last complete core offload)
Potentially Activated Steel and Concrete	847,767	pounds
Misc. Low-Level Radioactive Waste	3,289	pounds
Low-Level Radioactive Waste	13,299	cubic feet (excluding transfer cask)
Low-Level Radioactive Waste (packaged density)	64	pounds per cubic foot average weight density

Other Potentially Impacted Items

Item	Value	Notes
Number of VVMs used for GTCC storage	5	No residual radioactivity

TABLE G-2
ISFSI DECOMMISSIONING COST
(thousands, 2020 dollars)

	Costs						Waste Volume	Person-Hours	
	Removal	Packaging	Transport	Disposal	Other	Total	Cubic Feet	Craft	Oversight and Contractor
Decommissioning Contractor									
Planning (characterization, specifications and procedures)	-	-	-	-	239	239	-	-	1,024
Remediation (activated metal removal)	591	110	98	3,112	-	3,910	13,299	7,472	-
License Termination (radiological surveys)	-	-	-	-	1,307	1,307	-	9,549	-
Subtotal	**591**	**110**	**98**	**3,112**	**1,546**	**5,457**	**13,299**	**17,021**	**1,024**
Supporting Costs									
NRC and NRC Contractor Fees	-	-	-	-	473	473	-	-	1,153
Insurance	-	-	-	-	144	144	-	-	-
Property Taxes	-	-	-	-	35	35	-	-	-
Plant Energy Budget	-	-	-	-	56	56	-	-	-
Corporate A&G	-	-	-	-	329	329	-	-	-
Security (industrial)	-	-	-	-	420	420	-	-	4,958
Ameren Missouri Oversight	-	-	-	-	408	408	-	-	3,761
Subtotal	-	-	-	-	**1,865**	**1,865**	-	-	**9,872**
Total (w/o contingency)	**591**	**110**	**98**	**3,112**	**3,411**	**7,322**	**13,299**	**17,021**	**10,896**
Total (w/25% contingency)	**738**	**138**	**122**	**3,890**	**4,264**	**9,152**	-	-	-

The application of contingency (25%) is consistent with the evaluation criteria referenced by the NRC in NUREG-1757 (""Consolidated Decommissioning Guidance, Financial Assurance, Recordkeeping, and Timeliness,"" U.S. NRC's Office of Nuclear Material Safety and Safeguards, NUREG-1757, Vol. 3, Rev. 1, February 2012)"

TABLE G-3
ISFSI DEMOLITION COSTS [1]

	Costs (thousands, 2020 dollars)						Person-Hours	
	Removal	Packaging	Transport	Disposal	Other	Total	Craft	Oversight and Contractor
Decommissioning Contractor								
Excavation and Demolition	158					158	965	
Steel Removal	571					571	7,523	
Concrete Processing	129				22	151	494	
Backfill	295					295	618	
Tooling					37	37		
Final Report					26	26		160
Subtotal	**1,152**				**86**	**1,237**	**9,601**	**160**
Supporting Costs								
Property Taxes					18	18		
Heavy Equipment	115					115		
Plant Energy Budget					28	28		
Corporate A&G					164	164		
Security (industrial)					210	210		2,479
Ameren Missouri Oversight					172	172		1,539
Subtotal	**115**				592	706		4,018
Total (w/o contingency)	**1,266**				**677**	**1,944**	**9,601**	**4,178**
Total (w/15% contingency)	**1,456**				**779**	**2,235**		

Note 1: For funding planning purposes demolition costs are incurred in the time period 2051-53 (for the DECON alternative)

Base Currency: USD

BNY MELLON

Book And Market Summary
Show Individual
12/31/2022

Account Number	Account Name	Book Value	Market Value	Accrued Income	Total Net Assets	Unrealized Gain/Loss	Total Market Value %
A56F50559202	PLANT-FERC-FI	9,367,501.27	8,295,409.84	59,047.14	8,354,456.98	-1,013,044.29	35.78
A56F50559302	PLANT-FERC-EQ	7,034,677.75	14,979,041.00	13,360.34	14,992,401.34	7,957,723.59	64.22
A56G33671000	**PLANT - FERC CONS**	**16,402,179.02**	**23,274,450.84**	**72,407.48**	**23,346,858.32**	**6,944,679.30**	**100.00**
A56F50559002	PLANT-MO-FI	371,140,176.78	325,360,867.67	2,396,138.71	327,757,006.38	-43,383,170.40	35.20
A56F50559102	PLANT-MO-EQ	171,093,197.50	602,688,873.78	743,432.71	603,432,306.49	432,339,108.99	64.80
A56G36817000	**PLANT - MO - CONS**	**542,233,374.28**	**928,049,741.45**	**3,139,571.42**	**931,189,312.87**	**388,955,938.59**	**100.00**

Application for Acceptance of Decommissioning Cost Estimates for Callaway Energy Center, Including Independent Spent Fuel Storage Installation, and Approval of Funding Level for Nuclear Decommissioning Trust Fund - November 5, 2020

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

Application of Union Electric Company d/b/a Ameren Missouri for Acceptance of Its Triennial Filing of Cost Estimates for Callaway Energy Center Decommissioning, Including the Independent Spent Fuel Storage Installation, and Approval of the Funding Level of the Nuclear Decommissioning Trust Fund.	)	File No. EO-2021-0050

APPLICATION FOR ACCEPTANCE OF DECOMMISSIONING COST ESTIMATES FOR CALLAWAY ENERGY CENTER, INCLUDING INDEPENDENT SPENT FUEL STORAGE INSTALLATION, AND APPROVAL OF FUNDING LEVEL FOR NUCLEAR DECOMMISSIONING TRUST FUND

COMES NOW Union Electric Company, d/b/a Ameren Missouri ("Ameren Missouri" or "Company"), and pursuant to 20 CSR 4240-20.070(4), hereby respectfully requests that the Missouri Public Service Commission ("Commission") approve Ameren Missouri's decommissioning cost estimates for the Callaway Energy Center ("Callaway" or "Plant") and for the Callaway Independent Spent Fuel Storage Installation ("ISFSI"), as well as the continuation of the funding level of its nuclear decommissioning trust fund at the current $6,758,605 annual amount, with $6,242,226 allocated to plant decommissioning and $516,379 allocated to ISFSI decommissioning. Ameren Missouri further requests that the Commission find that the $6,758,605 annual funding level of its decommissioning trust fund be included in Ameren Missouri's current cost of service for ratemaking purposes and confirm that this funding level is based on the parameters and assumptions stated in this Application.

In support of its Application, Ameren Missouri states the following:

1. **INTRODUCTION**

1. Ameren Missouri submits this *Application for Acceptance of Decommissioning Cost Estimates for Callaway Energy Center, Including Independent Spent Fuel Storage Installation, and Approval of Funding Level of Nuclear Decommissioning Trust Fund* ("*Application*") in compliance with the general application requirements of 20 CSR 4240-2.060(1) as well as the more specific requirements of 20 CSR 4240-20.070 (4), which provides, in part:

> Every three (3) years, utilities with decommissioning trust funds shall perform and file with the commission cost studies detailing the utilities' latest cost estimates for decommissioning their nuclear generating unit(s) along with the funding levels necessary to defray these decommissioning costs. These studies shall be filed along with appropriate tariff(s) effectuating the change in rates necessary to accomplish the funding required….

2. Accordingly, this *Application* will be divided into the following sections:

I. 20 CSR 4240-2.060(1), (A) through (M)

II. 20 CSR 4240-20.070(4)

A. 2020 Cost Study

B. Required Annual Funding Level

C. Funding Adequacy Model Assumptions

D. Funding Adequacy Model Results

E. Contributions to the Tax-Qualified Decommissioning Trust

III. Requested Findings and Orders

The information requested by both rules, as well as the additional findings the Company requests, are discussed in more detail below.

3. In summary, based upon the 2020 cost estimate and Ameren Missouri's analysis, the Company is not requesting any increase or decrease to the total current decommissioning contribution amount. The total proposed annual decommissioning contribution amount remains at

$6,758,605. The allocation of this total amount between funding for the plant decommissioning and ISFSI decommissioning will be adjusted, but the total annual decommissioning expense and contribution amount of $6,758,605 remains adequate. Because the total costs remain unchanged, there should be no impact on Ameren Missouri's customers.

II. 20 CSR 4240-2.060(1), (A) through (M)

A. Paragraph (A) – Applicant

4. Company is a Missouri corporation doing business under the fictitious name of Ameren Missouri, organized and existing under the laws of the State of Missouri, in good standing in all respects, with its principal office and place of business located at One Ameren Plaza, 1901 Chouteau Avenue, Saint Louis, Missouri 63103. Company is engaged in providing electric and gas utility services in portions of Missouri as a public utility under the jurisdiction of the Commission. Ameren Missouri is the owner and operator of Callaway, a nuclear generating unit, and the ISFSI, a spent fuel storage installation at the Plant. The decommissioning cost estimates and decommissioning contributions to the nuclear decommissioning trust fund for Callaway and ISFSI are the subject of this application. Company is a subsidiary of Ameren Corporation.

B. Paragraph (B) – Articles of Incorporation; Paragraph (E) – Fictitious Name; Paragraph (G) – Information Previously Submitted; Paragraph (H) – Character of Business[1]

5. Company previously submitted to the Commission a certified copy of its Articles of Incorporation (See File No. EA-87-105). Company previously submitted its Fictitious Name Registrations as filed with the Missouri Secretary of State’s Office in File No. EA-2019-0181. Ameren Missouri submits with this *Application* an updated Certificate of Corporate Good Standing

[1] Paragraphs (C), (D), and (F) do not apply to Ameren Missouri.

as Attachment 1. These documents are incorporated by reference and made a part of this *Application* for all purposes.

C. Paragraph (I) – Correspondence and Communication

6. Pleadings, notices, orders and other correspondence concerning this Application should be addressed to:

Thomas M. Byrne
Senior Director, Regulatory Affairs
1901 Chouteau Avenue, MC-1450
P.O. Box 66149, MC-1450
St. Louis, Missouri 63101-6149
(314) 554-2514 (Telephone)
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D. Paragraph (K) – Actions, Judgments, and Decisions; Paragraph L - Fees[2]

7. Company has no final unsatisfied judgments or decisions against it from any state or federal agency or court that involve customer service or rates that have occurred within three years of the date of this *Application*. By the nature of its business, Company has, from time to time, pending actions in state and federal agencies and courts involving customer service or customer rates. Company has no annual report or assessment fees overdue to this Commission.

E. Paragraph (M) – Affidavit

8. An Affidavit in support of this application by an individual authorized by Ameren Missouri to execute such a document is included as Attachment 2 with this *Application*.

III. 20 CSR 4240-20.070(4)

A. 2020 Cost Study

9. Ameren Missouri contracted with TLG Services, Inc. ("TLG") to perform, under the direction of Ameren Missouri, the site specific cost study to determine the estimated cost for

[2] Paragraph (J) does not apply to Ameren Missouri.

decommissioning the Callaway Energy Center Plant and ISFSI. Since 1982, TLG has provided engineering and field services for contaminated facilities including estimates of decommissioning costs for nuclear generating units. TLG is an industry leader in nuclear power plant decontamination and decommissioning planning, cost estimating, and project field supervision and has prepared and updated decommissioning cost estimates for the vast majority of nuclear generation units in the country. TLG also is the company that prepared the decommissioning cost estimates that were filed with and approved by the Commission in 1993, 1999, 2002, 2005, 2008, 2011, 2015, and 2018 as well as the ISFSI decommissioning cost estimate in 2015 and 2018.

10. Attachment 3, which is attached hereto and made a part hereof for all purposes, is the updated decommissioning cost estimate prepared by TLG, titled *Decommissioning Cost Analysis for the Callaway Energy Center*, and dated October 2020. This cost estimate is comprehensive in that it covers both the Plant and ISFSI decommissioning; however, the costs are segregated for each. TLG estimated the total cost to decommission Callaway and the ISFSI, employing the DECON alternative, as $1,046,835,000 in 2020 dollars. Of this total, $1,036,260,000 is attributable to Plant decommissioning and $10,575,000 is attributable to ISFSI decommissioning. The estimate is based on an assumed 60-year plant operating life, and reflects the use of off-site, low-level radioactive waste processing to minimize the volume designated for controlled disposal.

B. Required Annual Funding Level

11. Ameren Missouri's analysis of the required annual funding level for the Missouri jurisdictional sub-account is based on the premise that the current annual contribution to the decommissioning trust should be changed only if that annual contribution continued over the licensed life at Callaway does not result in a final trust account balance that is just sufficient to

cover the estimated decommissioning cost given in Attachment 3 under a reasonable set of economic, financial, and investment assumptions and at a reasonable decommissioning inflation rate assumption.

12. The Company has developed a funding adequacy model that computes the required annual decommissioning contribution for the Plant and ISFSI based on specified economic and financial parameters and on a specified decommissioning inflation rate. Conversely, the model can also be used to derive the decommissioning inflation rate for which given annual contribution amounts for the Plant and ISFSI would provide adequate funding, under a given set of investment return assumptions.

13. Attachment 4, Ameren Missouri's analysis of the required funding level, is attached hereto and made a part hereof for all purposes. Please note that the analysis contained in Attachment 4 requests neither an increase nor a decrease to the aggregate funding amount for the consolidated Plant and ISFSI decommissioning.

C. Funding Adequacy Model Assumptions

14. The Company used its funding adequacy model to derive the decommissioning inflation rate for which the current annual decommissioning expense and contribution amount of $6,758,605 would be adequate under the economic, financial, and investment assumptions outlined below. In addition, the model determined the allocation of the total $6,758,605 annual decommissioning expense and contribution amount between the Plant and ISFSI.

15. The economic, financial and investment assumptions used as the basis for the funding adequacy modeling are as follows:

- For Callaway Energy Center - Plant:
    - The beginning balance (after-tax liquidation value) of the Callaway Energy Center Plant sub-account as-of September 30, 2020: $814,003,088

Note: The above balance includes the after-tax liquidation values of both the Missouri and FERC sub-accounts associated with Plant decommissioning, as the Missouri demand allocator is 100%.

- Decommissioning cost estimate: $1,036,260,000 (2020$)

- For the ISFSI:
  - The beginning balance (after-tax liquidation value) of the ISFSI sub-account as-of September 30, 2020: $2,414,043
  - Decommissioning cost estimate: $10,575,000 (2020$)
- Common parameters for the Callaway Energy Center and ISFSI:
  - The proposed expense and contribution amount and allocation between Plant and ISFSI is to be effective beginning with calendar year 2021.
  - Operating license expiration date of October 18, 2044
  - Missouri jurisdictional allocator 100%
  - Federal income tax rate 20%
  - State income tax rate 0%
  - Projected investment management and trust fees 15.00 basis points
  - Asset allocation 65% equities and 35% Bonds
  - Nominal Return on Bonds (Pre-Tax & Expense) 3.20%
  - Nominal return on Equities (Pre-Tax & Expense) 8.50%
  - Weighted-Average Return (Pre-Tax & Expense) (During period of investment in bonds & equities) 6.645%
  - General inflation level (CPI) 2.15%
  - Real Rate of return (Pre-Tax & Expense) (During period of investment in bonds & equities) 4.495%
  - Real Rate of return (Pre-Tax & Expense) (During period of investment in bonds alone) 1.050%

- Year in which divestiture from equity investments occurs 2043
- Annualized pre-tax and expense nominal return over the life of the fund (Plant & ISFSI Consolidated) 6.082%
- Decommissioning inflation rate 4.1916%

16. The *Non-Unanimous Stipulation and Agreement* approved by the Commission Order in File No. EO-2012-0070, states:

> The Parties agree that, it is reasonable to use capital market return expectation information provided by Ameren Missouri's pension plan consultant, or the 2% real rate of return set forth in 10 CFR §50.75(e)(1)(ii), for purposes of developing expected portfolio returns for Ameren Missouri's nuclear decommissioning trust fund. The Parties agree that any proposed changes to the annual contribution to Ameren Missouri's nuclear decommissioning trust fund shall be based on capital market return expectation information provided by Ameren Missouri's pension plan consultant, or the aforementioned 2% real rate of return, unless the Parties agree to use a different source and/or methodology for capital market return expectations or the Commission finds in a contested case that different source and/or methodology for capital market return expectation are more appropriate.

17. The nominal return on bonds and equities indicated in the forgoing and utilized in the funding adequacy analysis are consistent with the current *Pension Master Trust – Expected Return on Assets* provided February 13, 2020, by Willis Towers Watson, Ameren Missouri's pension plan consultant.

18. 10 CFR 50.75(e)(1)(ii) states, in part, as follows:

> (ii) External sinking fund. An external sinking fund is a fund established and maintained by setting funds aside periodically in an account segregated from licensee assets and outside the administrative control of the licensee and its subsidiaries or affiliates in which the total amount of funds would be sufficient to pay decommissioning costs at the time permanent termination of operations is expected . . . **A licensee that has collected funds based on a site-specific estimate under §50.75(b)(1) of this section may take credit for projected earnings on the external sinking funds using up to a 2 percent annual real rate of return**

> **from the time of future funds' collection through the decommissioning period, provided that the site-specific estimate is based on a period of safe storage that is specifically described in the estimate. This includes the periods of safe storage, final dismantlement, and license termination . . . A licensee may use a credit of greater than 2 percent if the licensee's rate-setting authority has specifically authorized a higher rate.** (Emphasis added.)

19. Consequently, the Company requests that the Commission authorize the return assumptions used in the Company's funding analysis on which the proposed decommissioning expense and contribution amount is based.

20. 10 CFR 50.75(e)(1)(ii) goes on to state, in part, as follows:

> (ii) External sinking fund . . . This method may be used as the exclusive mechanism relied upon for providing financial assurance for decommissioning in the following circumstances:
>
> (A) By a licensee that recovers, either directly or indirectly, the estimated total cost of decommissioning through rates established by "cost of service" or similar ratemaking regulation. Public utility districts, municipalities, rural electric cooperatives, and State and Federal agencies, including associations of any of the foregoing, that establish their own rates and are able to recover their cost of service allocable to decommissioning, are assumed to meet this condition.

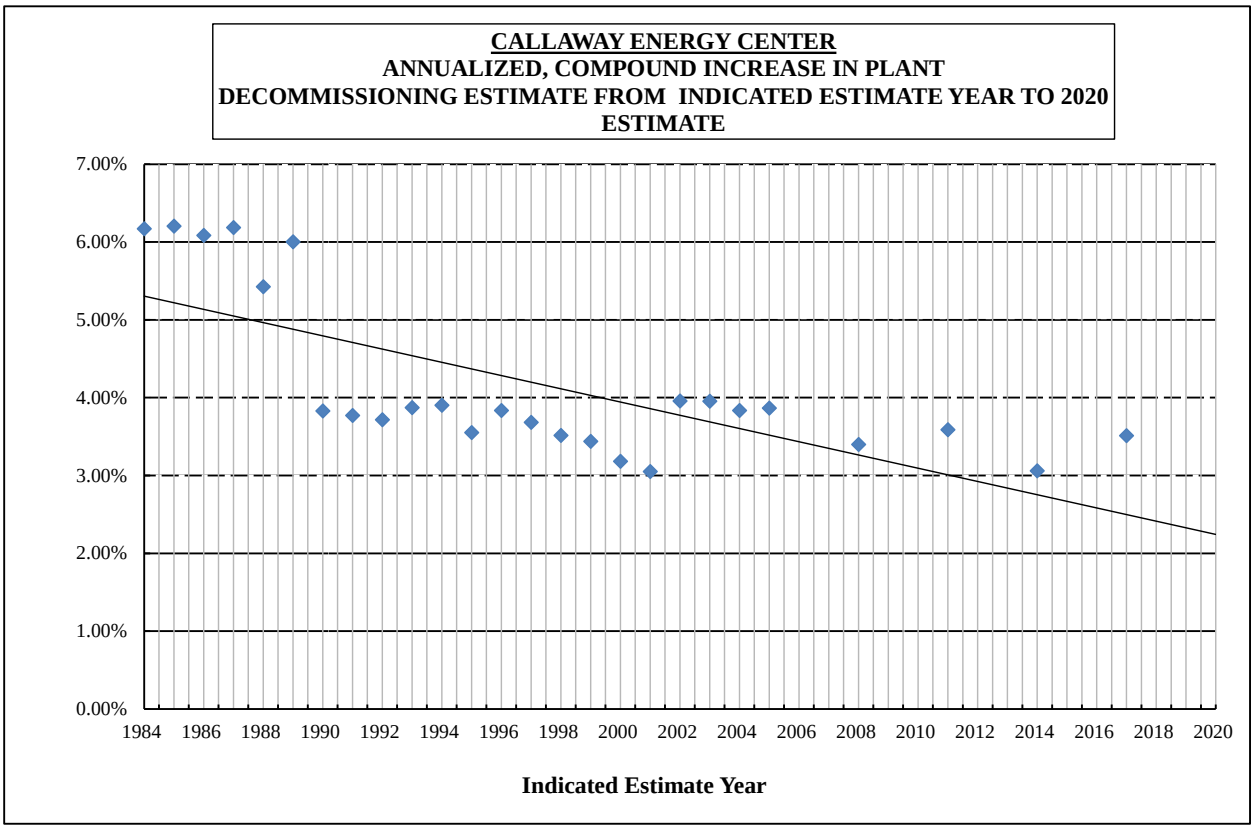
21. Consequently, in order for the Callaway decommissioning fund to continue to utilize the external sinking fund method of decommissioning funding, the Company requests that the Commission confirm that the current decommissioning costs for Callaway, including the ISFSI, are in Ameren Missouri's current Missouri retail cost of service and are reflected in its current retail rates for ratemaking purposes;

D. Funding Adequacy Model Results

22. As a basis for recommending that the current annual contribution amount remain unchanged at the current total aggregate annual funding level of $6,758,605, the Company

calculated the decommissioning inflation values for this funding level would be adequate under the economic, financial, and investment assumptions indicated in the foregoing section. Based on those same assumptions, an annual contribution of $6,758,605 would be adequate up to a decommissioning inflation rate level of 4.1916%. Pre-tax and expense nominal returns on the funds' investments would be 6.645% through 2043, and 3.200% thereafter. The annualized pre-tax expense nominal return for the consolidated Plant and ISFSI fund, over the life of the fund, would be 6.082%.

23. Although future levels of decommissioning inflation are very difficult to project, the Company feels that a 3% to 4% range is reasonable, given historical trends in the escalation rate of the site specific decommissioning cost estimates for Callaway. The vast majority of annualized compound escalation rates from historical site specific estimates to the current 2020 estimate fall within that range as indicated in the chart below:



24. The funding adequacy model output obtained from these analyses is presented in Attachment 4:

- Page 1 of Attachment 4 provides the annual decommissioning cash flows for the Plant and for the ISFSI and illustrates the escalation of these decommissioning expense cash flows at the 4.1916% decommissioning inflation rate, which is the maximum rate at which the proposed annual contribution level of $6,758,605 would be adequate.
- Page 2 of Attachment 4 contains a spreadsheet illustrating how the proposed annual "Plant allocation" of the total contribution amount will adequately cover Plant decommissioning expenses with a $0 balance upon completion at a decommissioning inflation rate of 4.1916% and the economic and financial assumptions specified in the foregoing section.
- Page 3 of Attachment 4 contains a spreadsheet illustrating how the proposed annual "ISFSI allocation" of the total contribution amount will adequately cover ISFSI decommissioning expenses with a $0 balance upon completion at a decommissioning inflation rate of 4.1916% and the economic and financial assumptions specified in the foregoing section.
- Page 4 of Attachment 4 contains a spreadsheet illustrating how the proposed total annual contribution amount will adequately cover consolidated Plant and ISFSI decommissioning expenses with a $0 balance upon completion at a decommissioning inflation rate of 4.1916% and the economic and financial assumptions specified in the foregoing section.
- Page 5 of Attachment 4 illustrates the derivation of the annualized return that the consolidated fund's assets would be required to earn, from September 30, 2020 through 2053, to adequately cover Plant and ISFSI decommissioning expenses with a $0 balance upon completion at a decommissioning inflation rate of 4.1916% and the economic and financial assumptions specified in the foregoing section.

25. In conclusion, the calculations set forth in Attachment 4 validate Ameren Missouri's request to continue funding the decommissioning trust fund using the same annual

amount previously authorized by the Commission, with a 2044 operating license expiration and the economic and financial assumptions specified in the funding adequacy model and summarized in this application.

26. Because Ameren Missouri is not seeking a change to the funding level, there is no need for Ameren Missouri to file new tariffs. Because it is unnecessary for Ameren Missouri to change the funding level of the decommissioning trust, and unnecessary to file new tariffs, Ameren Missouri does not request a hearing, nor does it believe one is required.

E. Making Contributions to the Tax-Qualified Decommissioning Trust

27. In orders entered in early cases regarding the establishment of the decommissioning trust fund (File No. EO-85-17 and File No. ER-85-160), the Commission stated that it: "… requires that [the Company] establish the external fund to take the maximum advantage of the 1984 tax law and follow the requirements of the tax law in making investments for the fund." Consequently, Ameren Missouri is required by Commission order to fund the future decommissioning liability through contributions to the tax-qualified trust fund. In order to make the proposed contributions to the tax-qualified trust fund, Ameren Missouri must comply with section 468A of the Internal Revenue Code. Specifically, in order to make contributions to the tax-qualified trust, a schedule of ruling amounts must be applied for and obtained from the Internal Revenue Service ("IRS"). See 26 CFR 1.468A-3(a)(1) of the Treasury regulations, which reads, in part:

> Except as otherwise provided in paragraph (g) of this section or in § 1.468A–8 (relating to deductions for special transfers into a nuclear decommissioning fund), an electing taxpayer is allowed a deduction under section 468A(a) for the taxable year in which the taxpayer makes a cash payment (or is deemed to make a cash payment) to a nuclear decommissioning fund only if the taxpayer has received a schedule of ruling amounts for the nuclear decommissioning fund that includes a ruling amount for such taxable year. Except as provided in paragraph (a)(4) or (5) of this section, a schedule of ruling amounts for a nuclear decommissioning fund (schedule of

> ruling amounts) is a ruling (within the meaning of § 601.201(a)(2) of this chapter) specifying the annual payments (ruling amounts) that, over the taxable years remaining in the funding period as of the date the schedule first applies, will result in a projected balance of the nuclear decommissioning fund as of the last day of the funding period equal to (and in no event greater than) the amount of decommissioning costs allocable to the fund.

In order for the IRS to issue a schedule of ruling amounts, the assumptions upon which it is based must be reasonable. See 26 CFR 1.468A-3(a)(3) of the Treasury regulations, which reads, in part:

> The Internal Revenue Service (IRS) shall provide a schedule of ruling amounts that is identical to the schedule of ruling amounts proposed by the taxpayer in connection with the taxpayer's request for a schedule of ruling amounts (see paragraph (e)(2)(viii) of this section), but no schedule of ruling amounts shall be provided unless the taxpayer's proposed schedule of ruling amounts is consistent with the principles and provisions of this section and is based on reasonable assumptions.

Further, the Treasury Regulations provide, at 26 CFR 1.468A-3(a)(4), that Ameren Missouri can satisfy this obligation by documenting that the proposed contributions are calculated using the decommissioning assumptions used by the Commission in its most recent order:

> The taxpayer bears the burden of demonstrating that the proposed schedule of ruling amounts is consistent with the principles and provisions of this section and is based on reasonable assumptions. If a public utility commission established or approved the currently applicable rates for the furnishing or sale by the taxpayer of electricity from the plant, the taxpayer can generally satisfy this burden of proof by demonstrating that the schedule of ruling amounts is calculated using the assumptions used by the public utility commission in its most recent order.

28. Finally, 26 CFR 1.468A-3(e)(2)(v) of the Treasury Regulations indicates specific information that a taxpayer such as Ameren Missouri must disclose to the IRS when requesting a schedule of ruling amounts:

> (A) Whether the public utility commission has determined the amount of decommissioning costs to be included in the taxpayer's cost of service for ratemaking purposes;

(B) The amount of decommissioning costs that are to be included in the taxpayer's cost of service for each taxable year under the current determination and amounts that otherwise are required to be included in the taxpayer's income under section 88 and the regulations thereunder;

(C) A description of the assumptions, estimates and other factors used by the public utility commission to determine the amount of decommissioning costs;

(D) A copy of such portions of any order or opinion of the public utility commission as pertain to the public utility commission's most recent determination of the amount of decommissioning costs to be included in cost of service; and

(E) A copy of each engineering or cost study that was relied on or used by the public utility commission in determining the amount of decommissioning costs to be included in the taxpayer's cost of service under the current determination.

IV. REQUESTED FINDINGS AND ORDERS

29. In order for Ameren Missouri to comply with the requirements of the foregoing regulations, Ameren Missouri requests that the Commission:

- Find that the Company's Missouri retail jurisdiction annual decommissioning expense accruals and trust fund payments shall continue at the current level of $6,758,605, with $6,242,226 allocated to decommissioning Callaway and $516,379 allocated to decommissioning the ISFSI;
- Find, in order for the Callaway decommissioning fund to continue to utilize the external sinking fund method of decommissioning funding, that the current decommissioning costs for Callaway, including the ISFSI, are in Ameren Missouri's current Missouri retail cost of service and are reflected in its current retail rates for ratemaking purposes;
- Approve, pursuant to 20 CSR 4240-20.070(5)(C), the use of a jurisdictional demand allocator of 100.00%;
- Recognize that Attachment 3, TLG's *Decommissioning Cost Analysis for the Callaway Energy Center*, dated October 2020, meets the requirements of 20 CSR 4240-20.070(4); and
- Acknowledge that this annual decommissioning expense and contribution amount is based on Attachment 3, the October 2020 *Decommissioning Cost Analysis for*

the Callaway Energy Center, and on the parameters and assumptions contained in Attachment 4 and summarized as follows:

- The after-tax value of Missouri jurisdictional sub-account of the Callaway Energy Center – Plant Tax-Qualified Nuclear Decommissioning Trust Fund as of September 30, 2020, was $814,003,088.

- The after-tax value of Missouri jurisdictional sub-account of the ISFSI Decommissioning Trust Fund as of September 30, 2020, was $2,414,043.

- The proposed expense and contribution amount and allocation between Plant and ISFSI is to be effective beginning with calendar year 2021.

- The Plant decommissioning cost estimate is $1,036,260,000 and the ISFSI decommissioning cost estimate is $10,575,000, both in terms of 2020 dollars.

- Operating license expiration date of October 18, 2044.

- The Missouri jurisdictional allocator is 100%.

- The federal income tax rate is 20%.

- The state income tax rate is 0%.

- The composite federal & state income tax rate is 20%.

- An asset allocation of 65% equities and 35% bonds is assumed to exist through 2043, at which time all equity investments will be divested.

- Investment management and trust fees are estimated at 15 basis points annually.

- An inflation rate of 2.150% is assumed for general (CPI) inflation.

- The pre-tax & expense nominal return on bonds is assumed to be 3.200%.
  - The pre-tax & expense real return on bonds is assumed to be 1.050%.

- The pre-tax & expense nominal return on equities is assumed to be 8.500%.
  - The pre-tax & expense real return on equities is assumed to be 6.350%

- The pre-tax & expense nominal weighted-average return is assumed to be 6.645% through the 2043 date of divestiture of equity investments.
  - The pre-tax & expense real weighted-average return is assumed to be 4.495% through the 2043 date of divestiture of equity investments.
  - The pre-tax & expense real weighted-average return is assumed to be 1.050% following the 2043 date of divestiture of equity investments.
  - The annualized pre-tax and expense nominal return over the life of the fund will be 6.082%

- Decommissioning cost escalation is assumed to be 4.1916%.

WHEREFORE, Ameren Missouri requests that the Commission: (1) approve Attachments 3 and 4, which are Ameren Missouri's estimate of decommissioning costs and the funding level necessary for said costs; (2) specifically find that the annual funding level contributed to the decommissioning trust fund is included in Ameren Missouri's current cost of service for rate-making purposes, and is based on the parameters and assumptions contained in Attachment 4 and summarized above; and 3) make the specific findings outlined above, which are necessary to fully comply with NRC and IRS requirements and regulations.

Respectfully submitted,

/s/ Paula N. Johnson

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and copy of the foregoing was served via e-mail on counsel for all parties of record this 5th day of November, 2020.

/s/ Paula N. Johnson
Paula N. Johnson

Callaway Energy Center Tax-Qualified Nuclear Decommissioning Trust Fund Projection

Decom Inflation	4.1916%			
Total Contribution	$ 6,758,605			
Plant Contribution		$ 6,242,226		
ISFSI Contribution		$ 516,379		
Difference			$	-

Ending Balance

Plant	$	(0.00)
ISFSI	$	0.00
Total	$	(0.00)

Ending balance < $0.001?
"0" = Yes; "1" = No 0

Ameren Missouri
Callaway Energy Center Tax-Qualified Nuclear Decommissioning Trust Fund Projection

Decommissioning Expense Calculation

Decommissioning Cost Estimate

	Plant Decommissioning	ISFSI Decommissioning	Combined Plant & ISFSI Decommissioning
License Termination Decommissioning Expenditures	$ 855,393,000	$ 9,152,000	$ 864,545,000
Spent Fuel Management Decommissioning Expenditures	69,200,000	-	69,200,000
Site Restoration Decommissioning Expenditures	111,667,000	1,423,000	113,090,000
Total Decommissioning Cost Estimate:	$ 1,036,260,000	$ 10,575,000	$ 1,046,835,000
Estimate in Terms of Year xxxx Dollars	2020	2020	
Estimate Based On:	2020 TLG Study	2020 TLG Study	2020 TLG Study
Decommissioning Inflation:	4.1916%	4.1916%	4.1916%

	DECOMMISSIONING EXPENSE CALCULATION PLANT DECOMMISSIONING				DECOMMISSIONING EXPENSE CALCULATION ISFSI DECOMMISSIONING				DECOMMISSIONING EXPENSE CALCULATION COMBINED
Year	2020$ Decommissioning Expenses	# of Years of Inflation	Inflation Factor At 4.192% Decommissioning Inflation Rate	(Inflated $$) Decommissioning Expenses	2020$ Decommissioning Expenses	# of Years of Inflation	Inflation Factor At 4.192% Decommissioning Inflation Rate	(Inflated $$) Decommissioning Expenses	(Inflated $$) Decommissioning Expenses
TOTALS:	$ 1,036,260,000			$ 3,249,339,382	$ 10,576,000			$ 36,658,552	$ 3,285,997,934
2020	$ -	0	1.0000	$ -	$ -	0	1.0000	$ -	$ -
2021	$ -	1	1.0419	$ -	$ -	1	1.0419	$ -	$ -
2022	$ -	2	1.0856	$ -	$ -	2	1.0856	$ -	$ -
2023	$ -	3	1.1311	$ -	$ -	3	1.1311	$ -	$ -
2024	$ -	4	1.1785	$ -	$ -	4	1.1785	$ -	$ -
2025	$ -	5	1.2279	$ -	$ -	5	1.2279	$ -	$ -
2026	$ -	6	1.2794	$ -	$ -	6	1.2794	$ -	$ -
2027	$ -	7	1.3330	$ -	$ -	7	1.3330	$ -	$ -
2028	$ -	8	1.3889	$ -	$ -	8	1.3889	$ -	$ -
2029	$ -	9	1.4471	$ -	$ -	9	1.4471	$ -	$ -
2030	$ -	10	1.5077	$ -	$ -	10	1.5077	$ -	$ -
2031	$ -	11	1.5709	$ -	$ -	11	1.5709	$ -	$ -
2032	$ -	12	1.6368	$ -	$ -	12	1.6368	$ -	$ -
2033	$ -	13	1.7054	$ -	$ -	13	1.7054	$ -	$ -
2034	$ -	14	1.7769	$ -	$ -	14	1.7769	$ -	$ -
2035	$ -	15	1.8514	$ -	$ -	15	1.8514	$ -	$ -
2036	$ -	16	1.9290	$ -	$ -	16	1.9290	$ -	$ -
2037	$ -	17	2.0098	$ -	$ -	17	2.0098	$ -	$ -
2038	$ -	18	2.0940	$ -	$ -	18	2.0940	$ -	$ -
2039	$ -	19	2.1818	$ -	$ -	19	2.1818	$ -	$ -
2040	$ -	20	2.2733	$ -	$ -	20	2.2733	$ -	$ -
2041	$ -	21	2.3686	$ -	$ -	21	2.3686	$ -	$ -
2042	$ -	22	2.4678	$ -	$ -	22	2.4678	$ -	$ -
2043	$ -	23	2.5713	$ -	$ -	23	2.5713	$ -	$ -
2044	$ 21,904,000	24	2.6791	$ 58,682,092	$ -	24	2.6791	$ -	$ 58,682,092
2045	$ 121,383,000	25	2.7914	$ 338,822,788	$ -	25	2.7914	$ -	$ 338,822,788
2046	$ 196,730,000	26	2.9084	$ 572,160,571	$ -	26	2.9084	$ -	$ 572,160,571
2047	$ 204,473,000	27	3.0303	$ 619,606,397	$ -	27	3.0303	$ -	$ 619,606,397
2048	$ 141,058,000	28	3.1573	$ 445,359,002	$ -	28	3.1573	$ -	$ 445,359,002
2049	$ 134,139,000	29	3.2896	$ 441,265,697	$ -	29	3.2896	$ -	$ 441,265,697
2050	$ 90,908,000	30	3.4275	$ 311,587,335	$ 9,152,000	30	3.4275	$ 31,368,497	$ 342,955,831
2051	$ 51,897,000	31	3.5712	$ 185,332,906	$ 270,000	31	3.5712	$ 964,215	$ 186,297,122
2052	$ 60,672,000	32	3.7209	$ 225,751,780	$ 949,000	32	3.7209	$ 3,531,092	$ 229,282,873
2053	$ 13,096,000	33	3.8768	$ 50,770,814	$ 205,000	33	3.8768	$ 794,748	$ 51,565,562
2054	$ -	34	4.0393	$ -	$ -	34	4.0393	$ -	$ -
2055	$ -	35	4.2086	$ -	$ -	35	4.2086	$ -	$ -
2056	$ -	36	4.3850	$ -	$ -	36	4.3850	$ -	$ -
2057	$ -	37	4.5688	$ -	$ -	37	4.5688	$ -	$ -
2058	$ -	38	4.7603	$ -	$ -	38	4.7603	$ -	$ -
2059	$ -	39	4.9599	$ -	$ -	39	4.9599	$ -	$ -

Ameren Missouri
Callaway Energy Center Tax-Qualified Nuclear Decommissioning Trust Fund Projection

Plant Decommissioning Fund Projection

September 30, 2020	Fund Balance:	$ 814,003,088	Equity Allocation:	65.00%	Federal Income Tax Rate:	20.00%
December 31, 2053	EOY Fund Balance:	$ (0)	Bond Allocation:	35.00%	Missouri State Income Tax Rate:	0.00%
			Switch Out of Equities at End-Of-Year:	2043	Percentage of Federal Taxes Deductible on MO Taxes:	50.00%
					Composite Federal & State Income Tax Rate:	20.0000%
Current contribution:		$ 6,323,396				
Revised contribution:		$ 6,242,226	Nominal Pre-Tax & Expense Returns			
			Bonds:	3.200%	Management & Trust Fees: (BP)	15.00
CPI Inflation:		2.150%	Equities:	8.500%		
Decommissioning Inflation:		4.1916%	Weighted Average - Bonds & Equities:	6.645%		
Effective Date of Revised Annual Contribution			Real Pre-Tax & Expense Returns			
	Year:	2021	Bonds:	1.050%		
	Quarter:	1	Equities:	6.350%		
			Weighted Average - Bonds & Equities:	4.495%		

Fund Projections

Year Ending December 31, 20xx	Beginning-of-Year Balance	Annual Cash Inflow From Contributions To Fund	Pre Tax & Fee Income	Investment Management & Trust Fees	Federal & State Income Taxes	After Tax & Fee Income	Decommissioning Expenses (Inflated $$)	End-Of-Year Balance
TOTAL		**$ 151,722,401**	**$ 2,933,272,284**	**$ 78,754,919**	**$ 570,903,473**	**$ 2,283,613,892**	**$ 3,249,339,382**	
September 30, 2020								$ 814,003,088
2020	814,003,088	1,580,849	13,535,757	308,086	2,645,534	10,582,137	-	826,166,074
2021	826,166,074	6,262,519	55,106,808	1,285,276	10,764,306	43,057,225	-	875,485,818
2022	875,485,818	6,242,226	58,383,431	1,361,698	11,404,347	45,617,386	-	927,345,430
2023	927,345,430	6,242,226	61,829,502	1,442,072	12,077,486	48,309,944	-	981,897,600
2024	981,897,600	6,242,226	65,454,493	1,526,619	12,785,575	51,142,300	-	1,039,282,126
2025	1,039,282,126	6,242,226	69,267,695	1,615,556	13,530,428	54,121,712	-	1,099,646,063
2026	1,099,646,063	6,242,226	73,278,879	1,709,110	14,313,954	57,255,815	-	1,163,144,105
2027	1,163,144,105	6,242,226	77,498,324	1,807,522	15,138,160	60,552,642	-	1,229,938,972
2028	1,229,938,972	6,242,226	81,936,843	1,911,043	16,005,160	64,020,640	-	1,300,201,838
2029	1,300,201,838	6,242,226	86,605,810	2,019,939	16,917,174	67,668,697	-	1,374,112,761
2030	1,374,112,761	6,242,226	91,517,191	2,134,489	17,876,540	71,506,162	-	1,451,861,149
2031	1,451,861,149	6,242,226	96,683,571	2,254,986	18,885,717	75,542,868	-	1,533,646,243
2032	1,533,646,243	6,242,226	102,118,191	2,381,740	19,947,290	79,789,161	-	1,619,677,630
2033	1,619,677,630	6,242,226	107,834,976	2,515,074	21,063,980	84,255,922	-	1,710,175,778
2034	1,710,175,778	6,242,226	113,848,578	2,655,332	22,238,649	88,954,597	-	1,805,372,601
2035	1,805,372,601	6,242,226	120,174,407	2,802,871	23,474,307	93,897,229	-	1,905,512,056
2036	1,905,512,056	6,242,226	126,828,674	2,958,071	24,774,121	99,096,482	-	2,010,850,764
2037	2,010,850,764	6,242,226	133,828,431	3,121,329	26,141,420	104,565,682	-	2,121,658,672
2038	2,121,658,672	6,242,226	141,191,617	3,293,063	27,579,711	110,318,843	-	2,238,219,741
2039	2,238,219,741	6,242,226	148,937,100	3,473,714	29,092,677	116,370,708	-	2,360,832,675
2040	2,360,832,675	6,242,226	157,084,729	3,663,744	30,684,197	122,736,788	-	2,489,811,689
2041	2,489,811,689	6,242,226	165,655,385	3,863,641	32,358,349	129,433,395	-	2,625,487,310
2042	2,625,487,310	6,242,226	174,671,030	4,073,916	34,119,423	136,477,691	-	2,768,207,227
2043	2,768,207,227	6,242,226	184,154,768	4,295,109	35,971,932	143,887,728	-	2,918,337,181
2044	2,918,337,181	6,550,062	92,552,677	4,407,821	17,628,971	70,515,885	58,682,092	2,936,721,036
2045	2,936,721,036	-	88,553,909	4,217,380	16,867,306	67,469,223	338,822,788	2,665,367,471
2046	2,665,367,471	-	76,137,190	3,626,034	14,502,231	58,008,925	572,160,571	2,151,215,826
2047	2,151,215,826	-	58,925,204	2,806,313	11,223,778	44,895,113	619,606,397	1,576,504,542
2048	1,576,504,542	-	43,322,401	2,063,229	8,251,834	33,007,338	445,359,002	1,164,152,877
2049	1,164,152,877	-	30,192,641	1,437,925	5,750,943	23,003,773	441,265,697	745,890,953
2050	745,890,953	-	18,883,113	899,308	3,596,761	14,387,044	311,587,335	448,690,662
2051	448,690,662	-	11,392,775	542,581	2,170,039	8,680,155	185,332,906	272,037,911
2052	272,037,911	-	5,093,185	242,563	970,124	3,880,497	225,751,780	50,166,628
2053	50,166,628	-	792,999	37,767	151,046	604,186	50,770,814	(0)
2054	(0)	-	(0)	(0)	(0)	(0)	-	(0)
2055	(0)	-	(0)	(0)	(0)	(0)	-	(0)
2056	(0)	-	(0)	(0)	(0)	(0)	-	(0)
2057	(0)	-	(0)	(0)	(0)	(0)	-	(0)
2058	(0)	-	(0)	(0)	(0)	(0)	-	(0)

Ameren Missouri
Callaway Energy Center Tax-Qualified Nuclear Decommissioning Trust Fund Projection

ISFSI Decommissioning Fund Projection

September 30, 2020	Fund Balance:	$ 2,414,043
December 31, 2051	EOY Fund Balance:	$ 0.00
Current contribution:		$ 435,209
Revised contribution:		$ 516,379
CPI Inflation:		2.150%
Decommissioning Inflation:		4.1916%
Effective Date of Revised Annual Contribution		
Year:		2021
Quarter:		1

Equity Allocation:	65.00%
Bond Allocation:	35.00%
Switch Out of Equities at End-Of-Year:	2043
Nominal Pre-Tax & Expense Returns	
Bonds:	3.200%
Equities:	8.500%
Weighted Average - Bonds & Equities:	6.645%
Real Pre-Tax & Expense Returns	
Bonds:	1.050%
Equities:	6.350%
Bonds & Equities	4.495%

Federal Income Tax Rate:	20.00%
Missouri State Income Tax Rate:	0.00%
Percentage of Federal Taxes Deductible on MO Taxes:	50.00%
Composite Federal & State Income Tax Rate:	20.0000%
Management & Trust Fees: (BP)	15.00

Fund Projections

Year Ending December 31, 20xx	Beginning-of-Year Balance	Annual Cash Inflow From Contributions To Fund	Pre Tax & Fee Income	Investment Management & Trust Fees	Federal & State Income Taxes	After Tax & Fee Income	Decommissioning Expenses (Inflated $$)	End-Of-Year Balance
TOTAL		**$ 12,507,081**	**$ 28,000,685**	**$ 828,900**	**$ 5,434,357**	**$ 21,737,428**	**$ 36,658,552**	
September 30, 2020								$ 2,414,043
2020	2,414,043	108,802	41,007	933	8,015	32,059	-	2,554,904
2021	2,554,904	496,087	186,256	4,344	36,382	145,529	-	3,196,521
2022	3,196,521	516,379	229,565	5,354	44,842	179,369	-	3,892,269
2023	3,892,269	516,379	275,798	6,433	53,873	215,492	-	4,624,141
2024	4,624,141	516,379	324,431	7,567	63,373	253,491	-	5,394,011
2025	5,394,011	516,379	375,589	8,760	73,366	293,463	-	6,203,854
2026	6,203,854	516,379	429,403	10,015	83,878	335,510	-	7,055,743
2027	7,055,743	516,379	486,011	11,335	94,935	379,740	-	7,951,863
2028	7,951,863	516,379	545,558	12,724	106,567	426,267	-	8,894,509
2029	8,894,509	516,379	608,197	14,185	118,802	475,209	-	9,886,098
2030	9,886,098	516,379	674,088	15,722	131,673	526,693	-	10,929,170
2031	10,929,170	516,379	743,400	17,339	145,212	580,849	-	12,026,399
2032	12,026,399	516,379	816,311	19,039	159,454	637,817	-	13,180,596
2033	13,180,596	516,379	893,007	20,828	174,436	697,743	-	14,394,719
2034	14,394,719	516,379	973,686	22,710	190,195	760,781	-	15,671,879
2035	15,671,879	516,379	1,058,553	24,689	206,773	827,091	-	17,015,350
2036	17,015,350	516,379	1,147,827	26,771	224,211	896,844	-	18,428,573
2037	18,428,573	516,379	1,241,735	28,961	242,555	970,219	-	19,915,172
2038	19,915,172	516,379	1,340,520	31,265	261,851	1,047,404	-	21,478,955
2039	21,478,955	516,379	1,444,433	33,689	282,149	1,128,595	-	23,123,930
2040	23,123,930	516,379	1,553,742	36,238	303,501	1,214,003	-	24,854,312
2041	24,854,312	516,379	1,668,726	38,920	325,961	1,303,844	-	26,674,536
2042	26,674,536	516,379	1,789,680	41,741	349,588	1,398,351	-	28,589,266
2043	28,589,266	516,379	1,916,913	44,709	374,441	1,497,764	-	30,603,409
2044	30,603,409	541,845	987,979	47,052	188,185	752,741	-	31,897,994
2045	31,897,994	-	1,020,736	48,613	194,425	777,699	-	32,675,693
2046	32,675,693	-	1,045,622	49,798	199,165	796,660	-	33,472,352
2047	33,472,352	-	1,071,115	51,012	204,021	816,083	-	34,288,435
2048	34,288,435	-	1,097,230	52,256	208,995	835,979	-	35,124,415
2049	35,124,415	-	1,123,981	53,530	214,090	856,361	-	35,980,776
2050	35,980,776	-	649,489	30,932	123,711	494,846	31,368,497	5,107,125
2051	5,107,125	-	148,001	7,049	28,190	112,762	964,215	4,255,671
2052	4,255,671	-	79,684	3,795	15,178	60,711	3,531,092	785,290
2053	785,290	-	12,413	591	2,364	9,458	794,748	0
2054	0	-	0	0	0	0	-	0
2055	0	-	0	0	0	0	-	0
2056	0	-	0	0	0	0	-	0
2057	0	-	0	0	0	0	-	0
2058	0	-	0	0	0	0	-	0

Ameren Missouri
Callaway Energy Center Tax-Qualified Nuclear Decommissioning Trust Fund Projection

Consolidated Plant & ISFSI Decommissioning Fund Projection

		Equity Allocation:	65.00%	Federal Income Tax Rate:	20.00%
		Bond Allocation:	35.00%	Missouri State Income Tax Rate:	0.00%
		Switch Out of Equities at End-Of-Year:	2043	Percentage of Federal Taxes Deductible on MO Taxes:	50.00%
Current Total Contribution:	$ 6,758,605			Composite Federal & State Income Tax Rate:	20.0000%
Revised Total Contribution:	$ 6,758,605	Nominal Pre-Tax & Expense Returns			
		Bonds:	3.200%	Management & Trust Fees: (BP)	15.00
CPI Inflation:	2.150%	Equities:	8.500%		
Decommissioning Inflation:	4.1916%	Weighted Average - Bonds & Equities:	6.645%		
Effective Date of Revised Annual Contribution		Real Pre-Tax & Expense Returns			
Year:	2021	Bonds:	1.050%		
Quarter:	1	Equities:	6.350%		
		Bonds & Equities	4.495%		

Fund Projections

Year Ending December 31, 20xx	Beginning-of-Year Balance	Annual Cash Inflow From Contributions To Fund	Pre Tax & Fee Income	Investment Management & Trust Fees	Federal & State Income Taxes	After Tax & Fee Income	Decommissioning Expenses (Inflated $$)	End-Of-Year Balance
TOTAL		**$ 164,229,482**	**$ 2,961,272,969**	**$ 79,583,818**	**$ 576,337,830**	**$ 2,305,351,321**	**$ 3,285,997,934**	
September 30, 2020								$ 816,417,131
2020	816,417,131	$ 1,689,651	$ 13,576,764	$ 309,019	$ 2,653,549	$ 10,614,196	$ -	828,720,979
2021	828,720,979	$ 6,758,605	$ 55,293,064	$ 1,289,620	$ 10,800,689	$ 43,202,755	$ -	878,682,339
2022	878,682,339	$ 6,758,605	$ 58,612,996	$ 1,367,052	$ 11,449,189	$ 45,796,755	$ -	931,237,699
2023	931,237,699	$ 6,758,605	$ 62,105,300	$ 1,448,504	$ 12,131,359	$ 48,525,436	$ -	986,521,741
2024	986,521,741	$ 6,758,605	$ 65,778,924	$ 1,534,186	$ 12,848,948	$ 51,395,791	$ -	1,044,676,137
2025	1,044,676,137	$ 6,758,605	$ 69,643,284	$ 1,624,316	$ 13,603,794	$ 54,415,175	$ -	1,105,849,917
2026	1,105,849,917	$ 6,758,605	$ 73,708,282	$ 1,719,125	$ 14,397,831	$ 57,591,325	$ -	1,170,199,848
2027	1,170,199,848	$ 6,758,605	$ 77,984,335	$ 1,818,857	$ 15,233,096	$ 60,932,382	$ -	1,237,890,835
2028	1,237,890,835	$ 6,758,605	$ 82,482,401	$ 1,923,767	$ 16,111,727	$ 64,446,907	$ -	1,309,096,348
2029	1,309,096,348	$ 6,758,605	$ 87,214,007	$ 2,034,124	$ 17,035,977	$ 68,143,906	$ -	1,383,998,860
2030	1,383,998,860	$ 6,758,605	$ 92,191,279	$ 2,150,211	$ 18,008,214	$ 72,032,855	$ -	1,462,790,320
2031	1,462,790,320	$ 6,758,605	$ 97,426,971	$ 2,272,325	$ 19,030,929	$ 76,123,717	$ -	1,545,672,642
2032	1,545,672,642	$ 6,758,605	$ 102,934,502	$ 2,400,779	$ 20,106,745	$ 80,426,978	$ -	1,632,858,226
2033	1,632,858,226	$ 6,758,605	$ 108,727,984	$ 2,535,902	$ 21,238,416	$ 84,953,665	$ -	1,724,570,497
2034	1,724,570,497	$ 6,758,605	$ 114,822,264	$ 2,678,041	$ 22,428,845	$ 89,715,378	$ -	1,821,044,480
2035	1,821,044,480	$ 6,758,605	$ 121,232,960	$ 2,827,560	$ 23,681,080	$ 94,724,320	$ -	1,922,527,406
2036	1,922,527,406	$ 6,758,605	$ 127,976,501	$ 2,984,842	$ 24,998,332	$ 99,993,327	$ -	2,029,279,338
2037	2,029,279,338	$ 6,758,605	$ 135,070,167	$ 3,150,291	$ 26,383,975	$ 105,535,901	$ -	2,141,573,844
2038	2,141,573,844	$ 6,758,605	$ 142,532,137	$ 3,324,329	$ 27,841,562	$ 111,366,246	$ -	2,259,698,696
2039	2,259,698,696	$ 6,758,605	$ 150,381,533	$ 3,507,403	$ 29,374,826	$ 117,499,304	$ -	2,383,956,605
2040	2,383,956,605	$ 6,758,605	$ 158,638,471	$ 3,699,983	$ 30,987,698	$ 123,950,791	$ -	2,514,666,001
2041	2,514,666,001	$ 6,758,605	$ 167,324,110	$ 3,902,561	$ 32,684,310	$ 130,737,240	$ -	2,652,161,846
2042	2,652,161,846	$ 6,758,605	$ 176,460,709	$ 4,115,657	$ 34,469,010	$ 137,876,042	$ -	2,796,796,493
2043	2,796,796,493	$ 6,758,605	$ 186,071,682	$ 4,339,817	$ 36,346,373	$ 145,385,491	$ -	2,948,940,590
2044	2,948,940,590	$ 7,091,906	$ 93,540,656	$ 4,454,874	$ 17,817,156	$ 71,268,626	$ 58,682,092	2,968,619,030
2045	2,968,619,030	$ -	$ 89,574,644	$ 4,265,992	$ 17,061,730	$ 68,246,922	$ 338,822,788	2,698,043,164
2046	2,698,043,164	$ -	$ 77,182,812	$ 3,675,831	$ 14,701,396	$ 58,805,585	$ 572,160,571	2,184,688,178
2047	2,184,688,178	$ -	$ 59,996,319	$ 2,857,325	$ 11,427,799	$ 45,711,196	$ 619,606,397	1,610,792,977
2048	1,610,792,977	$ -	$ 44,419,631	$ 2,115,485	$ 8,460,829	$ 33,843,317	$ 445,359,002	1,199,277,292
2049	1,199,277,292	$ -	$ 31,316,622	$ 1,491,454	$ 5,965,034	$ 23,860,134	$ 441,265,697	781,871,729
2050	781,871,729	$ -	$ 19,532,602	$ 930,240	$ 3,720,472	$ 14,881,889	$ 342,955,831	453,797,787
2051	453,797,787	$ -	$ 11,540,775	$ 549,629	$ 2,198,229	$ 8,792,917	$ 186,297,122	276,293,582
2052	276,293,582	$ -	$ 5,172,869	$ 246,358	$ 985,302	$ 3,941,209	$ 229,282,873	50,951,918
2053	50,951,918	$ -	$ 805,412	$ 38,358	$ 153,411	$ 613,644	$ 51,565,562	(0)
2054	(0)	$ -	$ (0)	$ (0)	$ (0)	$ (0)	$ -	(0)
2055	(0)	$ -	$ (0)	$ (0)	$ (0)	$ (0)	$ -	(0)
2056	(0)	$ -	$ (0)	$ (0)	$ (0)	$ (0)	$ -	(0)
2057	(0)	$ -	$ (0)	$ (0)	$ (0)	$ (0)	$ -	(0)
2058	(0)	$ -	$ (0)	$ (0)	$ (0)	$ (0)	$ -	(0)

Ameren Missouri
Callaway Energy Center Tax-Qualified Nuclear Decommissioning Trust Fund Projection

Overall Annualized Return Derivation - Plant

Amount Remaining in Fund at Completion of Decommissioning:	**$**	**0**
Required Annual Earnings Over Life of Fund:		**6.087%**

(1) Year Ending	(2) Beginning-of-Year Balance	(3) Contributions To Fund	(4) Pre Tax & Fee Income	(5) Management And Trust Fees	(6) Federal & State Income Taxes	(7) After Tax & Fee Income	(8) Decommissioning Expenses (Inflated $$)	(9) End-of-Year Balance
September 30, 2020	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$ 814,003,088
2020	814,003,088	1,580,849	12,398,207	307,872	2,418,067	9,672,268	-	825,256,205
2021	825,256,205	6,262,519	50,420,233	1,280,396	9,827,967	39,311,869	-	870,830,593
2022	870,830,593	6,242,226	53,193,524	1,350,823	10,368,540	41,474,161	-	918,546,979
2023	918,546,979	6,242,226	56,097,806	1,424,575	10,934,646	43,738,585	-	968,527,790
2024	968,527,790	6,242,226	59,139,914	1,501,828	11,527,617	46,110,469	-	1,020,880,485
2025	1,020,880,485	6,242,226	62,326,388	1,582,747	12,148,728	48,594,913	-	1,075,717,624
2026	1,075,717,624	6,242,226	65,664,079	1,667,506	12,799,315	51,197,258	-	1,133,157,108
2027	1,133,157,108	6,242,226	69,160,163	1,756,287	13,480,775	53,923,101	-	1,193,322,435
2028	1,193,322,435	6,242,226	72,822,157	1,849,282	14,194,575	56,778,300	-	1,256,342,961
2029	1,256,342,961	6,242,226	76,657,934	1,946,690	14,942,249	59,768,995	-	1,322,354,182
2030	1,322,354,182	6,242,226	80,675,741	2,048,720	15,725,404	62,901,617	-	1,391,498,025
2031	1,391,498,025	6,242,226	84,884,217	2,155,592	16,545,725	66,182,900	-	1,463,923,151
2032	1,463,923,151	6,242,226	89,292,410	2,267,536	17,404,975	69,619,899	-	1,539,785,277
2033	1,539,785,277	6,242,226	93,909,797	2,384,792	18,305,001	73,220,004	-	1,619,247,507
2034	1,619,247,507	6,242,226	98,746,307	2,507,613	19,247,739	76,990,956	-	1,702,480,689
2035	1,702,480,689	6,242,226	103,812,338	2,636,262	20,235,215	80,940,861	-	1,789,663,776
2036	1,789,663,776	6,242,226	109,118,782	2,771,016	21,269,553	85,078,212	-	1,880,984,214
2037	1,880,984,214	6,242,226	114,677,048	2,912,166	22,352,976	89,411,906	-	1,976,638,345
2038	1,976,638,345	6,242,226	120,499,086	3,060,014	23,487,814	93,951,258	-	2,076,831,829
2039	2,076,831,829	6,242,226	126,597,414	3,214,877	24,676,507	98,706,029	-	2,181,780,085
2040	2,181,780,085	6,242,226	132,985,144	3,377,091	25,921,611	103,686,443	-	2,291,708,754
2041	2,291,708,754	6,242,226	139,676,010	3,547,002	27,225,802	108,903,206	-	2,406,854,186
2042	2,406,854,186	6,242,226	146,684,396	3,724,976	28,591,884	114,367,536	-	2,527,463,948
2043	2,527,463,948	6,242,226	154,025,372	3,911,397	30,022,795	120,091,180	-	2,653,797,354
2044	2,653,797,354	6,550,062	159,938,231	4,061,551	31,175,336	124,701,344	58,682,092	2,726,366,668
2045	2,726,366,668	-	155,630,409	3,952,156	30,335,651	121,342,602	338,822,788	2,508,886,483
2046	2,508,886,483	-	135,292,252	3,435,678	26,371,315	105,485,259	572,160,571	2,042,211,171
2047	2,042,211,171	-	105,443,910	2,677,695	20,553,243	82,212,972	619,606,397	1,504,817,746
2048	1,504,817,746	-	78,038,009	1,981,736	15,211,255	60,845,019	445,359,002	1,120,303,762
2049	1,120,303,762	-	54,758,937	1,390,576	10,673,672	42,694,689	441,265,697	721,732,754
2050	721,732,754	-	34,446,176	874,743	6,714,287	26,857,146	311,587,335	437,002,566
2051	437,002,566	-	20,958,196	532,223	4,085,195	16,340,779	185,332,906	268,010,438
2052	268,010,438	-	9,442,345	239,784	1,840,512	7,362,049	225,751,780	49,620,706
2053	49,620,706	-	1,475,094	37,459	287,527	1,150,108	50,770,814	0
2054	0	-	0	0	0	0	-	0
2055	0	-	0	0	0	0	-	0
2056	0	-	0	0	0	0	-	0
2057	0	-	0	0	0	0	-	0
2058	0	-	0	0	0	0	-	0
TOTALS:		$ 151,722,401	$ 2,928,888,025	$ 74,370,660	$ 570,903,473	$ 2,283,613,892	$ 3,249,339,382	

Ameren Missouri
Callaway Energy Center Tax-Qualified Nuclear Decommissioning Trust Fund Projection

Overall Annualized Return Derivation - ISFSI

Amount Remaining in Fund at Completion of Decommissioning:	**$**	**(0)**
Required Annual Earnings Over Life of Fund:		**5.602%**

(1) Year Ending	(2) Beginning-of-Year Balance	(3) Contributions To Fund	(4) Pre Tax & Fee Income	(5) Management And Trust Fees	(6) Federal & State Income Taxes	(7) After Tax & Fee Income	(8) Decommissioning Expenses (Inflated $$)	(9) End-of-Year Balance
September 30, 2020	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$ 2,414,043
2020	2,414,043	108,802	34,568	932	6,727	26,909	-	2,549,754
2021	2,549,754	496,087	156,722	4,314	30,481	121,926	-	3,167,767
2022	3,167,767	516,379	191,909	5,283	37,325	149,301	-	3,833,447
2023	3,833,447	516,379	229,197	6,309	44,578	178,310	-	4,528,137
2024	4,528,137	516,379	268,111	7,381	52,146	208,584	-	5,253,100
2025	5,253,100	516,379	308,721	8,498	60,044	240,178	-	6,009,658
2026	6,009,658	516,379	351,100	9,665	68,287	273,148	-	6,799,185
2027	6,799,185	516,379	395,326	10,883	76,889	307,555	-	7,623,119
2028	7,623,119	516,379	441,480	12,153	85,865	343,461	-	8,482,960
2029	8,482,960	516,379	489,645	13,479	95,233	380,933	-	9,380,272
2030	9,380,272	516,379	539,909	14,863	105,009	420,037	-	10,316,689
2031	10,316,689	516,379	592,363	16,307	115,211	460,845	-	11,293,913
2032	11,293,913	516,379	647,103	17,813	125,858	503,432	-	12,313,724
2033	12,313,724	516,379	704,229	19,386	136,969	547,874	-	13,377,978
2034	13,377,978	516,379	763,844	21,027	148,563	594,254	-	14,488,611
2035	14,488,611	516,379	826,058	22,740	160,664	642,654	-	15,647,645
2036	15,647,645	516,379	890,982	24,527	173,291	693,164	-	16,857,188
2037	16,857,188	516,379	958,736	26,392	186,469	745,875	-	18,119,443
2038	18,119,443	516,379	1,029,442	28,339	200,221	800,883	-	19,436,705
2039	19,436,705	516,379	1,103,230	30,370	214,572	858,288	-	20,811,373
2040	20,811,373	516,379	1,180,234	32,490	229,549	918,195	-	22,245,948
2041	22,245,948	516,379	1,260,593	34,702	245,178	980,713	-	23,743,041
2042	23,743,041	516,379	1,344,454	37,010	261,489	1,045,955	-	25,305,375
2043	25,305,375	516,379	1,431,970	39,419	278,510	1,114,041	-	26,935,795
2044	26,935,795	541,845	1,524,013	41,953	296,412	1,185,648	-	28,663,288
2045	28,663,288	-	1,605,604	44,199	312,281	1,249,124	-	29,912,412
2046	29,912,412	-	1,675,575	46,125	325,890	1,303,560	-	31,215,972
2047	31,215,972	-	1,748,596	48,135	340,092	1,360,368	-	32,576,340
2048	32,576,340	-	1,824,798	50,233	354,913	1,419,652	-	33,995,992
2049	33,995,992	-	1,904,321	52,422	370,380	1,481,519	-	35,477,511
2050	35,477,511	-	1,108,741	30,521	215,644	862,575	31,368,497	4,971,590
2051	4,971,590	-	251,483	6,923	48,912	195,648	964,215	4,203,023
2052	4,203,023	-	136,538	3,759	26,556	106,223	3,531,092	778,154
2053	778,154	-	21,330	587	4,149	16,594	794,748	(0)
2054	(0)	-	(0)	(0)	(0)	(0)	-	(0)
2055	(0)	-	(0)	(0)	(0)	(0)	-	(0)
2056	(0)	-	(0)	(0)	(0)	(0)	-	(0)
2057	(0)	-	(0)	(0)	(0)	(0)	-	(0)
2058	(0)	-	(0)	(0)	(0)	(0)	-	(0)
TOTALS:		$ 12,507,081	$ 27,940,925	$ 769,139	$ 5,434,357	$ 21,737,428	$ 36,658,552	

Ameren Missouri

Callaway Energy Center Tax-Qualified Nuclear Decommissioning Trust Fund Projection

Overall Annualized Return Derivation - Plant & ISFSI Consolidated

Amount Remaining in Fund at Completion of Decommissioning:	**$**	**0**
Required Annual Earnings Over Life of Fund:		**6.082%**

(1) Year Ending	(2) Beginning-of-Year Balance	(3) Contributions To Fund	(4) Pre Tax & Fee Income	(5) Management And Trust Fees	(6) Federal & State Income Taxes	(7) After Tax & Fee Income	(8) Decommissioning Expenses (Inflated $$)	(9) End-of-Year Balance
September 30, 2020	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$ 816,417,131
2020	816,417,131	1,689,651	12,427,035	308,803	2,423,646	9,694,585	-	827,801,367
2021	827,801,367	6,758,605	50,554,713	1,284,687	9,854,005	39,416,021	-	873,975,994
2022	873,975,994	6,758,605	53,363,182	1,356,055	10,401,425	41,605,701	-	922,340,300
2023	922,340,300	6,758,605	56,304,833	1,430,808	10,974,805	43,899,220	-	972,998,126
2024	972,998,126	6,758,605	59,385,983	1,509,106	11,575,375	46,301,502	-	1,026,058,233
2025	1,026,058,233	6,758,605	62,613,245	1,591,116	12,204,426	48,817,703	-	1,081,634,541
2026	1,081,634,541	6,758,605	65,993,551	1,677,016	12,863,307	51,453,228	-	1,139,846,375
2027	1,139,846,375	6,758,605	69,534,156	1,766,989	13,553,433	54,213,733	-	1,200,818,713
2028	1,200,818,713	6,758,605	73,242,662	1,861,229	14,276,287	57,105,147	-	1,264,682,465
2029	1,264,682,465	6,758,605	77,127,033	1,959,938	15,033,419	60,133,676	-	1,331,574,747
2030	1,331,574,747	6,758,605	81,195,607	2,063,328	15,826,456	63,305,823	-	1,401,639,175
2031	1,401,639,175	6,758,605	85,457,120	2,171,621	16,657,100	66,628,399	-	1,475,026,180
2032	1,475,026,180	6,758,605	89,920,721	2,285,049	17,527,134	70,108,538	-	1,551,893,323
2033	1,551,893,323	6,758,605	94,595,994	2,403,856	18,438,428	73,753,710	-	1,632,405,639
2034	1,632,405,639	6,758,605	99,492,976	2,528,297	19,392,936	77,571,743	-	1,716,735,987
2035	1,716,735,987	6,758,605	104,622,182	2,658,640	20,392,708	81,570,834	-	1,805,065,426
2036	1,805,065,426	6,758,605	109,994,623	2,795,163	21,439,892	85,759,568	-	1,897,583,600
2037	1,897,583,600	6,758,605	115,621,835	2,938,161	22,536,735	90,146,939	-	1,994,489,144
2038	1,994,489,144	6,758,605	121,515,899	3,087,940	23,685,592	94,742,367	-	2,095,990,117
2039	2,095,990,117	6,758,605	127,689,469	3,244,821	24,888,930	99,555,719	-	2,202,304,441
2040	2,202,304,441	6,758,605	134,155,801	3,409,142	26,149,332	104,597,327	-	2,313,660,374
2041	2,313,660,374	6,758,605	140,928,778	3,581,256	27,469,504	109,878,017	-	2,430,296,996
2042	2,430,296,996	6,758,605	148,022,941	3,761,532	28,852,282	115,409,127	-	2,552,464,729
2043	2,552,464,729	6,758,605	155,453,521	3,950,356	30,300,633	121,202,532	-	2,680,425,866
2044	2,680,425,866	7,091,906	161,462,005	4,103,043	31,471,792	125,887,170	58,682,092	2,754,722,851
2045	2,754,722,851	-	157,245,812	3,995,902	30,649,982	122,599,928	338,822,788	2,538,499,991
2046	2,538,499,991	-	136,998,412	3,481,378	26,703,407	106,813,627	572,160,571	2,073,153,048
2047	2,073,153,048	-	107,251,827	2,725,464	20,905,273	83,621,091	619,606,397	1,537,167,742
2048	1,537,167,742	-	79,950,820	2,031,695	15,583,825	62,335,299	445,359,002	1,154,144,039
2049	1,154,144,039	-	56,778,739	1,442,851	11,067,178	44,268,711	441,265,697	757,147,052
2050	757,147,052	-	35,622,021	905,220	6,943,360	27,773,441	342,955,831	441,964,662
2051	441,964,662	-	21,215,962	539,136	4,135,365	16,541,461	186,297,122	272,209,001
2052	272,209,001	-	9,583,696	243,539	1,868,031	7,472,126	229,282,873	50,398,254
2053	50,398,254	-	1,497,181	38,046	291,827	1,167,308	51,565,562	0
2054	0	-	0	0	0	0	-	0
2055	0	-	0	0	0	0	-	0
2056	0	-	0	0	0	0	-	0
2057	0	-	0	0	0	0	-	0
2058	0	-	0	0	0	0	-	0
TOTALS:		$ 164,229,482	$ 2,956,820,333	$ 75,131,182	$ 576,337,830	$ 2,305,351,321	$ 3,285,997,934	

Enclosure 8 to
ULNRC-06798

Non-Unanimous Stipulation Agreement - February 9, 2021

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of Union Electric Company d/b/a Ameren Missouri for Acceptance of Its Triennial Filing of Cost Estimates for Callaway Energy Center Decommissioning, Including the Independent Spent Fuel Storage Installation, and Approval of the Funding Level of the Nuclear Decommissioning Trust Fund.	)))))))	**File No. EO-2021-0050**

STAFF RECOMMENDATION

The Staff of the Missouri Public Service Commission (Staff), through Staff Counsel's Office, and for its recommendation in this case respectfully requests the Commission to accept and adopt the Non-Unanimous Stipulation and Agreement with Union Electric Company d/b/a Ameren Missouri ("Ameren Missouri" or "Company"). In support of this request, Staff states the following:

1. Ameren Missouri filed an Application for Acceptance of Decommissioning Cost Estimates for Callaway Energy Center, Including Independent Spent Fuel Storage Installation, and Approval of Funding Level of Nuclear Decommissioning Trust Fund ("Application") pursuant to Section 393.292, RSMo (2016) and 20 CSR 4240-20.070(4) (2019), on November 5, 2020.

2. Staff has reviewed Ameren Missouri's Application, including the attached report and discovery responses. Based on this review, Staff recommends the Commission accept and adopt the Non-Unanimous Stipulation and Agreement, attached hereto and incorporated by reference.

WHEREFORE, Staff files this recommendation respectfully asking the Commission to accept and adopt the attached Non-Unanimous Stipulation and Agreement, and for such other and further relief the Commission deems just.

Respectfully submitted,

/s/ Curt Stokes
Curt Stokes
Deputy Chief Counsel
Mo. Bar No. 59836
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Curtis.Stokes@psc.mo.gov

Counsel for Staff of the Missouri Public Service Commission

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing was served by electronic mail, or First Class United States Postal Mail, postage prepaid, on this 9th day of February, 2021, to all parties and/or counsels of record.

/s/ Curt Stokes
Curt Stokes

BEFORE THE PUBLIC SERVICE COMMISSION OF THE STATE OF MISSOURI

In the Matter of the Application of Union Electric Company d/b/a Ameren Missouri for Acceptance of Its Triennial Filing of Cost Estimates for Callaway Energy Center Decommissioning, Including the Independent Spent Fuel Storage Installation, and Approval of the Funding Level of the Nuclear Decommissioning Trust Fund.	)	**File No. EO-2021-0050**

NON-UNANIMOUS STIPULATION AND AGREEMENT

COME NOW Union Electric Company d/b/a Ameren Missouri ("Ameren Missouri" or "Company") and the Staff of the Missouri Public Service Commission ("Staff") (collectively, the "Signatories") and submit this *Non-Unanimous Stipulation and Agreement* ("*Stipulation*") to the Missouri Public Service Commission ("Commission"). The Office of the Public Counsel has advised the Signatories that it will not oppose this Agreement.

I. INTRODUCTION[1] AND BACKGROUND

The Commission is authorized "to review and authorize changes to the rates and charges contained in the schedules of an electric corporation as a result of a change in the level or annual accrual of funding necessary for its nuclear power plant decommissioning trust fund only after a full hearing[2] and after considering all facts relevant to such funding level or accrual rate."[3] The Commission is authorized to adopt regulations governing the procedures for tariff changes under Section 393.292 and "to ensure that the amounts collected from ratepayers and paid into such trust

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[1] See Attachment A for the Callaway Energy Center Decommissioning Trust Fund History.

[2] The requirement for a hearing is met when the opportunity for hearing is provided and no proper party requests the opportunity to present evidence. *State ex rel. Rex Deffenderfer Enterprises, Inc. v. Pub. Serv. Comm'n*, 776 S.W.2d 494, 496 (Mo. App. W.D. 1989).

[3] § 393.292, RSMo (2016). This authority is an exception to the prohibition against single-issue ratemaking. *See, e.g.*, § 393.270.4, RSMo (2016); *State ex rel. Utility Consumers' Council of Mo., Inc. v. Pub. Serv. Comm'n*, 585 S.W.2d 41, 56 (Mo. banc 1979).

funds will be neither greater nor lesser than the amounts necessary to carry out the purposes of the trusts."[4]

Under the Commission's regulations, an electric utility shall establish a tax-qualified externally managed trust fund for the purpose of collecting funds to pay for decommissioning costs if it owns, in whole or in part, or operates nuclear generating units, the costs of which are reflected in the rates charged to Missouri ratepayers.[5] Every three years, electric utilities with decommissioning trust funds must perform a cost study detailing the utility's latest cost estimates for decommissioning its nuclear generating unit(s).[6] The study must also detail the funding levels necessary to defray these decommissioning costs.[7] The study must be filed with the Commission along with any appropriate tariff(s) to effectuate any rate change necessary to defray the decommissioning costs.[8]

Ameren Missouri established an external nuclear decommissioning trust fund as a result of its ownership in the Callaway Energy Center.[9] In Case EO-91-12, the Commission established Ameren Missouri's retail jurisdictional operations annual decommissioning accrual and trust fund

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[4] § 393.292, RSMo (2016).
[5] 20 CSR 4240-20.070(5) (2019). Under Federal law, The Nuclear Regulatory Commission (NRC) establishes minimum amounts necessary for licensees to provide reasonable assurance that funds will be available for the decommissioning process. 10 CFR 50.75 (2019). However, federal regulations also provide that "Funding for the decommissioning of power reactors may also be subject to the regulation of Federal or State Government agencies (e.g., Federal Energy Regulatory Commission (FERC) and State Public Utility Commissions) that have jurisdiction over rate regulations." 10 CFR 50.75(a) The NRC's federal regulations are "in addition to, and not substitution for, other requirements, and are not intended to be used by themselves or by other agencies to establish rates." *Id.*
[6] 20 CSR 4240-20.070(4) (2019).
[7] Id.
[8] Id.
[9] *In the Matter of Union Electric Co.*, Case Nos. EO-85-17; ER-85-160, 27 Mo.P.S.C. (N.S. 183, 249, 256-57 (1985).

payment at $2.9 million.[10] This annual amount has been adjusted several times, most recently in 2016, when where it was set at $6,758,605.[11]

II. THE 2020 COST STUDY AND PRIOR STIPULATIONS

Pursuant to 20 CSR 4240-20.070(4), on November 5, 2020, Ameren Missouri filed its Application for Acceptance of Decommissioning Cost Estimates for Callaway Energy Center, Including Independent Spent Fuel Storage Installation, and Approval of Funding Level for Nuclear Decommissioning Trust Fund ("Application"). The Application requested approval of the Company's decommissioning cost estimates for the Callaway Energy Center ("Callaway" or "Plant") and for the Callaway Independent Spent Fuel Storage Installation ("ISFSI"), as well as the continuation of the funding level of its nuclear decommissioning trust fund at the current $6,758,605 annual amount, with $6,242,226 allocated to Plant decommissioning and $516,379 allocated to ISFSI decommissioning. Ameren Missouri also requested that the Commission find that the $6,758,605 annual funding level of its decommissioning trust fund be included in the Company's current cost of service for ratemaking purposes, and confirm that this funding level is based on the parameters and assumptions set forth in the Application.

Attachment 3 to Ameren Missouri's *Application* is the 2020 decommissioning cost estimate analysis prepared by TLG Services, Inc. ("TLG"), titled *Decommissioning Cost Analysis for the Callaway Energy Center* (2020 Study). This cost estimate is comprehensive in that it covers both the Plant and ISFSI decommissioning; however, the costs are segregated for each. The total decommissioning cost estimate of $1,046,835,000 in 2020 dollars is based on the TLG's estimated

[10] Id.
[11] Case No. EO-2015-0253 (2016); EO-2018-0051 (2018).

cost to decommission the Plant and the ISFSI employing the DECON alternative process,[12] using an assumed 60-year plant operating life and reflecting the use of off-site, low-level radioactive waste processing to minimize the volume designated for controlled disposal. Of this total, $1,036,260,000 is attributable to Plant decommissioning, and $10,575,000 is attributable to ISFSI[13] decommissioning.

Attachment 4 to Ameren Missouri's *Application* is the Ameren Missouri updated funding adequacy analysis calculating the required annual funding levels to cover the total estimated cost to decommission the Plant and the ISFSI.[14]

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[12] DECON assumes decontaminating and decommissioning immediately following conclusion of power operations in 2044, when the 60-year operating license expires. Work is anticipated to be completed by 2053. DECON consists of removal of fuel assemblies, source material, radioactive fission and corrosion products, and other radioactive materials immediately after cessation of power operations. *General Requirements for Decommissioning Nuclear Facilities*, 53 Fed. Reg. 24018, 24022 (Jun. 27, 1988).

[13] The Department of Energy ("DOE") had a contract with Ameren Missouri and nuclear customers were paying in rates fees to remove, transport and dispose of spent nuclear fuel assemblies (high-level radioactive waste) from the Callaway Energy Center to a Nevada - Yucca Mountain repository site. With DOE not taking the spent nuclear fuel assemblies for the Yucca Mountain site, Ameren Missouri has been storing and will continue to store these spent nuclear fuel assemblies on site at the Callaway Energy Center. The ISFSI was constructed to hold the 3,782 spent fuel assemblies that are expected to be produced over the 60-year life of Callaway. Ameren is not the only utility affected by the Department of Energy's failure to accept and dispose of radioactive waste from United States nuclear utilities. *See, e.g., Yankee Atomic Elec. Co. v. U.S.*, 536 F.3d 1268, 1270 (Fec. Cir. 2008) (*Yankee I*).

[14] If decommissioning financial assurance is provided by an external sinking fund, as it is with Callaway, 10 CFR § 50.75(e)(1)(ii) requires that "the total amount of funds would be sufficient to pay decommissioning costs at the time permanent termination of operations is expected." 10 CFR § 50.75(e)(1)(ii) also goes on to state, in part:

> A licensee that has collected funds based on a site-specific estimate under § 50.75(b)(1) of this section may take credit for projected earnings on the external sinking funds using up to a 2 percent annual real rate of return from the time of future funds' collection through the decommissioning period, provided that the site-specific estimate is based on a period of safe storage that is specifically described in the estimate. This includes the periods of safe storage, final dismantlement, and license termination. A licensee that has collected funds based on the formulas in § 50.75(c) of this section may take credit for collected earnings on the decommissioning funds using up to a 2 percent annual real rate of return up to the time of permanent termination of operations. A licensee may use a credit of greater than 2 percent if the licensee's rate-setting authority has specifically authorized a higher rate. (Footnote continued on next page.)

After calculating the required contribution levels for the Plant and ISFSI, Ameren Missouri and the Staff believe that there is no need to increase the total amount collected from Ameren Missouri's customers. The current total annual contribution of $6,758,605 to Ameren Missouri's decommissioning trust fund is reasonable given the uncertainties in the numerous forecasted assumptions used to determine the contribution level. The forecasted assumptions include, but are not limited to, capital market expectations, projected decommissioning inflation rates and the costs to physically decommission the facilities. The Signatories agree on the foregoing total annual contribution level of $6,758,605, which remains unchanged from the amount previously approved by the Commission in File No. EO-2018-0051 on January 23, 2018. Ameren Missouri will allocate this total contribution amount between the plant and the ISFSI. The majority of the total contribution, $6,242,226 annually, will be used to fund the decommissioning trust fund for the Plant. The remainder, $516,379 annually, will be used to fund the decommissioning trust fund for the ISFSI.

Consistent with the Signatories' *Non-Unanimous Stipulation and Agreement* approved by the Commission in EO-2012-0070, the Signatories agree that it is reasonable to use capital market return expectation information provided by Ameren Missouri's pension plan consultant, or the 2% real rate of return set forth in 10 CFR §50.75(e)(1)(ii), for purposes of developing expected portfolio returns for Ameren Missouri's nuclear decommissioning trust fund. The Signatories

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(Footnote No. 14, Continued) Because Ameren Missouri does not contemplate shutting down Callaway prior to the end of its license life, the shutdown date used in the economic analysis, which is Attachment 4 to the November 5, 2020 *Application*, is 2044, the year in which Callaway's NRC Operating License expires. Ameren Missouri collects decommissioning funds based on a site specific estimate. The economic analysis assumes credit for earnings at an expected 4.495% annual real pre-tax & expense rate of return through 2043 and at 1.050% thereafter.

agree that any proposed changes to the annual contribution to Ameren Missouri's nuclear decommissioning trust fund shall be based on capital market return expectation information provided by Ameren Missouri's pension plan consultant, or the aforementioned 2% real rate of return, unless the Signatories agree to use a different source and/or methodology for capital market return expectations or the Commission finds in a contested case that different source and/or methodology for capital market return expectation are more appropriate.

The funding adequacy analysis included as Attachment 4 to Ameren Missouri's *Application* used an average of the Willis Towers Watson projected 10 and 20-year mean arithmetic returns for "US Large Cap Equity" and "Long Bonds" for the equity and fixed income portfolios of the decommissioning fund, respectively. These projections were provided by Willis Towers Watson on February 13, 2020.

III. Stipulations and Agreements

The Signatories to this case have reached certain understandings to that Staff and Ameren Missouri stipulate and agree as follows:

1. Ameren Missouri's Missouri retail jurisdictional authorized annual decommissioning expense accrual and trust fund payment is currently set at $6,758,605, and this amount need not be adjusted at this time.

2. On November 5, 2020, Ameren Missouri filed its Application along with the 2020 Study.

3. ISFSI funds recovered from the DOE will be used to reduce plant-in-service and depreciation reserve balances by the amount of the proceeds until the costs of the re-racking project and dry cask storage construction project are covered.

4. Any ISFSI funds recovered from the DOE in excess of the re-racking project and dry cask storage construction project costs will be used to offset the decommissioning costs of the Plant and ISFSI pursuant to the terms of 20 CSR 4240-20.070(16) (2019).

5. Ameren Missouri shall continue its Missouri retail jurisdiction expense accruals and trust fund payments at current levels without any change in its Missouri retail jurisdictional rates, unless and until the Commission subsequently approves such a change.

6. Annual Missouri retail jurisdictional decommissioning costs, inclusive of the ISFSI, in the amount of $6,758,605 are, and should continue to be, included in Ameren Missouri's cost of service and reflected in its current rates for ratemaking purposes.

7. Except as explicitly agreed otherwise herein, none of the Signatories to this *Stipulation* shall be deemed to have approved or acquiesced in any question of Commission authority, decommissioning methodology, ratemaking principle, valuation methodology, cost of service methodology or determination, depreciation principle or method, rate design methodology, cost allocation, cost recovery, or prudence that may underlie this *Stipulation* or for which provision is made in this *Stipulation*.

8. If the Commission does not unconditionally approve this *Stipulation* without modification, and notwithstanding its provision that it shall become void thereon, neither this *Stipulation* nor any matters associated with its consideration by the Commission shall be considered or argued to be a waiver of the rights that any Party has to a hearing on the issues presented by the *Stipulation*, regarding cross-examination or a decision in accordance with Section 386.280 RSMo (2016) or Article V, Section 18 of the Missouri Constitution. The Signatories shall retain all procedural and due process rights as fully as though this *Stipulation* had not been presented for approval, and any suggestions or memoranda, testimony or exhibits that

may have been offered or received in support of or in opposition to this *Stipulation* shall thereupon become privileged as reflecting the substantive content of settlement discussions, and shall be stricken from and not be considered as part of the administrative or evidentiary record before the Commission for any further purpose whatsoever.

9. To assist the Commission in its review of this *Stipulation*, the Signatories also request that the Commission advises them of any additional information that the Commission may desire from the Signatories related to the matters addressed in this *Stipulation*, including any procedures for furnishing such information to the Commission.

10. If requested by the Commission, the Staff shall submit to the Commission a memorandum responsive to the Commission's request. Each Party of record shall be served with a copy of any memorandum and shall be entitled to submit to the Commission within five (5) days of receipt of the Staff's memorandum, a responsive memorandum which shall also be served on all Parties. The contents of any memorandum provided by any Party are its own and are not acquiesced in or otherwise adopted by the other Signatory to this *Stipulation* or Party, whether or not the Commission approves and adopts this *Stipulation*.

11. The Staff also shall provide, at any agenda meeting at which this *Stipulation* is noticed to be considered by the Commission, whatever oral explanation the Commission requests. The Staff shall, to the extent reasonably practicable, provide the other Parties with advance notice of when the Staff shall respond to the Commission's request for such explanation once such explanation is requested from the Staff. The Staff's oral explanation shall be subject to public disclosure, except to the extent it refers to matters that are privileged or protected from disclosure pursuant to any Protective Order issued in this case.

12. Because this is a *Stipulation* with the sole purpose of addressing the authority requested by the *Application* of Ameren Missouri, except as specified herein, the Signatories to the *Stipulation* shall not be prejudiced, bound by, or in any way affected by the terms of this *Stipulation*: (a) in any future proceeding; (b) in any proceeding currently pending under a separate docket; and/or (c) in this proceeding, should the Commission decide not to approve the *Stipulation* or in any way condition its approval of the same, except as stated herein. Because this is a *Stipulation* for the purpose of settling matters in this case, it shall not be cited as precedent or referred to in testimony in any subsequent or pending judicial or administrative proceeding, except that this shall not be construed to prohibit reference to its existence in future proceedings, including proceedings to enforce compliance with its terms.

13. Pursuant to Section 393.292 RSMo. and 20 CSR 4240-20.070, the Signatories agree that the Commission may review for good cause, including a change of circumstances of a material nature, and authorize changes to Ameren Missouri's rates and charges as a result of a change in the annual accrual of funding for the Missouri jurisdictional account of the Callaway decommissioning trust, after a full hearing, including but not limited to any general rate increase case or excess earnings complaint case, and after considering all facts relevant to such accrual rate.

14. The provisions of this *Stipulation* have resulted from numerous discussions/negotiations among the Signatories and are interdependent. In the event that the Commission does not approve and adopt the terms of this *Stipulation* in total, it shall be void and no Party hereto shall be bound by, prejudiced, or in any way affected by any of the agreements or provisions hereof unless otherwise provided herein.

15. In the event the Commission accepts the specific terms of this *Stipulation*, the Signatories waive their respective rights: a) to cross-examine witnesses pursuant to

Section 536.070(2) RSMo.; b) to present oral argument and written briefs pursuant to Section 536.080.1 RSMo.; c) to the reading of the transcript by the Commission pursuant to Section 536.080.2 RSMo.; and d) to judicial review pursuant to Section 386.510 RSMo. This waiver applies only to a Commission Order respecting this *Stipulation* issued in this proceeding, and does not apply to any matters raised in any subsequent Commission proceeding, or any matters not explicitly addressed by this *Stipulation*.

WHEREFORE, the Signatories hereto request that the Commission issue an Order:

1. Approving this Non-Unanimous Stipulation and Agreement;

2. Receiving into evidence this Non-Unanimous Stipulation and Agreement; Attachment 3 to Ameren Missouri's *Application*, TLG's "*Decommissioning Cost Analysis for the Callaway Energy Center*" (2020 Study), dated October 2020; and Attachment 4 to Ameren Missouri's *Application*, Ameren Missouri's funding adequacy analysis calculating the required annual funding levels for Plant and ISFSI decommissioning, assuming a decommissioning cost escalation rate of 4.1916%;

3. Finding that Ameren Missouri's Application and the 2020 Study satisfy the requirements of 20 CSR 4240-20.070(4) (2019);

4. Finding that the Company's Missouri retail jurisdictional annual decommissioning expense accruals and trust fund payments shall continue at the current level of $6,758,605, with $6,242,226 allocated to Plant decommissioning and $516,379 allocated to ISFSI decommissioning;

5. Finding, in order for the decommissioning fund to continue to utilize the external sinking fund method of decommissioning funding, that the current decommissioning costs for the

Plant and ISFSI are in Ameren Missouri's current Missouri retail cost of service and are reflected in its current retail rates for ratemaking purposes;

6. Approving, pursuant to 20 CSR 4240-20.070(5)(C) (2019), the use of a jurisdictional demand allocator of 100.00%;

7. Acknowledging that the annual decommissioning expense and contribution amount proposed in this *Stipulation* is based on Attachment 3, the October 2020 *Decommissioning Cost Analysis for the Callaway Energy Center*.

8. Approving the actuarial assumptions used in Attachment 4 to Ameren Missouri's *Application*, Ameren Missouri's funding adequacy analysis calculating the required annual funding levels for the Plant and ISFSI decommissioning, specifically:

- The after-tax value of Missouri jurisdictional sub-account of the Plant Tax-Qualified Nuclear Decommissioning Trust Fund as of September 30, 2020, was $814,003,088.
- The after-tax value of Missouri jurisdictional sub-account of the ISFSI Tax-Qualified Nuclear Decommissioning Trust Fund as of September 30, 2020, was $2,414,043.
- The proposed expense and contribution amount and allocation between Plant and ISFSI is to be effective beginning with calendar year 2021.
- The Plant decommissioning cost estimate is $1,036,260,000 and the ISFSI decommissioning cost estimate is $10,575,000, both in terms of 2020 dollars.
- Operating license expiration date of October 18, 2044
- The Missouri jurisdictional allocator (for both Plant and ISFSI) is 100%.

- The federal income tax rate is 20%.
- The state income tax rate is 0%.
- The composite federal & state income tax rate is 20%.
- An asset allocation of 65% equities and 35% bonds is assumed to exist through 2043, at which time all equity investments will be divested.
- Investment management and trust fees are estimated at 15 basis points annually.
- An inflation rate of 2.150% is assumed for general (CPI) inflation.
- The pre-tax & expense nominal return on bonds is assumed to be 3.200%.
    - The pre-tax & expense real return on bonds is assumed to be 1.050%.
- The pre-tax & expense nominal return on equities is assumed to be 8.500%.
    - The pre-tax & expense real return on equities is assumed to be 6.350%
- The pre-tax & expense nominal weighted-average return is assumed to be 6.645% through the 2043 date of divestiture of equity investments.
    - The pre-tax & expense real weighted-average return is assumed to be 4.495% through the 2043 date of divestiture of equity investments.
    - The pre-tax & expense real weighted-average return is assumed to be 1.050% following the 2043 date of divestiture of equity investments.

- The annualized pre-tax and expense nominal return over the life of the fund (Plant & ISFSI consolidated) will be 6.082%

- Decommissioning cost escalation is assumed to be 4.1916%.

9. Recognizing that ISFSI funds recovered from the DOE will be used to reduce plant-in-service and depreciation reserve balances by the amount of the proceeds until the costs of the re-racking project and dry cask storage construction project are covered. Any ISFSI funds recovered from the DOE in excess of the re-racking project and dry cask storage construction project costs will be used to offset the decommissioning costs of the Plant and ISFSI.

10. Recognize that, pursuant to 20 CSR 4240-20.070(16) (2016), excess trust funds from the costs of decommissioning the Plant and ISFSI are to be reimbursed to the ratepayers through the ratemaking process.

Respectfully submitted,

/s/ Paula N. Johnson
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Counsel for Staff of the Missouri Public Service Commission

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing was served by electronic mail, or First Class United States Postal Mail, postage prepaid, on this 9th day of February, 2021, to all parties and/or counsels of record.

/s/ Curt Stokes
Curt Stokes

CALLAWAY ENERGY CENTER DECOMMISSIONING TRUST FUND HISTORY

1. In 1984 in Ameren Missouri's (then d/b/a Union Electric Company ("UE")) Callaway rate case, Ameren Missouri and the Staff stipulated that the decommissioning cost of the Callaway Energy Center was $120 million in 1983 dollars. As a result of the Commission's Callaway *Report and Order*, Ameren Missouri's Missouri retail jurisdictional annual trust fund payment requirement was set at $2.9 million. *Re Union Electric Co.*, Case Nos. EO-85-17 and ER-85-160, 27 Mo.P.S.C.(N.S.) 183, 249 (1985). In Case No. EO-91-300, which was Ameren Missouri's first filing pursuant to 4 CSR 240-20.070,[1] a *Unanimous Stipulation and Agreement* was accepted by the Commission which identified the cost in 1990 dollars to immediately decommission Callaway, as if it had completed 40 years of service, as being $347 million and set Ameren Missouri's Missouri retail jurisdiction annual trust fund accrual and payment requirement as $6,214,184. The great increase in the cost estimate was due principally to a major increase in the projected cost charged by licensed facilities for disposal of low-level radioactive waste. (Low-level radioactive waste should not be confused with high-level radioactive waste and spent nuclear fuel. The federal fee, which was collected with each kilowatt hour of electricity generated by Callaway, relates to disposal facilities for high-level radioactive waste and spent nuclear fuel, not disposal facilities for low-level radioactive waste.)

2. Ameren Missouri's Missouri retail jurisdiction annual decommissioning expense accrual and trust fund payment was again set by the Commission at $6,214,184, in Case No. EO-94-81, *Re Union Electric Co.*, 3 Mo.P.S.C.3d 68 (1994); Case No. EO-97-86, *Re Union Electric Co.*, 7 Mo.P.S.C.3d 117 (1998); Case No. EO-2000-205, *Re Union Electric Co.*, 8 Mo.P.S.C.3d 497 (2000); and Case No. EO-2003-0083, *Re Union Electric Co.*, 12 Mo.P.S.C.3d 68 (2002). In

[1] Prior to April 30, 2003, 4 CSR 240-3.185 Submission of Reports Pertaining to the Decommissioning of Electric Utility Plants was contained in 4 CSR 240-20.070 Decommissioning Trust Funds.

Case Nos. EO-94-81, EO-97-86, EO-2000-205 and EO-2003-0083, *Unanimous Stipulation and Agreements* were accepted by the Commission which identified the costs in 1993, 1996, 1999 and 2002 dollars, respectively, to immediately decommission Callaway, as if it had completed 40-years of service, as being $371,511,680, $419,975,000, $509,451,856 and $515,339,000, respectively.

3. In Case No. EO-2004-0108, the Commission addressed decommissioning trust funding along with the transfer of Ameren Missouri's MetroEast (Illinois) service territory and property to AmerenCIPS as Ameren Missouri's Missouri jurisdictional demand allocator increased to 97.92% post-transfer. In its *Report and Order on Rehearing* in that case, *Re Union Electric Co.*, 13 Mo.P.S.C.3d 266 (2005), the Commission ordered an increase in Ameren Missouri's annual Missouri decommissioning expense and contribution amount from $6,214,184 to $6,486,378[2] to reflect the increased liability for decommissioning costs assumed by Missouri ratepayers. In Case Nos. EO-2004-0108, EO-2006-0098, and EO-2009-0081, a methodology was utilized by which Missouri ratepayers were responsible for less than 100% of Ameren Missouri's decommissioning liability. Ameren Missouri serves wholesale customers, such as municipals, with power from Callaway. The provision of service to other than Missouri retail ratepayers was recognized by the utilization of an allocation methodology with a Missouri jurisdictional demand allocator of less than 100% to Missouri retail customers. In File No. ER-2011-0028, Ameren Missouri commenced a methodology of the Missouri jurisdictional demand allocator for Callaway increased to 100%; the annual accrual increased to $6,758,605. The Staff followed this methodology in the Ameren Missouri general rate increase case File No. ER-2012-0166; Ameren Missouri did not perform an allocation. Callaway was treated as allocated 100% to the Missouri retail jurisdiction; municipal

[2] *Report and Order on Rehearing* in Case No. EO-2004-0108 contains a typographical error that transposed the second and third digits in the annual contribution amount to the Missouri jurisdictional subaccount. (*See* 13 Mo.P.S.C.3d at 297 and 304 compared to 13 Mo.P.S.C.3d at 296). Because this error has an insignificant impact on trust fund funding, Ameren Missouri used this actual ordered amount as its present annual contribution amount.

customers, sales, and costs were treated as off-system customers, sales, and costs. The $6,758,605 of annual decommissioning expense accrual was included in the determination of Ameren Missouri retail customer rates approved by the Commission as part of *Re Union Electric Co.*, File No. ER-2011-0028 (July 13, 2011) and the Missouri jurisdictional demand allocator was reflected as 100%. Ameren Missouri and the Staff followed this methodology in File No. EO-2012-0070, Ameren Missouri's most recent prior Triennial Decommissioning Update, and File No. ER-2012-0166, Ameren Missouri's most recent general rate increase case.

4. In the four triennial decommissioning cost study cases prior to Case No. EO-2004-0108, Ameren Missouri's Missouri retail jurisdiction, annual trust fund accrual and payment requirement remained at $6,214,184, as that amount was determined to be adequate for the funding of decommissioning expenses. In Case No. EO-2004-0108, the Missouri retail jurisdiction annual trust fund accrual and payment requirement was increased to $6,486,378 to reflect the increased liability for decommissioning costs assumed by the Missouri retail ratepayers as a result of the MetroEast Property Transfer. In Case No. EO-2006-0098, a *Unanimous Stipulation and Agreement* was accepted by the Commission which identified the costs in 2005 dollars to immediately decommission Callaway, as if it had completed 40 years of service, as being $586,515,200. Ameren Missouri's Missouri retail jurisdiction annual trust fund accrual and payment requirement remained at $6,486,378, as that amount was determined to be adequate for the funding of future decommissioning expenses. The 2011 Cost Study estimated the decommissioning cost for the DECON alternative to be $754,500,000 in 2011 dollars, which was 8.7% higher than the 2008 estimate of $693,907,000 (Case No. EO-2009-0081) and represented approximately a 2.83% annualized escalation rate over the 3-year period. Ameren Missouri's

economic analysis found the annual contribution of $6,758,605 to the nuclear decommissioning trust fund to be reasonable.

5. On August 15, 2014, Ameren Missouri filed in File No. EE-2015-0046 a request for a seven (7) month extension of time to file its 2014 TLG Decommissioning Cost Study to no later than April 1, 2015, rather than September 1, 2014, due to its license extension request that was pending before the Nuclear Regulatory Commission ("NRC") and the potential impact of the request upon the necessary funding level of its decommissioning trust. The Staff recommended that the Commission grant Ameren Missouri its request for a variance from the Commission's rule. The Commission issued an order on March 4, 2015 granting the Ameren Missouri's request for an extension of time to file pending decommissioning cost analysis.

6. On April 1, 2015, Ameren Missouri filed in File No. EO-2015-0253 its Application, a 2014 TLG "*Decommissioning Cost Analysis for the Callaway Energy Center*," not including the cost of decommissioning the Independent Spent Fuel Storage Installation ("ISFSI"), and Ameren Missouri's analysis of the required funding level under a 2044 operating license expiration date. TLG estimated the cost to decommission the Callaway Energy Center, exclusive of the cost of decommissioning the ISFSI, employing the DECON alternative, as $864,734,000 in 2014 dollars based on an assumed 60-year plant operating life to 2044 and an annual contribution of $6,758,605. A *Non-Unanimous Stipulation and Agreement* ("*Stipulation*") was filed with the Commission on March 14, 2016, followed by a *Notice of Correction to Stipulation and Agreement* on March 30, 2016 ("*Corrected Stipulation*"). Attached to the *Corrected Stipulation* as Attachment 1 was the "*Callaway Energy Center Independent Spent Fuel Storage Installation Decommissioning Cost Analysis*," dated February 1, 2016. The *Stipulation* and *Corrected Stipulation* found that Ameren Missouri's Missouri retail jurisdiction annual decommissioning expense accruals and trust fund

payments should continue at the current level of $6,758,605, with $6,314,620 allocated to decommissioning the Callaway Energy Center and $443,985 allocated to decommissioning the ISFSI. The Commission issued its Order approving the *Corrected Stipulation* on April 6, 2016.

7. On September 1, 2017, Ameren Missouri filed in File No. EO-2018-0051 its Application, a TLG "*Decommissioning Cost Analysis for the Callaway Energy Center*" dated August 2017 and including segregated cost estimates for both the Plant and ISFSI decommissioning. TLG estimated the total cost to decommissioning Callaway and the ISFI, employing the DECON alternative, as $943,465,000 in 2017 dollars. Of this total, $934,296,000 was attributable to Plant decommissioning and $9,169,000 was attributable to ISFSI decommissioning. The estimate was based on an assumed 60-year plant operating life to 2044, and reflected the use of off-site, low-level radioactive waste processing to minimize the volume designated for controlled disposal. This resulted in an annual contribution at the same level as 2015 of $6,758,605. Of this amount, $6,323,396 was allocated to plant decommissioning and $435,209 was attributed to ISFSI decommissioning. A Stipulation and Agreement was filed with the Commission on January 4, 2018, indicating that Ameren Missouri's Missouri retail jurisdiction annual decommissioning expense accruals and trust fund payments should continue at the current level of $6,758,605, with $6,323,396 allocated to decommissioning the Callaway Energy Center and $435,209 allocated to decommissioning the ISFSI. The Commission issued an *Order Approving Stipulation and Agreement* on January 23, 2018.

Enclosure 9 to
ULNRC-06798

Order Approving Stipulation and Agreement - February 24, 2021 (effective March 26, 2021)

STATE OF MISSOURI
PUBLIC SERVICE COMMISSION

At a session of the Public Service Commission held by telephone and internet audio conference on the 24th day of February, 2021.

In the Matter of the Application of Union Electric Company d/b/a Ameren Missouri for Approval of Decommissioning Cost Estimate for Callaway Energy Center and Funding Level of Nuclear Decommissioning Trust Fund	)))))	**File No. EO-2021-0050**

ORDER APPROVING STIPULATION AND AGREEMENT

Issue Date: February 24, 2021 Effective Date: March 26, 2021

This order approves the stipulation and agreement between the Union Electric Company d/b/a Ameren Missouri (Ameren Missouri) and the Staff of the Commission (Staff) regarding Ameren Missouri's funding for the decommissioning of its Callaway Energy Center.

Commission Rule 20 CSR 4240-20.070(4) states, in part:

> On or before September 1, 1990, and every three years after that, utilities with decommissioning trust funds shall perform and file with the commission cost studies detailing the utilities' latest cost estimates for decommissioning their nuclear generating unit(s) along with the funding levels necessary to defray these decommissioning costs. These studies shall be filed along with appropriate tariff(s) effectuating the change in rates necessary to accomplish the funding required.

On November 5, 2020, Ameren Missouri filed an application pertaining to Callaway asking the Commission to 1) approve Ameren Missouri's decommissioning cost estimates for the Callaway Energy Center (Callaway or Plant) and for the Callaway Independent Spent Fuel Storage Installation (ISFSI); 2) approve the continuation of the funding level of its nuclear decommissioning trust fund at the current $6,758,605 amount, with $6,242,226 allocated to plant decommissioning and $516,379 allocated to ISFSI decommissioning;

3) find that the Callaway decommissioning costs are to be included in Ameren Missouri's current cost of service for ratemaking purposes; and 4) confirm that this funding level is based on the parameters and assumptions stated in the application.

Staff and Ameren Missouri filed a non-unanimous stipulation and agreement on February 9, 2021. Commission Rule 20 CSR 4240-2.115(2) provides that if no party objects to a non-unanimous stipulation and agreement within seven days of its filing, the Commission may treat the stipulation and agreement as unanimous. The Office of the Public Counsel, the only other party, did not sign the stipulation and agreement, but has not opposed the agreement. Therefore, the Commission will treat the stipulation and agreement as unanimous.

Having considered the 2020 decommissioning cost study, Ameren Missouri's funding adequacy analysis calculating the required annual funding levels for Plant and ISFSI decommissioning, assuming a decommissioning cost escalation rate of 4.1916%, and the stipulation and agreement, which will be received into evidence, the Commission determines that the stipulation and agreement should be approved. In doing so, the Commission finds that Ameren Missouri's 2020 decommissioning cost study satisfies the requirements of Commission Rule 20 CSR 4240-20.070(4).

In addition, the Commission finds that Ameren Missouri's retail jurisdiction annual decommissioning expense accruals and trust fund payments shall continue at the current level of $6,758,605, with $6,242,226 allocated to Plant decommissioning and $516,379 allocated to ISFSI decommissioning. The Commission also finds that the current decommissioning costs for Callaway are included in Ameren Missouri's current Missouri cost of service and are reflected in its current retail rates for ratemaking purposes. The

Commission acknowledges that the annual decommissioning expense and contribution amount proposed in the stipulation and agreement is based on Attachment 3, the October 2020 *Decommissioning Cost Analysis for the Callaway Energy Center,* and that Attachment 3, the October 2020 *Decommissioning Cost Analysis for the Callaway Energy Center,* meets the requirements of Commission Rule 20 CSR 4240-20.070(4).

THE COMMISSION ORDERS THAT:

1. The stipulation and agreement filed by Ameren Missouri and Staff on February 9, 2021, is approved.

2. The signatories shall comply with the terms of the stipulation and agreement.

3. The following documents are admitted into evidence: The Non-Unanimous Stipulation and Agreement; Attachment 3 to Ameren Missouri's *Application,* TLG Services, Inc.'s (TLG) "*Decommissioning Cost Analysis for the Callaway Energy Center*," dated October, 2020; and Attachment 4 to Ameren Missouri's *Application*, Ameren Missouri's funding adequacy analysis calculating the required annual funding levels for Plant and ISFSI decommissioning, assuming a decommissioning cost escalation rate of 4.1916%.

4. Ameren Missouri's Application and the 2020 Study satisfy the requirements of 20 CSR 4240-20.070(4).

5. Ameren Missouri's Missouri retail jurisdictional annual decommissioning expense accruals and trust fund payments shall continue at the current level of $6,758,605, with $6,242,226 allocated to Plant decommissioning and $516,379 allocated to ISFSI decommissioning.

6. For the decommissioning fund to continue to utilize the external sinking fund method of decommissioning funding, the current decommissioning costs for the Plant and

ISFSI are in Ameren Missouri's current Missouri retail cost of service and are reflected in its current retail rates for ratemaking purposes.

7. Pursuant to 20 CSR 4240-20.070(5)(C), the use of a jurisdictional demand allocator of 100.00% is approved.

8. The annual decommissioning expense and contribution amount proposed in this *Stipulation* is based on Attachment 3, the October 2020 *Decommissioning Cost Analysis for the Callaway Energy Center*.

9. The Commission approves the actuarial assumptions used in Attachment 4 to Ameren Missouri's *Application*, Ameren Missouri's funding adequacy analysis calculating the required annual funding levels for the Plant and ISFSI decommissioning, specifically:

- The after-tax value of Missouri jurisdictional sub-account of the Plant Tax-Qualified Nuclear Decommissioning Trust Fund as of September 30, 2020, was $814,003,088.
- The after-tax value of Missouri jurisdictional sub-account of the ISFSI Tax-Qualified Nuclear Decommissioning Trust Fund as of September 30, 2020, was $2,414,043.
- The proposed expense and contribution amount and allocation between Plant and ISFSI is to be effective beginning with calendar year 2021.
- The Plant decommissioning cost estimate is $1,036,260,000 and the ISFSI decommissioning cost estimate is $10,575,000, both in terms of 2020 dollars.
- Operating license expiration date of October 18, 2044.
- The Missouri jurisdictional allocator (for both Plant and ISFSI) is 100%.
- The federal income tax rate is 20%.

- The state income tax rate is 0%.
- The composite federal and state income tax rate is 20%.
- An asset allocation of 65% equities and 35% bonds is assumed to exist through 2043, at which time all equity investments will be divested.
- Investment management and trust fees are estimated at 15 basis points annually.
- An inflation rate of 2.150% is assumed for general (CPI) inflation.
- The pre-tax and expense nominal return on bonds is assumed to be 3.200%.
    - The pre-tax and expense real return on bonds is assumed to be 1.050%.
- The pre-tax and expense nominal return on equities is assumed to be 8.500%.
    - The pre-tax and expense real return on equities is assumed to be 6.350%.
- The pre-tax and expense nominal weighted-average return is assumed to be 6.645% through the 2043 date of divestiture of equity investments.
    - The pre-tax and expense real weighted-average return is assumed to be 4.495% through the 2043 date of divestiture of equity investments.
    - The pre-tax and expense real weighted-average return is assumed to be 1.050% following the 2043 date of divestiture of equity investments.
    - The annualized pre-tax and expense nominal return over the life of the fund (Plant and ISFSI consolidated) will be 6.082%
- Decommissioning cost escalation is assumed to be 4.1916%.

10. ISFSI funds recovered from the DOE will be used to reduce plant-in-service and depreciation reserve balances by the amount of the proceeds until the costs of the re-racking project and dry cask storage construction project are covered. Any ISFSI funds recovered from the DOE in excess of the re-racking project and dry cask storage construction project costs will be used to offset the decommissioning costs of the Plant and ISFSI.

11. Pursuant to 20 CSR 4240-20.070(16), excess trust funds from the costs of decommissioning the Plant and ISFSI are to be reimbursed to the ratepayers through the ratemaking process.

12. This order shall become effective on March 26, 2021.

13. This file shall be closed on March 27, 2021.

BY THE COMMISSION

Morris L. Woodruff
Secretary

Silvey, Chm., Kenney, Rupp, Coleman, and Holsman CC., concur.

Pridgin, Regulatory Law Judge