DECOMMISSIONING COST ANALYSIS

for the

CALLAWAY PLANT

prepared for

AmerenUE

prepared by

TLG Services, Inc.
Bridgewater, Connecticut

August 2008

APPROVALS

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REVISION LOG

No.	CRA No.	Date	Item Revised	Reason for Revision
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EXECUTIVE SUMMARY

This report presents estimates of the cost to decommission the Callaway Plant (Callaway) for the selected decommissioning scenarios following the scheduled cessation of plant operations. The analysis relies upon site-specific, technical information from an evaluation prepared in 2005,[1] updated to reflect current assumptions pertaining to the disposition of the nuclear unit and relevant industry experience in undertaking such projects. The current estimates are designed to provide AmerenUE with sufficient information to assess its financial obligations, as they pertain to the eventual decommissioning of the nuclear unit.

The currently projected cost to decommission the station, assuming the DECON alternative, is estimated at $693.9 million, as reported in 2008 dollars. An estimate for the SAFSTOR alternative is also provided.

The estimates 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 estimates incorporate a minimum cooling period of approximately 5½ years for the spent fuel that resides in the storage pool when operations cease. During this period, it is assumed the U.S. Department of Energy (DOE) will complete the transfer of the residual spent fuel inventory to a DOE repository. The estimates also include the dismantling of non-essential structures and limited restoration of the site.

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.

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1 "Decommissioning Cost Analysis for the Callaway Plant," Document No. A22-1534-002, Rev. 0, TLG Services, Inc., August 2005

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.

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] 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.

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 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.

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3 Ibid. Page FR24022, Column 3.
4 Ibid.
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.

Regulatory Guide 1.184, issued in July 2000, further described the methods and procedures acceptable to the NRC staff for implementing the requirements of the 1996 revised rule relating to the initial activities and major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and processes described in the 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]

Methodology

The methodology used to develop the estimates described within this document follows the basic approach originally presented in the cost estimating guidelines[8] 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.

The estimates also reflect lessons learned from TLG's involvement in the Shippingport Station decommissioning, completed in 1989, and the decommissioning of the Cintichem reactor, hot cells and associated facilities, completed in 1997. In addition, the planning and engineering for the Pathfinder, Shoreham, Rancho Seco, Trojan, Yankee Rowe, Big Rock Point, Maine Yankee, Humboldt Bay-3, Connecticut Yankee and San Onofre-1 nuclear units have provided additional insight into the process, the regulatory aspects, and technical challenges of decommissioning commercial nuclear units.

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.

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

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

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

unforeseeable events which will increase costs are likely to occur."[9] 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,[10] and its Amendments of 1985,[11] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

Until recently, there were two facilities available to AmerenUE for the disposal of low-level radioactive waste generated by Callaway. As of July 1, 2008, however, the facility in Barnwell, South Carolina was closed to generators outside the Atlantic Compact (comprised of the states of Connecticut, New Jersey and South Carolina). This leaves the facility in Clive, Utah, operated by EnergySolutions, as the only available destination for low-level radioactive waste requiring controlled disposal.

For the purpose of this analysis, the EnergySolutions' facility is used as the basis for estimating the disposal cost for the majority of the radioactive waste (Class A [12]). EnergySolutions does not have a license to dispose of the more highly radioactive waste (Classes B and C), for example, generated in the dismantling of the reactor vessel. As a proxy, the disposal cost for this material is based upon the last published rate schedule for non-compact waste for the Barnwell facility.

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

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

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

12 U.S. Code of Federal Regulations, Title 10, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste"

The dismantling of the components residing closest to the reactor core generates 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. However, to date, the federal government has not identified a cost for disposing of GTCC or a schedule for acceptance. As such, the GTCC radioactive waste has been packaged and disposed of as high-level waste, at a cost equivalent to that envisioned for the spent fuel.

For purposes of this study, GTCC is packaged in the same canisters used for spent fuel. The GTCC material is 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 waste 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 Callaway reflect the savings from waste recovery/volume reduction.

<u>High-Level Radioactive Waste Management</u>

Congress passed the "Nuclear Waste Policy Act"[13] (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 NWPA provided that DOE would enter into contracts with utilities in which DOE would promise to take the utilities' spent fuel and high-level radioactive waste and utilities would pay the cost of the disposition services for that material. NWPA, along with the individual contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

Since the original legislation, the DOE has announced several delays in the program schedule. By January 1998, the DOE had failed to accept any spent fuel or high level waste, as required by the NWPA and utility contracts. Delays continue and, as a

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

result, generators have initiated legal action against the DOE in an attempt to obtain compensation for DOE's breach of contract.

Operation of DOE's yet-to-be constructed repository is contingent upon the review and approval of the facility's license application by the NRC and the successful resolution of pending litigation. The DOE submitted its license application to the NRC on June 3, 2008, seeking authorization to construct the repository at Yucca Mountain, Nevada. Assuming a timely review, and adequate funding, the DOE expects that receipt of fuel could begin by 2020.[14]

It is generally necessary that spent fuel be actively 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 Secretary of Energy, pursuant to 10 CFR Part 50.54(bb).[15] This funding requirement is fulfilled through inclusion of certain cost elements in the decommissioning estimates, for example, associated with the isolation and continued operation of the spent fuel pool.

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 5½ 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.

DOE's contracts with utilities generally order the acceptance of spent fuel from utilities based upon the oldest fuel receiving the highest priority. For estimating purposes, AmerenUE has assumed that all spent fuel will be removed to the DOE high-level waste repository within 5½ years after shutdown. Interim storage of the fuel, until the DOE has completed the transfer, will be in the pool located in the Fuel Building. The pool will be isolated, allowing AmerenUE to proceed with decommissioning (or safe-storage preparations) in the shortest time possible.

Site Restoration

Prompt dismantling of site structures (once the facilities are decontaminated) is clearly the most appropriate and cost-effective option. 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

14 "Testimony of Edward Sproat, Director, Office of Civilian Radioactive Waste Management, before a U.S. House of Representatives subcommittee on the status of Yucca Mountain, July 15, 2008.

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

work force already mobilized on site is more efficient than if the process is deferred. Site facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and the demolition work force. Consequently, this study assumes that site structures are removed to a nominal depth of three feet below the local grade level wherever possible. The site is then to be graded and stabilized.

Summary

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

Decommissioning is accomplished within the 60-year period 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. The major cost contributors are identified in Section 6, with detailed activity costs, waste volumes, and associated manpower requirements delineated in Appendices C and D. 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 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 2008 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.

DECON COST SUMMARY
DECOMMISSIONING COST ELEMENTS
(thousands of 2008 dollars)

Cost Element	Cost
Decontamination	17,593
Removal	146,429
Packaging	16,531
Transportation	12,505
Waste Disposal	75,885
Off-site Waste Processing	22,814
Program Management [1]	297,742
Corporate Allocations	10,098
Spent Fuel Pool Isolation	10,819
Spent Fuel Management [2]	34,647
Insurance and Regulatory Fees	11,469
Energy	9,144
Characterization and Licensing Surveys	19,093
Property Taxes	2,780
Miscellaneous Equipment	6,359
Total [3]	693,907

Cost Element	
License Termination	572,236
Spent Fuel Management	34,647
Site Restoration	87,024
Total [3]	693,907

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

SAFSTOR COST SUMMARY
DECOMMISSIONING COST ELEMENTS
(thousands of 2008 dollars)

Cost Element	Costs
Decontamination	15,473
Removal	146,469
Packaging	13,753
Transportation	9,747
Waste Disposal	53,525
Off-site Waste Processing	25,137
Program Management [1]	476,544
Corporate Allocations	13,464
Spent Fuel Pool Isolation	10,819
Spent Fuel Management [2]	34,647
Insurance and Regulatory Fees	51,122
Energy	18,872
Characterization and Licensing Surveys	20,627
Property Taxes	20,296
Miscellaneous Equipment	19,074
Total [3]	929,568

Cost Element	
License Termination	774,447
Spent Fuel Management [4]	68,084
Site Restoration	87,037
Total [3]	929,568

[1] Includes engineering and security costs
[2] Direct costs only. Excludes program management costs (staffing) but includes costs for spent fuel loading/packaging/spent fuel pool O&M and EP 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.

1. INTRODUCTION

This report presents estimates of the costs to decommission the Callaway Plant, (Callaway) following a scheduled cessation of plant operations. The analysis relies upon site-specific, technical information from an earlier evaluation prepared in 2005,[1]* updated to reflect current assumptions pertaining to the disposition of the nuclear unit and relevant industry experience in undertaking such projects. The supporting analysis was designed to provide AmerenUE with sufficient information to assess its financial obligations, as they pertain to the eventual decommissioning of the nuclear station. It is not a detailed engineering document, but a financial analysis prepared in advance of the detailed engineering that will be required to carry out the 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 the purposes of this study, the final shutdown date (license expiration) is projected to be October of 2024, based upon a 40 year operating life. This date was used as input to scheduling the decommissioning activities.

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 1284 MWe.

* References provided in Section 7 of the document

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] However, 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, the unresolved issues associated with the disposition of greater-than-Class C material (GTCC), and the NRC's current priorities, at least until after the additional research studies are complete. The Commission concurred with the staff's recommendation.

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).

1.3.1 Nuclear Waste Policy Act

Congress passed the "Nuclear Waste Policy Act"[7] (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 NWPA provided that DOE would enter into contracts with utilities in which DOE would promise to take the utilities' spent fuel and high-level radioactive waste and utilities would pay the cost of the disposition services for that material. NWPA, along with the individual contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

Since the original legislation, the DOE has announced several delays in the program schedule. By January 1998, the DOE had failed to accept any spent fuel or high level waste, as required by the NWPA and utility contracts. Delays continue and, as a result, generators have initiated legal action against the DOE in an attempt to obtain compensation for DOE's breach of contract.

Operation of DOE's yet-to-be constructed repository is contingent upon the review and approval of the facility's license application by the NRC and the successful resolution of pending litigation. The DOE submitted its license application to the NRC on June 3, 2008, seeking authorization to construct the repository at Yucca Mountain, Nevada. Assuming a timely review, and adequate funding, the DOE expects that receipt of fuel could begin by 2020.[8]

It is generally necessary that spent fuel be actively 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 until title of the fuel is transferred to the Secretary of Energy, pursuant to 10 CFR Part 50.54(bb).[9] This funding requirement is fulfilled through inclusion of certain cost elements in the decommissioning estimate, for example, associated with the isolation and continued operation of the spent fuel pool.

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 5½ years the assemblies are packaged into multipurpose canisters (provided by the DOE) for transfer to the DOE. It is assumed that this period provides the necessary cooling for the final core to meet the transport system requirements for decay heat.

For estimating purposes, AmerenUE has assumed that all spent fuel will be removed to a DOE high-level waste repository within 5½ years after shutdown. Interim storage of the fuel, until the DOE has completed the transfer, will be in the storage pool located in the Fuel Building. The pool will be isolated, allowing AmerenUE to proceed with decommissioning (or safe-storage preparations) in the shortest time possible.

1.3.2 Low-Level Radioactive Waste Acts

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,[10] and its Amendments of 1985,[11] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

Until recently, there were two facilities available to AmerenUE for the disposal of low-level radioactive waste generated by Callaway. As of July 1, 2008, however, the facility in Barnwell, South Carolina was closed to generators outside the Atlantic Compact (comprised of the states of Connecticut, New Jersey and South Carolina). This leaves the facility in Clive, Utah, operated by EnergySolutions, as the only available destination for low-level radioactive waste requiring controlled disposal.

For the purpose of this analysis, the EnergySolutions' facility is used as the basis for estimating the disposal cost for the majority of the radioactive waste (Class A[12]). EnergySolutions does not have a license to dispose of the more highly radioactive waste (Class B and C), for example, generated in the dismantling of the reactor vessel. As a proxy, the disposal cost for this material is based upon the last published rate schedule for non-compact waste for the Barnwell facility.

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For purposes of this study, GTCC is packaged in the same canisters used for spent fuel. The GTCC material is 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 waste 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 Callaway 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,"[13] 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).[14] An additional and separate limit of 4 millirem per year, as defined in 40 CFR §141.16, is applied to drinking water.[15]

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)[16] 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

Detailed cost estimates were developed to decommission the Callaway nuclear unit for the approved decommissioning alternatives: DECON and SAFSTOR. 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 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.

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. However, the study does estimate the costs incurred with the interim on-site storage of the fuel pending shipment by the DOE to an off-site disposal facility.

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 within two years of the notice to cease 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 5½ years following the cessation of operations before the inventory resident at shutdown can be transferred to the DOE.
- 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 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 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)."[17] 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 final termination of the license.

The NRC will terminate the operating license 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 facility 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, fuel handling, and radioactive waste 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.

Prompt dismantling of site structures is clearly the most appropriate and cost-effective option. 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 on site is more efficient than if the process were deferred. Site facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public as well as to future workers. Abandonment creates a breeding ground for vermin infestation as well as other biological hazards.

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 the spent fuel from the storage pool to the DOE following the minimum required cooling period in the spent fuel pool.
- 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 alternatives. 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 5½ years of the cessation of operations. The pool is secured for storage and decommissioned along with the power block structures in Period 4.

After an optional 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 thirty to forty 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 estimates were developed using the site-specific, technical information from the 2005 analysis. 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,"[18] and the DOE "Decommissioning Handbook."[19] 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 R.S. Means.[20]

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.

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 Pathfinder, Shoreham, Rancho Seco, Trojan, Yankee Rowe, Big Rock Point, Maine Yankee, Humboldt Bay-3, Oyster Creek, Connecticut Yankee, and San Onofre-1 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 radiologically 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"[21] 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%

- Reactor Segmentation 75%
- NSSS Component Removal 25%
- Reactor Waste Packaging 25%
- Reactor Waste Transport 25%
- Reactor Vessel Component Disposal 50%
- GTCC Disposal 15%

- Non-Radioactive Component Removal 15%
- Heavy Equipment and Tooling 15%
- Supplies 25%
- Engineering 15%
- Energy 15%

- Characterization and Termination Surveys 30%
- Construction 15%
- Taxes and Fees 10%
- Insurance 10%
- Staffing 15%

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 and D). For example, the composite contingency value reported for the DECON alternative in Appendix C is approximately 18.6%.

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.

It has been TLG's experience that the results of a risk analysis, when compared with the base case estimate for decommissioning, indicate

that the chances of the base decommissioning estimate's being too high is a low probability, and the chances that the estimate is too low is a higher probability. This is mostly due to the pricing uncertainty for low-level radioactive waste burial, and to a lesser extent due to schedule increases from changes in plant conditions and to pricing variations in the cost of labor (both craft and staff). This cost study, however, 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 base 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, the disposal cost is financed by a 1 mill/kWhr surcharge paid into the DOE's waste fund during operations. However, the NRC 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, AmerenUE has assumed that all spent fuel will be removed to the DOE high-level waste repository within 5½ years after shutdown. Interim storage of the fuel, until the DOE has completed the transfer, will be in the spent fuel pool located in the Fuel Building on the Callaway site. This will allow AmerenUE to proceed with decommissioning (or safe-storage) operations in the shortest time possible. A delay in the startup of the repository, 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 5½ years also 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 to the DOE.

Canister Loading and Transfer

A cost of $220,000 is used for the labor to load/transport the spent fuel from the pool to a DOE transport vehicle (assuming the DOE casks are multi-purpose canister designs within a storage or transportation overpack).

Operations and Maintenance

An annual cost (excluding labor) of approximately $941,000 is used for operation and maintenance of the spent fuel pool. Pool operations are expected to continue approximately 5½ years after the cessation of operations.

GTCC

The dismantling of the reactor internals will 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 Commission 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. As such, the GTCC radioactive waste has been packaged and disposed of as high-level waste, at a cost equivalent to that envisioned for the spent fuel.

For purposes of this study, GTCC is packaged in the same canisters used to transport spent fuel. It is not anticipated that the DOE would accept this waste prior to completing the transfer of spent fuel. Therefore, the GTCC waste is assumed to be stored in the spent fuel storage pool (for the DECON alternative) until all the fuel has been transferred to the DOE (for the DECON alternative). In the SAFSTOR scenario, the GTCC

material is generated after the fuel has been removed. As such, 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 disposal site 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 the Callaway unit 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. With lower levels of activation, the vessel shell can be packaged more efficiently than the curie-limited internal components. This will allow the use of more conventional waste packages rather than shielded casks for transport (although some shielded casks are still required).

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. Disposal of the decontamination solution effluent is included within the estimate as a "process liquid waste" charge. 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 estimates include the cost to dispose of the retired steam generators expected to be in storage at the site upon the cessation of plant operations. The components are size-reduced to facilitate transportation.

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.[22] 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 material requiring controlled disposal are based upon the mileage to the EnergySolutions facility in Clive, Utah. Transportation costs for off-site waste processing are based upon the mileage to Memphis, Tennessee. Truck transport costs are estimated using published tariffs from Tri-State Motor Transit.[23]

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 detailed Appendices C and D, 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.

Disposal fees are based upon estimated charges, with surcharges added for the highly activated components, for example, generated in the segmentation of the reactor vessel. The cost to dispose of the majority of the material generated from the decontamination and dismantling activities is based upon the current cost for disposal at EnergySolutions facility in Clive, Utah. Disposal costs for the higher activity waste (Class B and C) were based upon the last published rate schedule for non-compact waste for the Barnwell facility (as a proxy).

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 just below ground level, backfilling and the collapsing of below grade voids, and general terra-forming such that the site upon

which the power block and supplemental structures are located is transformed into a "grassy plain."

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 EnergySolutions' facility.

The existing and replacement cooling tower discharge pipes will be left in place and 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

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

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.

AmerenUE, 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 AmerenUE. Overhead costs are included for site and corporate support, reduced commensurate with the staffing of the project.

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

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.[24] 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 were derived from CR-0130[25] and CR-0672,[26] 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. More extensive activation (at very low levels) of the interior structures within containment has been detected at several reactors and the owners have elected to dispose of the affected material at a controlled facility rather than reuse the material as fill on site or send it to a landfill. The ultimate disposition of the material removed from the containment building will depend upon the site release criteria selected, as well as the designated end use for the site.

3.5.4 General

Transition Activities

Existing warehouses are cleared of non-essential material and remain for use by AmerenUE 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. AmerenUE 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 required 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 and the limits for coverage defined in the NRC's proposed rulemaking "Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors."[27] 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 are provided in Tables 3.1 and 3.2. The tables delineate the cost contributors by year of expenditures as well as cost contributor (e.g., labor, materials, and waste disposal).

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.

The "Spent Fuel Management" subcategory contains costs associated with the five and one-half years of post-shutdown pool operations, and the management of the spent fuel until such time that the transfer of all fuel from this facility to an off-site location (e.g., geologic repository) 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 and backfilled to conform to local grade.

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.

Decommissioning costs are reported in 2008 dollars. Costs are not inflated, escalated, or discounted over the period of expenditure (or projected lifetime of the plant). The schedules are based upon the detailed activity costs reported in Appendices C and D, along with the timeline presented in Section 4.

TABLE 3.1
DECON ALTERNATIVE
SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
2024	11,042	1,068	320	10	1,192	13,632
2025	58,763	9,187	1,877	2,475	7,134	79,435
2026	67,944	25,027	1,967	30,611	17,409	142,958
2027	61,458	21,980	1,411	31,737	16,633	133,219
2028	54,046	10,531	1,171	7,310	6,111	79,170
2029	53,898	10,503	1,168	7,290	6,094	78,953
2030	41,726	6,640	772	6,643	4,857	60,639
2031	32,102	7,549	267	28	2,185	42,131
2032	28,133	22,979	156	0	1,063	52,331
2033	6,149	5,023	34	0	232	11,438
	415,261	120,486	9,144	86,104	62,911	693,907

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

TABLE 3.1a
DECON ALTERNATIVE
SCHEDULE OF LICENSE TERMINATION EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2024	10,669	327	320	10	868	12,194
2025	56,714	5,549	1,877	2,475	5,558	72,172
2026	64,536	21,255	1,967	30,611	16,003	134,372
2027	57,970	18,216	1,411	31,737	15,306	124,640
2028	50,965	6,799	1,171	7,310	4,806	71,051
2029	50,826	6,780	1,168	7,290	4,793	70,857
2030	40,817	5,539	772	6,643	4,472	58,243
2031	24,224	1,082	224	28	2,091	27,648
2032	142	0	0	0	726	868
2033	31	0	0	0	159	190
	356,894	65,546	8,910	86,104	54,781	572,236

TABLE 3.1b
DECON ALTERNATIVE
SCHEDULE OF SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2024	247	741	0	0	324	1,312
2025	1,213	3,638	0	0	1,576	6,427
2026	1,243	3,728	0	0	1,383	6,354
2027	1,236	3,708	0	0	1,301	6,246
2028	1,234	3,703	0	0	1,305	6,242
2029	1,231	3,693	0	0	1,301	6,225
2030	364	1,093	0	0	385	1,842
2031	0	0	0	0	0	0
2032	0	0	0	0	0	0
2033	0	0	0	0	0	0
	6,768	20,303	0	0	7,576	34,647

TABLE 3.1c
DECON ALTERNATIVE
SCHEDULE OF SITE RESTORATION EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2024	127	0	0	0	0	127
2025	836	0	0	0	0	836
2026	2,165	44	0	0	23	2,232
2027	2,252	55	0	0	26	2,333
2028	1,846	30	0	0	0	1,876
2029	1,841	30	0	0	0	1,871
2030	545	9	0	0	0	554
2031	7,877	6,467	44	0	95	14,483
2032	27,991	22,979	156	0	337	51,463
2033	6,118	5,023	34	0	74	11,249
	51,599	34,637	234	0	554	87,024

TABLE 3.2
SAFSTOR ALTERNATIVE
SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
2024	9,057	978	320	10	1,152	11,517
2025	46,322	7,386	1,557	433	5,948	61,646
2026	27,404	11,085	683	596	4,251	44,020
2027	12,103	4,005	311	34	2,767	19,221
2028	12,137	4,016	312	34	2,774	19,273
2029	12,103	4,005	311	34	2,767	19,221
2030	5,658	1,381	202	32	1,636	8,909
2031	2,950	278	156	31	1,161	4,575
2032	2,958	278	156	31	1,164	4,588
2033	2,950	278	156	31	1,161	4,575
2034	2,950	278	156	31	1,161	4,575
2035	2,950	278	156	31	1,161	4,575
2036	2,958	278	156	31	1,164	4,588
2037	2,950	278	156	31	1,161	4,575
2038	2,950	278	156	31	1,161	4,575
2039	2,950	278	156	31	1,161	4,575
2040	2,958	278	156	31	1,164	4,588
2041	2,950	278	156	31	1,161	4,575
2042	2,950	278	156	31	1,161	4,575
2043	2,950	278	156	31	1,161	4,575
2044	2,958	278	156	31	1,164	4,588
2045	2,950	278	156	31	1,161	4,575
2046	2,950	278	156	31	1,161	4,575
2047	2,950	278	156	31	1,161	4,575
2048	2,958	278	156	31	1,164	4,588
2049	2,950	278	156	31	1,161	4,575
2050	2,950	278	156	31	1,161	4,575
2051	2,950	278	156	31	1,161	4,575
2052	2,958	278	156	31	1,164	4,588
2053	2,950	278	156	31	1,161	4,575
2054	2,950	278	156	31	1,161	4,575
2055	2,950	278	156	31	1,161	4,575
2056	2,958	278	156	31	1,164	4,588

TABLE 3.2 (continued)
SAFSTOR ALTERNATIVE
SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other [1]	Total [2]
2057	2,950	278	156	31	1,161	4,575
2058	2,950	278	156	31	1,161	4,575
2059	2,950	278	156	31	1,161	4,575
2060	2,958	278	156	31	1,164	4,588
2061	2,950	278	156	31	1,161	4,575
2062	2,950	278	156	31	1,161	4,575
2063	2,950	278	156	31	1,161	4,575
2064	2,958	278	156	31	1,164	4,588
2065	2,950	278	156	31	1,161	4,575
2066	2,950	278	156	31	1,161	4,575
2067	2,950	278	156	31	1,161	4,575
2068	2,958	278	156	31	1,164	4,588
2069	2,950	278	156	31	1,161	4,575
2070	2,950	278	156	31	1,161	4,575
2071	2,950	278	156	31	1,161	4,575
2072	2,958	278	156	31	1,164	4,588
2073	2,950	278	156	31	1,161	4,575
2074	2,950	278	156	31	1,161	4,575
2075	2,950	278	156	31	1,161	4,575
2076	2,958	278	156	31	1,164	4,588
2077	2,950	278	156	31	1,161	4,575
2078	22,606	997	720	36	1,476	25,836
2079	42,441	3,074	1,557	48	3,937	51,057
2080	54,819	23,699	1,491	35,976	20,187	136,173
2081	47,468	10,044	1,229	13,367	7,893	80,000
2082	45,331	6,139	1,168	6,845	4,444	63,926
2083	45,331	6,139	1,168	6,845	4,444	63,926
2084	32,776	6,101	315	311	2,388	41,891
2085	28,056	22,916	156	0	1,060	52,188
2086	8,378	6,844	46	0	316	15,585
	590,727	131,871	18,872	66,068	122,030	929,568

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

TABLE 3.2a
SAFSTOR ALTERNATIVE
SCHEDULE OF LICENSE TERMINATION EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2024	8,810	237	320	10	828	10,205
2025	45,109	3,748	1,557	433	4,372	55,219
2026	20,609	7,366	574	596	2,669	31,815
2027	2,950	305	156	34	1,182	4,627
2028	2,958	306	156	34	1,185	4,639
2029	2,950	305	156	34	1,182	4,627
2030	2,950	286	156	32	1,167	4,590
2031	2,950	278	156	31	1,161	4,575
2032	2,958	278	156	31	1,164	4,588
2033	2,950	278	156	31	1,161	4,575
2034	2,950	278	156	31	1,161	4,575
2035	2,950	278	156	31	1,161	4,575
2036	2,958	278	156	31	1,164	4,588
2037	2,950	278	156	31	1,161	4,575
2038	2,950	278	156	31	1,161	4,575
2039	2,950	278	156	31	1,161	4,575
2040	2,958	278	156	31	1,164	4,588
2041	2,950	278	156	31	1,161	4,575
2042	2,950	278	156	31	1,161	4,575
2043	2,950	278	156	31	1,161	4,575
2044	2,958	278	156	31	1,164	4,588
2045	2,950	278	156	31	1,161	4,575
2046	2,950	278	156	31	1,161	4,575
2047	2,950	278	156	31	1,161	4,575
2048	2,958	278	156	31	1,164	4,588
2049	2,950	278	156	31	1,161	4,575
2050	2,950	278	156	31	1,161	4,575
2051	2,950	278	156	31	1,161	4,575
2052	2,958	278	156	31	1,164	4,588
2053	2,950	278	156	31	1,161	4,575
2054	2,950	278	156	31	1,161	4,575
2055	2,950	278	156	31	1,161	4,575
2056	2,958	278	156	31	1,164	4,588

TABLE 3.2a (continued)
SAFSTOR ALTERNATIVE
SCHEDULE OF LICENSE TERMINATION EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2057	2,950	278	156	31	1,161	4,575
2058	2,950	278	156	31	1,161	4,575
2059	2,950	278	156	31	1,161	4,575
2060	2,958	278	156	31	1,164	4,588
2061	2,950	278	156	31	1,161	4,575
2062	2,950	278	156	31	1,161	4,575
2063	2,950	278	156	31	1,161	4,575
2064	2,958	278	156	31	1,164	4,588
2065	2,950	278	156	31	1,161	4,575
2066	2,950	278	156	31	1,161	4,575
2067	2,950	278	156	31	1,161	4,575
2068	2,958	278	156	31	1,164	4,588
2069	2,950	278	156	31	1,161	4,575
2070	2,950	278	156	31	1,161	4,575
2071	2,950	278	156	31	1,161	4,575
2072	2,958	278	156	31	1,164	4,588
2073	2,950	278	156	31	1,161	4,575
2074	2,950	278	156	31	1,161	4,575
2075	2,950	278	156	31	1,161	4,575
2076	2,958	278	156	31	1,164	4,588
2077	2,950	278	156	31	1,161	4,575
2078	22,088	997	720	36	1,476	25,317
2079	41,545	3,074	1,557	48	3,937	50,161
2080	51,854	23,629	1,491	35,976	20,157	133,107
2081	45,529	10,007	1,229	13,367	7,886	78,018
2082	43,701	6,113	1,168	6,845	4,444	62,270
2083	43,701	6,113	1,168	6,845	4,444	62,270
2084	26,973	1,391	283	311	2,319	31,277
2085	141	0	0	0	724	865
2086	42	0	0	0	216	258
	500,647	76,938	18,015	66,068	112,779	774,447

TABLE 3.2b
SAFSTOR ALTERNATIVE
SCHEDULE OF SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2024	247	741	0	0	324	1,312
2025	1,213	3,638	0	0	1,576	6,427
2026	6,795	3,719	109	0	1,582	12,205
2027	9,154	3,700	156	0	1,585	14,594
2028	9,179	3,710	156	0	1,589	14,634
2029	9,154	3,700	156	0	1,585	14,594
2030	2,708	1,095	46	0	469	4,318
2031	0	0	0	0	0	0
2032	0	0	0	0	0	0
2033	0	0	0	0	0	0
2034	0	0	0	0	0	0
2035	0	0	0	0	0	0
2036	0	0	0	0	0	0
2037	0	0	0	0	0	0
2038	0	0	0	0	0	0
2039	0	0	0	0	0	0
2040	0	0	0	0	0	0
2041	0	0	0	0	0	0
2042	0	0	0	0	0	0
2043	0	0	0	0	0	0
2044	0	0	0	0	0	0
2045	0	0	0	0	0	0
2046	0	0	0	0	0	0
2047	0	0	0	0	0	0
2048	0	0	0	0	0	0
2049	0	0	0	0	0	0
2050	0	0	0	0	0	0
2051	0	0	0	0	0	0
2052	0	0	0	0	0	0
2053	0	0	0	0	0	0
2054	0	0	0	0	0	0
2055	0	0	0	0	0	0
2056	0	0	0	0	0	0

TABLE 3.2b (continued)
SAFSTOR ALTERNATIVE
SCHEDULE OF SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2057	0	0	0	0	0	0
2058	0	0	0	0	0	0
2059	0	0	0	0	0	0
2060	0	0	0	0	0	0
2061	0	0	0	0	0	0
2062	0	0	0	0	0	0
2063	0	0	0	0	0	0
2064	0	0	0	0	0	0
2065	0	0	0	0	0	0
2066	0	0	0	0	0	0
2067	0	0	0	0	0	0
2068	0	0	0	0	0	0
2069	0	0	0	0	0	0
2070	0	0	0	0	0	0
2071	0	0	0	0	0	0
2072	0	0	0	0	0	0
2073	0	0	0	0	0	0
2074	0	0	0	0	0	0
2075	0	0	0	0	0	0
2076	0	0	0	0	0	0
2077	0	0	0	0	0	0
2078	0	0	0	0	0	0
2079	0	0	0	0	0	0
2080	0	0	0	0	0	0
2081	0	0	0	0	0	0
2082	0	0	0	0	0	0
2083	0	0	0	0	0	0
2084	0	0	0	0	0	0
2085	0	0	0	0	0	0
2086	0	0	0	0	0	0
	38,448	20,303	623	0	8,709	68,084

TABLE 3.2c
SAFSTOR ALTERNATIVE
SCHEDULE OF SITE RESTORATION EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2024	0	0	0	0	0	0
2025	0	0	0	0	0	0
2026	0	0	0	0	0	0
2027	0	0	0	0	0	0
2028	0	0	0	0	0	0
2029	0	0	0	0	0	0
2030	0	0	0	0	0	0
2031	0	0	0	0	0	0
2032	0	0	0	0	0	0
2033	0	0	0	0	0	0
2034	0	0	0	0	0	0
2035	0	0	0	0	0	0
2036	0	0	0	0	0	0
2037	0	0	0	0	0	0
2038	0	0	0	0	0	0
2039	0	0	0	0	0	0
2040	0	0	0	0	0	0
2041	0	0	0	0	0	0
2042	0	0	0	0	0	0
2043	0	0	0	0	0	0
2044	0	0	0	0	0	0
2045	0	0	0	0	0	0
2046	0	0	0	0	0	0
2047	0	0	0	0	0	0
2048	0	0	0	0	0	0
2049	0	0	0	0	0	0
2050	0	0	0	0	0	0
2051	0	0	0	0	0	0
2052	0	0	0	0	0	0
2053	0	0	0	0	0	0
2054	0	0	0	0	0	0
2055	0	0	0	0	0	0
2056	0	0	0	0	0	0

TABLE 3.2c (continued)
SAFSTOR ALTERNATIVE
SCHEDULE OF SITE RESTORATION EXPENDITURES
(thousands, 2008 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2057	0	0	0	0	0	0
2058	0	0	0	0	0	0
2059	0	0	0	0	0	0
2060	0	0	0	0	0	0
2061	0	0	0	0	0	0
2062	0	0	0	0	0	0
2063	0	0	0	0	0	0
2064	0	0	0	0	0	0
2065	0	0	0	0	0	0
2066	0	0	0	0	0	0
2067	0	0	0	0	0	0
2068	0	0	0	0	0	0
2069	0	0	0	0	0	0
2070	0	0	0	0	0	0
2071	0	0	0	0	0	0
2072	0	0	0	0	0	0
2073	0	0	0	0	0	0
2074	0	0	0	0	0	0
2075	0	0	0	0	0	0
2076	0	0	0	0	0	0
2077	0	0	0	0	0	0
2078	519	0	0	0	0	519
2079	896	0	0	0	0	896
2080	2,965	70	0	0	30	3,065
2081	1,939	37	0	0	7	1,982
2082	1,630	26	0	0	0	1,657
2083	1,630	26	0	0	0	1,657
2084	5,803	4,710	32	0	69	10,614
2085	27,915	22,916	156	0	336	51,322
2086	8,336	6,844	46	0	100	15,326
	51,632	34,630	234	0	541	87,037

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 5½ 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 2003" computer software.[28]

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.

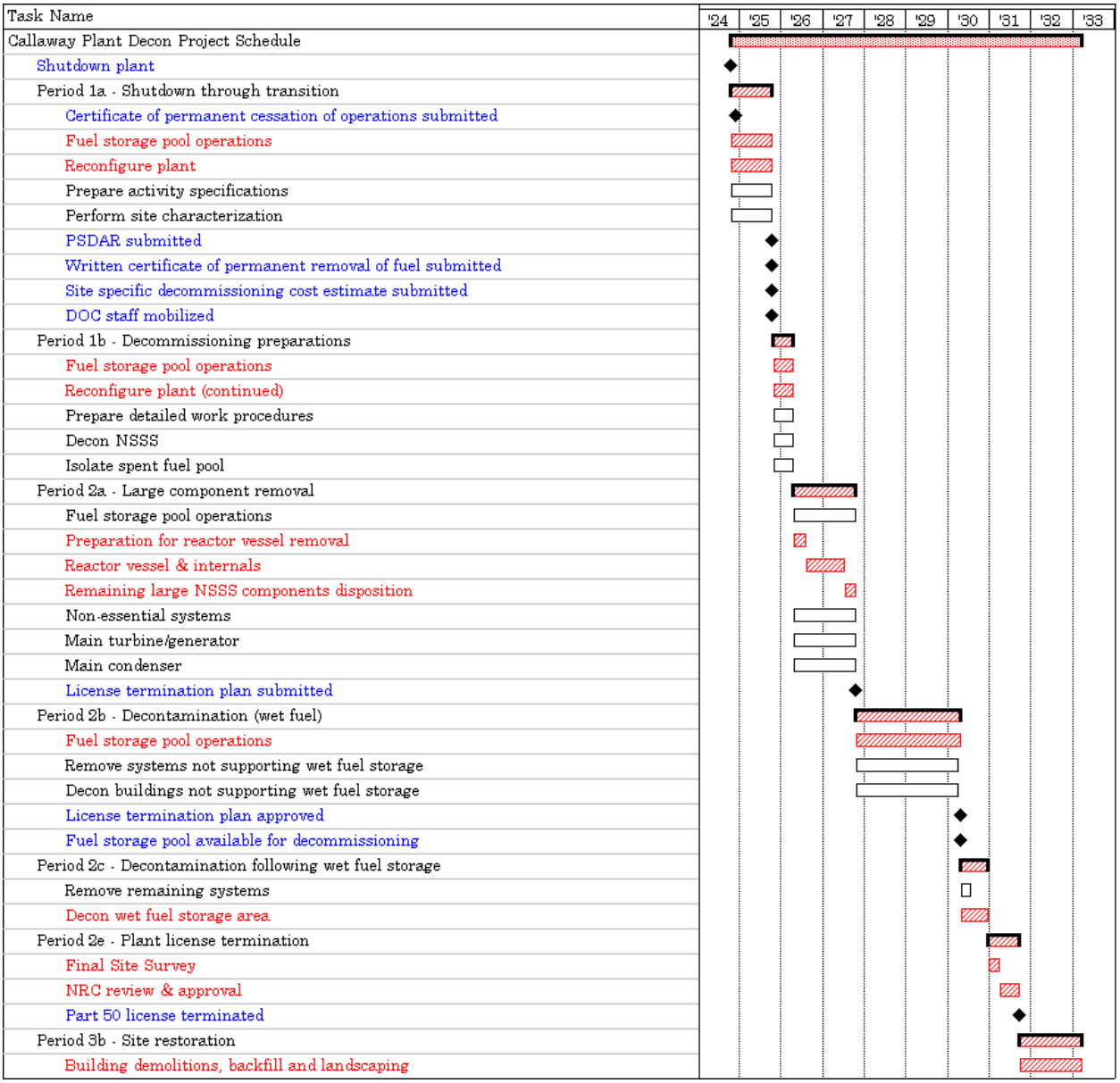
- For plant systems removal, the systems with the longest removal durations in areas on the critical path are considered to determine the duration of the activity.

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 2024 shutdown date. The fuel pool is emptied approximately 5½ 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.

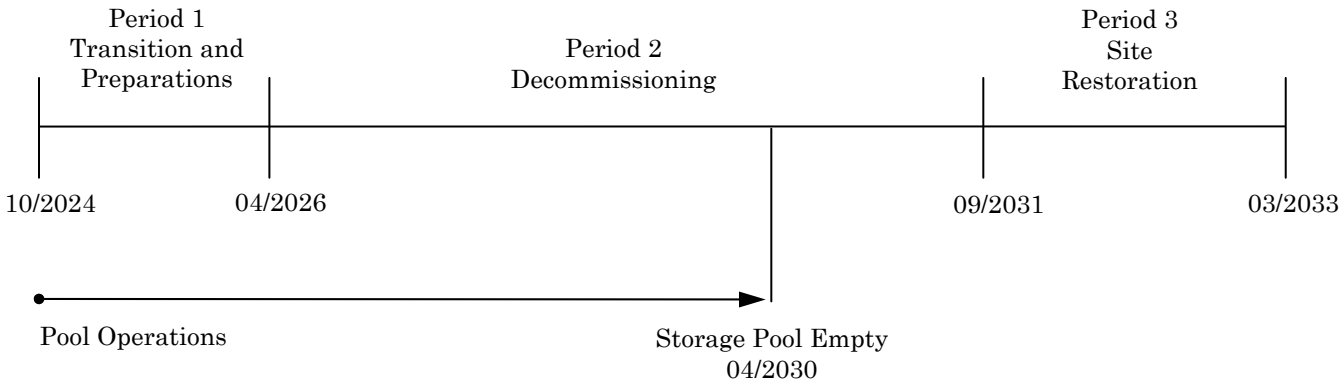
FIGURE 4.1
ACTIVITY SCHEDULE



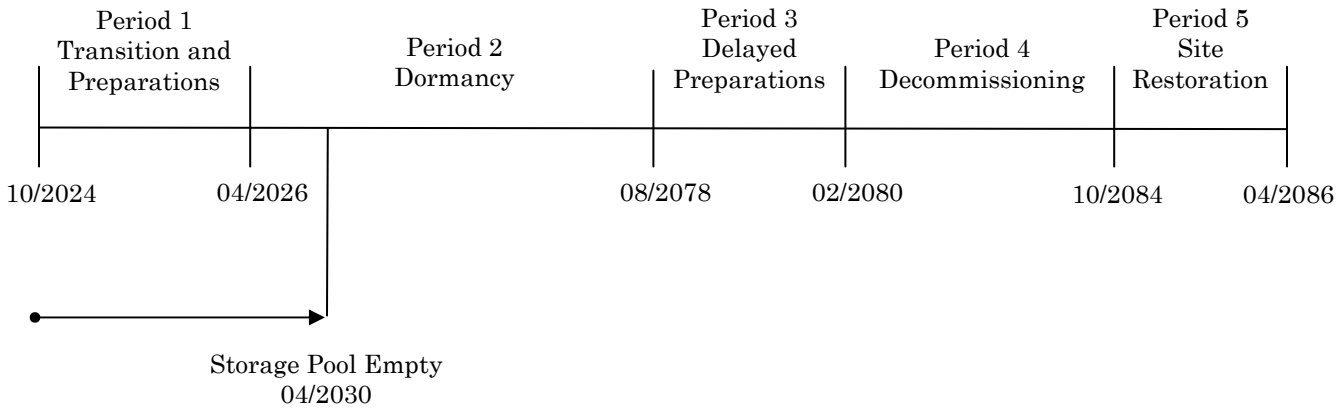
Legend:
1. Red text and/or shaded scheduling bars indicate critical path activities
2. Shaded scheduling bars associated with major decommissioning periods, e.g., Period 1a, indicate overall duration of that period
3. Blue text and/or diamond symbols indicate major milestones

FIGURE 4.2
DECOMMISSIONING TIMELINES
(not to scale)

DECON Alternative



SAFSTOR Alternative



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,[29] 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 volumes of radioactive waste generated during the various decommissioning activities at the site are shown on a line-item basis in Appendices C and D, and summarized in Tables 5.1 and 5.2. 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 EnergySolutions 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 EnergySolutions 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 the last published rate schedule for non-compact waste for the Barnwell facility (as a proxy). Additional surcharges were included for activity, dose rate, and/or handling added as appropriate for the particular package.

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)	EnergySolutions	A	141,483	12,114,319
	Barnwell	B	4,668	570,124
	Barnwell	C	459	48,448
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	499	104,146
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	411,681	10,682,990
Totals [2]			558,790	23,520,027

[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)	EnergySolutions	A	139,840	10,482,398
	Barnwell	B	3,330	350,113
	Barnwell	C	470	47,758
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	499	104,146
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	437,494	11,780,860
Totals [2]			581,632	22,765,175

[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 2005. 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 5½ years following the cessation of operations for continued cooling of the assemblies. Once sufficiently cooled, the assemblies will be transferred to a DOE facility (e.g., geologic repository).

The cost projected to promptly decommission (DECON) Callaway is estimated to be $693.9 million. The majority of this cost (approximately 82.5%) is associated with the physical decontamination and dismantling of the nuclear unit so that the operating license can be terminated. Another 5.0% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 12.5% is for the demolition of the designated structures and limited restoration of the site.

The cost projected for deferred decommissioning (SAFSTOR) is estimated to be $929.6 million. The majority of this cost (approximately 83.3%) 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 7.3% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 9.4% 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 AmerenUE 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 5½ 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 5½-year period, the spent fuel will be packaged into transportable canisters for loading into a DOE-provided transport cask.

The cost for waste disposal includes only 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 EnergySolutions' 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 2008 dollars)

Cost Element	Total	Percentage
Decontamination	17,593	2.5
Removal	146,429	21.1
Packaging	16,531	2.4
Transportation	12,505	1.8
Waste Disposal	75,885	10.9
Off-site Waste Processing	22,814	3.3
Program Management [1]	297,742	42.9
Corporate Allocations	10,098	1.5
Spent Fuel Pool Isolation	10,819	1.6
Spent Fuel Management [2]	34,647	5.0
Insurance and Regulatory Fees	11,469	1.7
Energy	9,144	1.3
Characterization and Licensing Surveys	19,093	2.8
Property Taxes	2,780	0.4
Miscellaneous Equipment	6,359	0.9
Total [3]	693,907	100

Cost Element	Total	Percentage
License Termination	572,236	82.5
Spent Fuel Management	34,647	5.0
Site Restoration	87,024	12.5
Total [3]	693,907	100

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

TABLE 6.2
SAFSTOR ALTERNATIVE
DECOMMISSIONING COST ELEMENTS
(thousands of 2008 dollars)

Cost Element	Total	Percentage
Decontamination	15,473	1.7
Removal	146,469	15.8
Packaging	13,753	1.5
Transportation	9,747	1.0
Waste Disposal	53,525	5.8
Off-site Waste Processing	25,137	2.7
Program Management [1]	476,544	51.3
Corporate Allocations	13,464	1.4
Spent Fuel Pool Isolation	10,819	1.2
Spent Fuel Management [2]	34,647	3.7
Insurance and Regulatory Fees	51,122	5.5
Energy	18,872	2.0
Characterization and Licensing Surveys	20,627	2.2
Property Taxes	20,296	2.2
Miscellaneous Equipment	19,074	2.1
Total [3]	929,568	100

Cost Element	Total	Percentage
License Termination	774,447	83.31
Spent Fuel Management [4]	68,084	7.32
Site Restoration	87,037	9.36
Total [3]	929,568	100

[1] Includes engineering and security costs
[2] Direct costs only. Excludes program management costs (staffing) but includes costs for spent fuel loading/packaging costs/spent fuel pool O&M and EP 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 Plant," Document No. A22-1534-002, Rev. 0, TLG Services, Inc., August 2005

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. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.159, "Assuring the Availability of Funds for Decommissioning Nuclear Reactors," October 2003

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

5. U.S. Code of Federal Regulations, Title 10, Parts 20 and 50, "Entombment Options for Power Reactors," Advanced Notice of Proposed Rulemaking, Federal Register Volume 66, Number 200, October 16, 2001

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.

7. "Nuclear Waste Policy Act of 1982 and Amendments," U.S. Department of Energy's Office of Civilian Radioactive Management, 1982

8. Testimony of Edward Sproat, Director, Office of Civilian Radioactive Waste Management, before a U.S. House of Representatives subcommittee on the status of Yucca Mountain, July 15, 2008

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

10. "Low Level Radioactive Waste Policy Act," Public Law 96-573, 1980

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

7. REFERENCES
(continued)

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

13. U.S. Code of Federal Regulations, Title 10, Part 20, Subpart E, "Radiological Criteria for License Termination," Federal Register, Volume 62, Number 139 (p 39058 et seq.), July 21, 1997

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

15. U.S. Code of Federal Regulations, Title 40, Part 141.16, "Maximum contaminant levels for beta particle and photon radioactivity from man-made radionuclides in community water systems"

16. "Memorandum of Understanding Between the Environmental Protection Agency and the Nuclear Regulatory Commission: Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites," OSWER 9295.8-06a, October 9, 2002

17. "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," NUREG/CR-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, August 2000

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

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

20. "Building Construction Cost Data 2008," Robert Snow Means Company, Inc., Kingston, Massachusetts

21. Project and Cost Engineers' Handbook, Second Edition, p. 239, American Association of Cost Engineers, Marcel Dekker, Inc., New York, New York, 1984

22. U.S. Department of Transportation, Title 49 of the Code of Federal Regulations, "Transportation," Parts 173 through 178, 2007

7. REFERENCES
(continued)

23. Tri-State Motor Transit Company, published tariffs, Interstate Commerce Commission (ICC), Docket No. MC-427719 Rules Tariff, March 2004, Radioactive Materials Tariff, February 2006

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

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

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

27. “Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors,” 10 CFR Parts 50 and 140, Federal Register Notice, Vol. 62, No. 210, October 30, 1997

28. "Microsoft Project Professional 2003," Microsoft Corporation, Redmond, WA.

29. “Atomic Energy Act of 1954,” (68 Stat. 919)

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 hr *****

* alpha designators indicate activities that can be performed in parallel

APPENDIX A
(continued)

3. LABOR REQUIRED

Crew	Number	Duration (hours)	Rate ($/hr)	Cost
Laborers	3.00	11.217	$34.72	$1168.36
Craftsmen	2.00	11.217	$52.38	$1175.09
Foreman	1.00	11.217	$54.86	$615.36
General Foreman	0.25	11.217	$55.89	$156.73
Fire Watch	0.05	11.217	$34.72	$19.47
Health Physics Technician	1.00	11.217	$58.57	$656.98
Total Labor Cost				$3,791.99

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Blotting paper 50 @ $0.52 sq ft {1}	$26.00
-Plastic sheets/bags 50 @ $0.16/sq ft {2}	$8.00
-Gas torch consumables 1 @ $9.35/hr x 1 hr {3}	$9.35
Subtotal cost of equipment and materials	$43.35
Overhead & profit on equipment and materials @ 14.23 %	$6.17
Total costs, equipment & material	$49.52

TOTAL COST:

Removal of contaminated **heat exchanger <3000 pounds:**	**$3,841.51**
Total labor cost:	$3,791.99
Total equipment/material costs:	$49.52
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. McMaster-Carr, Item 7193T88, Spill Control
  2. R.S. Means (2008) Division 01 56, Section 13.60-0200, page 20
  3. R.S. Means (2008) Division 01 54 33, Section 40-6360, Reference-10

- Material and consumable costs were adjusted using the regional indices for Columbia, Missouri.

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	0.40
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	4.16
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	6.04
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	12.19
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	23.21
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	30.14
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	44.35
Removal of clean pipe >36 inches diameter, $/linear foot	52.71
Removal of clean valve >2 to 4 inches	79.92
Removal of clean valve >4 to 8 inches	121.89
Removal of clean valve >8 to 14 inches	232.12
Removal of clean valve >14 to 20 inches	301.35
Removal of clean valve >20 to 36 inches	443.46
Removal of clean valve >36 inches	527.10
Removal of clean pipe hanger for small bore piping	25.90
Removal of clean pipe hanger for large bore piping	92.23
Removal of clean pump, <300 pound	204.60
Removal of clean pump, 300-1000 pound	578.66
Removal of clean pump, 1000-10,000 pound	2,277.30
Removal of clean pump, >10,000 pound	4,400.68
Removal of clean pump motor, 300-1000 pound	243.45
Removal of clean pump motor, 1000-10,000 pound	948.62
Removal of clean pump motor, >10,000 pound	2,134.39
Removal of clean heat exchanger <3000 pound	1,221.71
Removal of clean heat exchanger >3000 pound	3,070.43

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean feedwater heater/deaerator	8,663.61
Removal of clean moisture separator/reheater	17,822.02
Removal of clean tank, <300 gallons	263.32
Removal of clean tank, 300-3000 gallon	832.15
Removal of clean tank, >3000 gallons, $/square foot surface area	7.08
Removal of clean electrical equipment, <300 pound	112.03
Removal of clean electrical equipment, 300-1000 pound	396.37
Removal of clean electrical equipment, 1000-10,000 pound	792.74
Removal of clean electrical equipment, >10,000 pound	1,895.66
Removal of clean electrical transformer < 30 tons	1,316.51
Removal of clean electrical transformer > 30 tons	3,791.31
Removal of clean standby diesel generator, <100 kW	1,344.70
Removal of clean standby diesel generator, 100 kW to 1 MW	3,001.45
Removal of clean standby diesel generator, >1 MW	6,213.61
Removal of clean electrical cable tray, $/linear foot	10.45
Removal of clean electrical conduit, $/linear foot	4.56
Removal of clean mechanical equipment, <300 pound	112.03
Removal of clean mechanical equipment, 300-1000 pound	396.37
Removal of clean mechanical equipment, 1000-10,000 pound	792.74
Removal of clean mechanical equipment, >10,000 pound	1,895.66
Removal of clean HVAC equipment, <300 pound	112.03
Removal of clean HVAC equipment, 300-1000 pound	396.37
Removal of clean HVAC equipment, 1000-10,000 pound	792.74
Removal of clean HVAC equipment, >10,000 pound	1,895.66
Removal of clean HVAC ductwork, $/pound	0.42

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated instrument and sampling tubing, $/linear foot	1.39
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	18.04
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	31.36
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	51.68
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	100.00
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	120.27
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	166.85
Removal of contaminated pipe >36 inches diameter, $/linear foot	197.40
Removal of contaminated valve >2 to 4 inches	397.26
Removal of contaminated valve >4 to 8 inches	478.56
Removal of contaminated valve >8 to 14 inches	961.12
Removal of contaminated valve >14 to 20 inches	1,222.45
Removal of contaminated valve >20 to 36 inches	1,629.62
Removal of contaminated valve >36 inches	1,935.16
Removal of contaminated pipe hanger for small bore piping	96.84
Removal of contaminated pipe hanger for large bore piping	306.03
Removal of contaminated pump, <300 pound	851.64
Removal of contaminated pump, 300-1000 pound	1,971.83
Removal of contaminated pump, 1000-10,000 pound	6,281.66
Removal of contaminated pump, >10,000 pound	15,299.93
Removal of contaminated pump motor, 300-1000 pound	834.62
Removal of contaminated pump motor, 1000-10,000 pound	2,554.70
Removal of contaminated pump motor, >10,000 pound	5,735.58
Removal of contaminated heat exchanger <3000 pound	3,841.51
Removal of contaminated heat exchanger >3000 pound	11,116.28

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated tank, <300 gallons	1,414.77
Removal of contaminated tank, >300 gallons, $/square foot	27.75
Removal of contaminated electrical equipment, <300 pound	663.38
Removal of contaminated electrical equipment, 300-1000 pound	1,603.50
Removal of contaminated electrical equipment, 1000-10,000 pound	3,087.01
Removal of contaminated electrical equipment, >10,000 pound	6,023.00
Removal of contaminated electrical cable tray, $/linear foot	31.98
Removal of contaminated electrical conduit, $/linear foot	14.71
Removal of contaminated mechanical equipment, <300 pound	738.56
Removal of contaminated mechanical equipment, 300-1000 pound	1,772.89
Removal of contaminated mechanical equipment, 1000-10,000 pound	3,407.64
Removal of contaminated mechanical equipment, >10,000 pound	6,023.00
Removal of contaminated HVAC equipment, <300 pound	738.56
Removal of contaminated HVAC equipment, 300-1000 pound	1,772.89
Removal of contaminated HVAC equipment, 1000-10,000 pound	3,407.64
Removal of contaminated HVAC equipment, >10,000 pound	6,023.00
Removal of contaminated HVAC ductwork, $/pound	1.96
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	3.46
Additional decontamination of surface by washing, $/square foot	7.01
Additional decontamination of surfaces by hydrolasing, $/square foot	32.83
Decontamination rig hook up and flush, $/ 250 foot length	6,268.70
Chemical flush of components/systems, $/gallon	14.51
Removal of clean standard reinforced concrete, $/cubic yard	121.20
Removal of grade slab concrete, $/cubic yard	159.05
Removal of clean concrete floors, $/cubic yard	317.14

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of sections of clean concrete floors, $/cubic yard	938.18
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	213.33
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	1,904.04
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	269.76
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	2,520.31
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cubic yard	409.36
Removal of below-grade suspended floors, $/cubic yard	317.14
Removal of clean monolithic concrete structures, $/cubic yard	794.02
Removal of contaminated monolithic concrete structures, $/cubic yard	1,901.68
Removal of clean foundation concrete, $/cubic yard	623.54
Removal of contaminated foundation concrete, $/cubic yard	1,771.66
Explosive demolition of bulk concrete, $/cubic yard	27.64
Removal of clean hollow masonry block wall, $/cubic yard	83.08
Removal of contaminated hollow masonry block wall, $/cubic yard	304.42
Removal of clean solid masonry block wall, $/cubic yard	83.08
Removal of contaminated solid masonry block wall, $/cubic yard	304.42
Backfill of below-grade voids, $/cubic yard	15.71
Removal of subterranean tunnels/voids, $/linear foot	98.03
Placement of concrete for below-grade voids, $/cubic yard	132.20
Excavation of clean material, $/cubic yard	2.67
Excavation of contaminated material, $/cubic yard	38.37
Removal of clean concrete rubble (tipping fee included), $/cubic yard	201.42
Removal of contaminated concrete rubble, $/cubic yard	23.69
Removal of building by volume, $/cubic foot	0.27
Removal of clean building metal siding, $/square foot	0.94

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated building metal siding, $/square foot	3.72
Removal of standard asphalt roofing, $/square foot	1.87
Removal of transite panels, $/square foot	1.90
Scarifying contaminated concrete surfaces (drill & spall), $/square foot	12.92
Scabbling contaminated concrete floors, $/square foot	7.25
Scabbling contaminated concrete walls, $/square foot	18.70
Scabbling contaminated ceilings, $/square foot	63.74
Scabbling structural steel, $/square foot	6.24
Removal of clean overhead crane/monorail < 10 ton capacity	565.17
Removal of contaminated overhead crane/monorail < 10 ton capacity	1,697.01
Removal of clean overhead crane/monorail >10-50 ton capacity	1,356.39
Removal of contaminated overhead crane/monorail >10-50 ton capacity	4,072.11
Removal of polar crane > 50 ton capacity	5,686.94
Removal of gantry crane > 50 ton capacity	23,695.67
Removal of structural steel, $/pound	0.19
Removal of clean steel floor grating, $/square foot	4.12
Removal of contaminated steel floor grating, $/square foot	12.48
Removal of clean free standing steel liner, $/square foot	10.62
Removal of contaminated free standing steel liner, $/square foot	32.48
Removal of clean concrete-anchored steel liner, $/square foot	5.31
Removal of contaminated concrete-anchored steel liner, $/square foot	37.84
Placement of scaffolding in clean areas, $/square foot	14.76
Placement of scaffolding in contaminated areas, $/square foot	24.53
Landscaping with topsoilout, $/acre	1,091.13
Cost of CPC B-88 LSA box & preparation for use	1,654.23

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	1,456.03
Cost of CPC B-12V 12 gauge LSA box & preparation for use	1,425.53
Cost of CPC B-144 LSA box & preparation for use	8,778.65
Cost of LSA drum & preparation for use	131.90
Cost of cask liner for CNSI 14 195 cask	152.36
Cost of cask liner for CNSI 8 120A cask (resins)	6,825.54
Cost of cask liner for CNSI 8 120A cask (filters)	922.30
Decontamination of surfaces with vacuuming, $/square foot	0.58

APPENDIX C

DETAILED COST ANALYSIS

DECON

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	237	36	273	273	-	-	-	-	-	-	-	-	-	2,000
1a.1.7	Review plant dwgs & specs.	-	-	-	-	-	-	545	82	627	627	-	-	-	-	-	-	-	-	-	4,600
1a.1.8	Perform detailed rad survey									a											
1a.1.9	Estimate by-product inventory	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
1a.1.10	End product description	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	Detailed by-product inventory	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	1,300
1a.1.12	Define major work sequence	-	-	-	-	-	-	889	133	1,022	1,022	-	-	-	-	-	-	-	-	-	7,500
1a.1.13	Perform SER and EA	-	-	-	-	-	-	367	55	422	422	-	-	-	-	-	-	-	-	-	3,100
1a.1.14	Perform Site-Specific Cost Study	-	-	-	-	-	-	592	89	681	681	-	-	-	-	-	-	-	-	-	5,000
1a.1.15	Prepare/submit License Termination Plan	-	-	-	-	-	-	485	73	558	558	-	-	-	-	-	-	-	-	-	4,096
1a.1.16	Receive NRC approval of termination plan									a											
Activity Specifications																					
1a.1.17.1	Plant & temporary facilities	-	-	-	-	-	-	583	87	670	603	-	67	-	-	-	-	-	-	-	4,920
1a.1.17.2	Plant systems	-	-	-	-	-	-	494	74	568	511	-	57	-	-	-	-	-	-	-	4,167
1a.1.17.3	NSSS Decontamination Flush	-	-	-	-	-	-	59	9	68	68	-	-	-	-	-	-	-	-	-	500
1a.1.17.4	Reactor internals	-	-	-	-	-	-	841	126	967	967	-	-	-	-	-	-	-	-	-	7,100
1a.1.17.5	Reactor vessel	-	-	-	-	-	-	770	116	886	886	-	-	-	-	-	-	-	-	-	6,500
1a.1.17.6	Biological shield	-	-	-	-	-	-	59	9	68	68	-	-	-	-	-	-	-	-	-	500
1a.1.17.7	Steam generators	-	-	-	-	-	-	370	55	425	425	-	-	-	-	-	-	-	-	-	3,120
1a.1.17.8	Reinforced concrete	-	-	-	-	-	-	190	28	218	109	-	109	-	-	-	-	-	-	-	1,600
1a.1.17.9	Main Turbine	-	-	-	-	-	-	47	7	55	-	-	55	-	-	-	-	-	-	-	400
1a.1.17.10	Main Condensers	-	-	-	-	-	-	47	7	55	-	-	55	-	-	-	-	-	-	-	400
1a.1.17.11	Plant structures & buildings	-	-	-	-	-	-	370	55	425	213	-	213	-	-	-	-	-	-	-	3,120
1a.1.17.12	Waste management	-	-	-	-	-	-	545	82	627	627	-	-	-	-	-	-	-	-	-	4,600
1a.1.17.13	Facility & site closeout	-	-	-	-	-	-	107	16	123	61	-	61	-	-	-	-	-	-	-	900
1a.1.17	Total	-	-	-	-	-	-	4,482	672	5,154	4,538	-	616	-	-	-	-	-	-	-	37,827
Planning & Site Preparations																					
1a.1.18	Prepare dismantling sequence	-	-	-	-	-	-	284	43	327	327	-	-	-	-	-	-	-	-	-	2,400
1a.1.19	Plant prep. & temp. svces	-	-	-	-	-	-	2,700	405	3,105	3,105	-	-	-	-	-	-	-	-	-	-
1a.1.20	Design water clean-up system	-	-	-	-	-	-	166	25	191	191	-	-	-	-	-	-	-	-	-	1,400
1a.1.21	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,100	315	2,415	2,415	-	-	-	-	-	-	-	-	-	-
1a.1.22	Procure casks/liners & containers	-	-	-	-	-	-	146	22	168	168	-	-	-	-	-	-	-	-	-	1,230
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	13,538	2,031	15,569	14,953	-	616	-	-	-	-	-	-	-	73,753
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	4,180	627	4,807	-	4,807	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	4,180	627	4,807	-	4,807	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	1,662	166	1,828	1,828	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	300	30	330	330	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	432	-	-	-	-	-	108	540	540	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	424	-	-	-	-	-	64	488	488	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	11	6	-	41	-	12	70	70	-	-	-	675	-	-	-	13,531	22	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,354	203	1,557	1,557	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	706	71	776	776	-	-	-	-	-	-	-	-	-	-

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Table C
Callaway Plant
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(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 1a Period-Dependent Costs (continued)																					
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	450	45	495	-	495	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	256	38	295	295	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	940	141	1,082	-	1,082	-	-	-	-	-	-	-	-	-
1a.4.11	Corporate Allocations	-	-	-	-	-	-	900	90	990	990	-	-	-	-	-	-	-	-	-	-
1a.4.12	Security Staff Cost	-	-	-	-	-	-	5,658	849	6,507	6,507	-	-	-	-	-	-	-	-	-	157,471
1a.4.13	Utility Staff Cost	-	-	-	-	-	-	26,966	4,045	31,011	31,011	-	-	-	-	-	-	-	-	-	423,400
1a.4	Subtotal Period 1a Period-Dependent Costs	-	856	11	6	-	41	39,192	5,862	45,967	44,391	1,576	-	-	675	-	-	-	13,531	22	580,871
1a.0	TOTAL PERIOD 1a COST	-	856	11	6	-	41	56,911	8,519	66,343	59,345	6,383	616	-	675	-	-	-	13,531	22	654,624
PERIOD 1b - Decommissioning Preparations																					
Period 1b Direct Decommissioning Activities																					
Detailed Work Procedures																					
1b.1.1.1	Plant systems	-	-	-	-	-	-	561	84	645	580	-	64	-	-	-	-	-	-	-	4,733
1b.1.1.2	NSSS Decontamination Flush	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.3	Reactor internals	-	-	-	-	-	-	296	44	341	341	-	-	-	-	-	-	-	-	-	2,500
1b.1.1.4	Remaining buildings	-	-	-	-	-	-	160	24	184	46	-	138	-	-	-	-	-	-	-	1,350
1b.1.1.5	CRD cooling assembly	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.6	CRD housings & ICI tubes	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.7	Incore instrumentation	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.8	Reactor vessel	-	-	-	-	-	-	430	65	495	495	-	-	-	-	-	-	-	-	-	3,630
1b.1.1.9	Facility closeout	-	-	-	-	-	-	142	21	164	82	-	82	-	-	-	-	-	-	-	1,200
1b.1.1.10	Missile shields	-	-	-	-	-	-	53	8	61	61	-	-	-	-	-	-	-	-	-	450
1b.1.1.11	Biological shield	-	-	-	-	-	-	142	21	164	164	-	-	-	-	-	-	-	-	-	1,200
1b.1.1.12	Steam generators	-	-	-	-	-	-	545	82	627	627	-	-	-	-	-	-	-	-	-	4,600
1b.1.1.13	Reinforced concrete	-	-	-	-	-	-	118	18	136	68	-	68	-	-	-	-	-	-	-	1,000
1b.1.1.14	Main Turbine	-	-	-	-	-	-	185	28	213	-	-	213	-	-	-	-	-	-	-	1,560
1b.1.1.15	Main Condensers	-	-	-	-	-	-	185	28	213	-	-	213	-	-	-	-	-	-	-	1,560
1b.1.1.16	Auxiliary building	-	-	-	-	-	-	323	49	372	335	-	37	-	-	-	-	-	-	-	2,730
1b.1.1.17	Reactor building	-	-	-	-	-	-	323	49	372	335	-	37	-	-	-	-	-	-	-	2,730
1b.1.1	Total	-	-	-	-	-	-	3,939	591	4,529	3,678	-	852	-	-	-	-	-	-	-	33,243
1b.1.2	Decon primary loop	523	-	-	-	-	-	-	261	784	784	-	-	-	-	-	-	-	-	1,067	-
1b.1	Subtotal Period 1b Activity Costs	523	-	-	-	-	-	3,939	852	5,313	4,461	-	852	-	-	-	-	-	-	1,067	33,243
Period 1b Additional Costs																					
1b.2.1	Site Characterization	-	-	-	-	-	-	3,160	948	4,108	4,108	-	-	-	-	-	-	-	-	19,100	7,852
1b.2.2	Spent Fuel Pool Isolation	-	-	-	-	-	-	9,407	1,411	10,819	10,819	-	-	-	-	-	-	-	-	-	-
1b.2	Subtotal Period 1b Additional Costs	-	-	-	-	-	-	12,567	2,359	14,927	14,927	-	-	-	-	-	-	-	-	19,100	7,852
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	831	-	-	-	-	-	-	125	956	956	-	-	-	-	-	-	-	-	-	-
1b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,423	213	1,636	1,636	-	-	-	-	-	-	-	-	-	-
1b.3.3	Process liquid waste	51	-	104	535	-	4,754	-	1,305	6,749	6,749	-	-	-	324	1,512	-	-	187,252	358	-
1b.3.4	Small tool allowance	-	2	-	-	-	-	-	0	2	2	-	-	-	-	-	-	-	-	-	-
1b.3.5	Pipe cutting equipment	-	1,000	-	-	-	-	-	150	1,150	1,150	-	-	-	-	-	-	-	-	-	-
1b.3.6	Decon rig	1,400	-	-	-	-	-	-	210	1,610	1,610	-	-	-	-	-	-	-	-	-	-
1b.3.7	Spent Fuel Capital and Transfer	-	-	-	-	-	-	2,200	330	2,530	-	2,530	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	2,282	1,002	104	535	-	4,754	3,623	2,333	14,634	12,104	2,530	-	-	324	1,512	-	-	187,252	358	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	26	-	-	-	-	-	-	6	32	32	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	838	84	922	922	-	-	-	-	-	-	-	-	-	-

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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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 1b Period-Dependent Costs (continued)																					
1b.4.3	Property taxes	-	-	-	-	-	-	151	15	166	166	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	245	-	-	-	-	-	61	306	306	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	214	-	-	-	-	-	32	246	246	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	6	4	-	24	-	7	41	41	-	-	-	399	-	-	-	7,988	13	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	1,365	205	1,570	1,570	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	356	36	391	391	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	227	23	249	-	249	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	474	71	545	-	545	-	-	-	-	-	-	-	-	-
1b.4.11	Corporate Allocations	-	-	-	-	-	-	900	90	990	990	-	-	-	-	-	-	-	-	-	-
1b.4.12	Security Staff Cost	-	-	-	-	-	-	2,852	428	3,280	3,280	-	-	-	-	-	-	-	-	-	79,383
1b.4.13	DOC Staff Cost	-	-	-	-	-	-	5,420	813	6,233	6,233	-	-	-	-	-	-	-	-	-	64,137
1b.4.14	Utility Staff Cost	-	-	-	-	-	-	13,667	2,050	15,717	15,717	-	-	-	-	-	-	-	-	-	214,491
1b.4	Subtotal Period 1b Period-Dependent Costs	26	459	6	4	-	24	26,250	3,921	30,689	29,894	795	-	-	399	-	-	-	7,988	13	358,011
1b.0	TOTAL PERIOD 1b COST	2,830	1,461	111	539	-	4,778	46,379	9,465	65,562	61,386	3,325	852	-	722	1,512	-	-	195,240	20,538	399,106
PERIOD 1 TOTALS		2,830	2,317	122	545	-	4,819	103,289	17,984	131,906	120,730	9,708	1,467	-	1,397	1,512	-	-	208,772	20,560	1,053,731
PERIOD 2a - Large Component Removal																					
Period 2a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
2a.1.1.1	Reactor Coolant Piping	173	175	19	27	-	418	-	241	1,054	1,054	-	-	-	1,157	-	-	-	139,959	6,838	-
2a.1.1.2	Pressurizer Relief Tank	29	25	5	8	-	109	-	50	225	225	-	-	-	328	-	-	-	36,395	1,068	-
2a.1.1.3	Reactor Coolant Pumps & Motors	88	84	41	151	119	914	-	338	1,736	1,736	-	-	198	3,386	-	-	-	897,754	3,772	-
2a.1.1.4	Pressurizer	43	52	595	417	-	1,019	-	412	2,539	2,539	-	-	-	3,882	-	-	-	240,508	2,502	1,875
2a.1.1.5	Steam Generators	367	4,634	2,769	2,181	2,322	6,068	-	3,812	22,153	22,153	-	-	40,262	23,116	-	-	-	3,566,316	23,233	3,500
2a.1.1.6	Retired Steam Generator Units	-	-	2,017	1,530	2,322	5,893	-	2,253	14,013	14,013	-	-	40,262	22,448	-	-	-	3,346,591	10,800	2,250
2a.1.1.7	CRDMs/ICIs/Service Structure Removal	147	85	193	47	-	257	-	185	914	914	-	-	-	3,881	-	-	-	86,025	4,285	-
2a.1.1.8	Reactor Vessel Internals	115	2,599	4,470	967	-	7,055	230	6,927	22,362	22,362	-	-	-	1,377	903	459	-	326,029	27,883	1,247
2a.1.1.9	Vessel & Internals GTCC Disposal	-	-	-	-	-	10,634	-	1,595	12,229	12,229	-	-	-	-	-	-	499	104,146	-	-
2a.1.1.10	Reactor Vessel	87	5,324	1,567	699	-	7,668	230	8,472	24,048	24,048	-	-	-	6,511	2,254	-	-	948,723	27,883	1,247
2a.1.1	Totals	1,050	12,978	11,676	6,027	4,763	40,035	461	24,284	101,274	101,274	-	-	80,722	66,086	3,156	459	499	9,692,446	108,265	10,120
Removal of Major Equipment																					
2a.1.2	Main Turbine/Generator	-	477	316	36	770	696	-	446	2,741	2,741	-	-	4,921	2,740	-	-	-	664,183	9,888	-
2a.1.3	Main Condensers	-	1,308	163	64	638	609	-	601	3,383	3,383	-	-	7,701	2,270	-	-	-	550,231	27,762	-
Cascading Costs from Clean Building Demolition																					
2a.1.4.1	Reactor	-	840	-	-	-	-	-	126	966	966	-	-	-	-	-	-	-	-	10,575	-
2a.1.4.2	Auxiliary	-	422	-	-	-	-	-	63	486	486	-	-	-	-	-	-	-	-	5,551	-
2a.1.4.3	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	16	-
2a.1.4.4	Radwaste	-	88	-	-	-	-	-	13	101	101	-	-	-	-	-	-	-	-	1,108	-
2a.1.4.5	Fuel Building	-	206	-	-	-	-	-	31	236	236	-	-	-	-	-	-	-	-	2,395	-
2a.1.4	Totals	-	1,557	-	-	-	-	-	233	1,790	1,790	-	-	-	-	-	-	-	-	19,645	-
Disposal of Plant Systems																					
2a.1.5.1	100 Aux.Bldg Non-System Specific RCA	-	655	10	22	570	-	-	253	1,510	1,510	-	-	7,629	-	-	-	-	309,812	13,471	-
2a.1.5.2	100 Auxiliary Bldg Non-System Specific	-	109	4	5	35	53	-	47	253	253	-	-	474	199	-	-	-	37,110	2,280	-
2a.1.5.3	AB - Main Steam	-	241	-	-	-	-	-	36	277	-	-	277	-	-	-	-	-	-	5,833	-
2a.1.5.4	AB - Main Steam RCA	-	73	3	6	161	-	-	44	286	286	-	-	2,156	-	-	-	-	87,550	1,495	-
2a.1.5.5	AC - Main Turbine	-	237	-	-	-	-	-	36	273	-	-	273	-	-	-	-	-	-	5,641	-
2a.1.5.6	AD - Condensate	-	264	-	-	-	-	-	40	303	-	-	303	-	-	-	-	-	-	6,144	-
2a.1.5.7	AE - Feedwater	-	181	-	-	-	-	-	27	208	-	-	208	-	-	-	-	-	-	4,271	-
2a.1.5.8	AF - Feedwater Heater Extraction	-	221	-	-	-	-	-	33	255	-	-	255	-	-	-	-	-	-	5,352	-

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Disposal of Plant Systems (continued)																					
2a.1.5.9	AK - Condensate Demineralizer	-	82	-	-	-	-	-	12	94	-	-	94	-	-	-	-	-	-	1,944	-
2a.1.5.10	AL - Auxiliary Feedwater	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	852	-
2a.1.5.11	AQ - Condensate & Feedwater Chem Addtn	-	20	-	-	-	-	-	3	23	-	-	23	-	-	-	-	-	-	468	-
2a.1.5.12	BM - Steam Generator Blowdown	-	106	4	5	67	36	-	47	264	264	-	-	892	140	-	-	-	48,310	2,220	-
2a.1.5.13	BM - Steam Generator Blowdown - RCA	-	336	5	12	307	-	-	132	793	793	-	-	4,109	-	-	-	-	166,857	6,849	-
2a.1.5.14	BN - Borated Refueling Water Storage	-	325	14	22	412	101	-	173	1,047	1,047	-	-	5,512	416	-	-	-	257,593	6,819	-
2a.1.5.15	CA - Steam Seal	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	455	-
2a.1.5.16	CB - Main Turbine Lube Oil	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	1,207	-
2a.1.5.17	CC - Generator Hydrogen Seal & CO2	-	9	-	-	-	-	-	1	10	-	-	10	-	-	-	-	-	-	198	-
2a.1.5.18	CD - Generator Seal Oil	-	12	-	-	-	-	-	2	14	-	-	14	-	-	-	-	-	-	287	-
2a.1.5.19	CE - Stator Cooling Water	-	11	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	241	-
2a.1.5.20	CF - Lube Oil Storage Xfer & Prfication	-	34	-	-	-	-	-	5	40	-	-	40	-	-	-	-	-	-	812	-
2a.1.5.21	CG - Condenser Air Removal	-	28	-	-	-	-	-	4	32	-	-	32	-	-	-	-	-	-	657	-
2a.1.5.22	CH - Main Turbine Control Oil	-	55	-	-	-	-	-	8	64	-	-	64	-	-	-	-	-	-	1,219	-
2a.1.5.23	DA - Circulating Water	-	311	-	-	-	-	-	47	358	-	-	358	-	-	-	-	-	-	7,502	-
2a.1.5.24	DB - Cooling Tower Makeup & Blowdown	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	1,260	-
2a.1.5.25	DD - Cooling Water Chemical Control Sys	-	46	-	-	-	-	-	7	53	-	-	53	-	-	-	-	-	-	1,073	-
2a.1.5.26	DD - Cooling Wtr Chem Control RCA	-	251	5	10	266	-	-	105	636	636	-	-	3,555	-	-	-	-	144,376	4,866	-
2a.1.5.27	EJ - Residual Heat Removal	-	355	33	38	205	457	-	243	1,331	1,331	-	-	2,744	1,715	-	-	-	264,214	7,550	-
2a.1.5.28	EM - High Pressure Coolant Injection	-	278	11	12	98	123	-	118	639	639	-	-	1,315	458	-	-	-	94,439	5,793	-
2a.1.5.29	EN - Containment Spray	-	196	4	9	226	-	-	85	519	519	-	-	3,026	-	-	-	-	122,874	4,005	-
2a.1.5.30	EP - Accumulator Safety Injection	-	155	7	8	119	53	-	72	414	414	-	-	1,599	208	-	-	-	82,796	3,207	-
2a.1.5.31	FA - Auxiliary Steam Generator	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	521	-
2a.1.5.32	FB - Auxiliary Steam	-	87	-	-	-	-	-	13	100	-	-	100	-	-	-	-	-	-	2,106	-
2a.1.5.33	FB - Auxiliary Steam RCA	-	74	1	2	61	-	-	28	167	167	-	-	816	-	-	-	-	33,148	1,492	-
2a.1.5.34	FC - Auxiliary Turbines	-	57	-	-	-	-	-	9	65	-	-	65	-	-	-	-	-	-	1,320	-
2a.1.5.35	FE - Auxiliary Steam Chemical Addition	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	105	-
2a.1.5.36	GE - Turbine Building HVAC	-	152	-	-	-	-	-	23	174	-	-	174	-	-	-	-	-	-	3,792	-
2a.1.5.37	GS - Containment Hydrogen Control	-	70	3	3	49	20	-	31	175	175	-	-	658	73	-	-	-	33,309	1,464	-
2a.1.5.38	HE - Boron Recycle	368	444	25	25	194	267	-	397	1,720	1,720	-	-	2,600	1,111	-	-	-	194,922	15,831	-
2a.1.5.39	HF - Secondary Liquid Waste	675	894	55	57	462	606	-	796	3,545	3,545	-	-	6,186	2,522	-	-	-	453,942	30,614	-
2a.1.5.40	JA - Auxiliary Oil & Transfer	-	29	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	687	-
2a.1.5.41	KS - Bulk Chemical Storage	-	86	8	18	482	-	-	97	691	691	-	-	6,449	-	-	-	-	261,890	1,808	-
2a.1.5.42	LE - Oily Waste	-	161	-	-	-	-	-	24	186	-	-	186	-	-	-	-	-	-	3,865	-
2a.1.5.43	LE - Oily Waste RCA	-	213	3	6	169	-	-	80	471	471	-	-	2,256	-	-	-	-	91,628	4,181	-
2a.1.5.44	Turbine Bldg Non-System Specific	-	677	-	-	-	-	-	101	778	-	-	778	-	-	-	-	-	-	15,405	-
2a.1.5	Totals	1,043	7,720	193	261	3,884	1,716	-	3,211	18,028	14,462	-	3,566	51,976	6,842	-	-	-	2,684,769	187,162	-
2a.1.6	Scaffolding in support of decommissioning	-	1,490	21	5	102	12	-	394	2,024	2,024	-	-	1,233	69	-	-	-	62,010	35,883	-
2a.1	Subtotal Period 2a Activity Costs	2,093	25,529	12,369	6,394	10,156	43,069	461	29,170	129,240	125,674	-	3,566	146,552	78,008	3,156	459	499	13,653,640	388,605	10,120
Period 2a Collateral Costs																					
2a.3.1	Process liquid waste	244	-	117	582	-	664	-	387	1,994	1,994	-	-	-	2,052	-	-	-	143,192	400	-
2a.3.2	Small tool allowance	-	311	-	-	-	-	-	47	357	321	-	36	-	-	-	-	-	-	-	-
2a.3.3	Spent Fuel Capital and Transfer	-	-	-	-	-	-	6,380	957	7,337	-	7,337	-	-	-	-	-	-	-	-	-
2a.3.4	Survey and Release of Scrap Metal	-	-	-	-	-	-	753	113	866	866	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	244	311	117	582	-	664	7,133	1,504	10,555	3,182	7,337	36	-	2,052	-	-	-	143,192	400	-
Period 2a Period-Dependent Costs																					
2a.4.1	Decon supplies	75	-	-	-	-	-	-	19	94	94	-	-	-	-	-	-	-	-	-	-
2a.4.2	Insurance	-	-	-	-	-	-	846	85	931	931	-	-	-	-	-	-	-	-	-	-
2a.4.3	Property taxes	-	-	-	-	-	-	444	44	489	440	-	49	-	-	-	-	-	-	-	-
2a.4.4	Health physics supplies	-	2,212	-	-	-	-	-	553	2,765	2,765	-	-	-	-	-	-	-	-	-	-
2a.4.5	Heavy equipment rental	-	3,022	-	-	-	-	-	453	3,475	3,475	-	-	-	-	-	-	-	-	-	-
2a.4.6	Disposal of DAW generated	-	-	102	57	-	382	-	114	656	656	-	-	-	6,366	-	-	-	127,579	209	-

Attachment 1

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 2a Period-Dependent Costs (continued)																					
2a.4.7	Plant energy budget	-	-	-	-	-	-	1,907	286	2,192	2,192	-	-	-	-	-	-	-	-	-	-
2a.4.8	NRC Fees	-	-	-	-	-	-	976	98	1,073	1,073	-	-	-	-	-	-	-	-	-	-
2a.4.9	Emergency Planning Fees	-	-	-	-	-	-	296	30	326	-	326	-	-	-	-	-	-	-	-	-
2a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,394	209	1,603	-	1,603	-	-	-	-	-	-	-	-	-
2a.4.11	Corporate Allocations	-	-	-	-	-	-	2,970	297	3,267	3,267	-	-	-	-	-	-	-	-	-	-
2a.4.12	Security Staff Cost	-	-	-	-	-	-	7,127	1,069	8,196	8,196	-	-	-	-	-	-	-	-	-	195,533
2a.4.13	DOC Staff Cost	-	-	-	-	-	-	19,507	2,926	22,433	22,433	-	-	-	-	-	-	-	-	-	234,949
2a.4.14	Utility Staff Cost	-	-	-	-	-	-	28,469	4,270	32,739	32,739	-	-	-	-	-	-	-	-	-	437,437
2a.4	Subtotal Period 2a Period-Dependent Costs	75	5,234	102	57	-	382	63,935	10,453	80,239	78,262	1,929	49	-	6,366	-	-	-	127,579	209	867,919
2a.0	TOTAL PERIOD 2a COST	2,412	31,074	12,588	7,034	10,156	44,116	71,529	41,126	220,034	207,118	9,266	3,650	146,552	86,427	3,156	459	499	13,924,410	389,214	878,038
PERIOD 2b - Site Decontamination																					
Period 2b Direct Decommissioning Activities																					
Disposal of Plant Systems																					
2b.1.1.1	200 Reactor Bldg Non-System Specific	-	86	2	3	20	35	-	34	180	180	-	-	269	131	-	-	-	22,692	1,758	-
2b.1.1.2	200 Reactor Bldg Non-System Specific RCA	-	521	6	14	356	-	-	186	1,084	1,084	-	-	4,768	-	-	-	-	193,612	10,425	-
2b.1.1.3	300 Control Bldg Non-System Specific	-	167	3	6	160	-	-	67	403	403	-	-	2,139	-	-	-	-	86,849	3,413	-
2b.1.1.4	300 Control Bldg Non-System Specific Cln	-	1,361	-	-	-	-	-	204	1,566	-	-	1,566	-	-	-	-	-	-	29,076	-
2b.1.1.5	700 Radwaste Bldg Non-Sys Specific RCA	-	1,071	16	36	948	-	-	417	2,489	2,489	-	-	12,684	-	-	-	-	515,103	21,919	-
2b.1.1.6	700 Radwaste Bldg Non-System Specific	-	175	6	8	53	94	-	77	413	413	-	-	705	351	-	-	-	60,095	3,649	-
2b.1.1.7	AN - Demineralized Wtr Storage & Xfer	-	136	-	-	-	-	-	20	156	-	-	156	-	-	-	-	-	-	3,283	-
2b.1.1.8	AN - Demineralized Wtr Strg & Xfer RCA	-	36	0	1	23	-	-	13	73	73	-	-	314	-	-	-	-	12,759	711	-
2b.1.1.9	AP - Condensate Storage & Transfer	-	81	-	-	-	-	-	12	93	-	-	93	-	-	-	-	-	-	1,794	-
2b.1.1.10	BB - Reactor Coolant System	-	291	25	26	135	319	-	179	976	976	-	-	1,812	1,399	-	-	-	180,294	6,251	-
2b.1.1.11	BG - Chemical & Volume Control	705	828	71	75	368	933	-	866	3,847	3,847	-	-	4,931	3,562	-	-	-	512,267	26,126	-
2b.1.1.12	BL - Reactor Makeup Water	-	274	16	16	144	161	-	134	744	744	-	-	1,928	700	-	-	-	132,091	5,684	-
2b.1.1.13	DE - Intake & Water Treatment	-	107	-	-	-	-	-	16	123	-	-	123	-	-	-	-	-	-	2,478	-
2b.1.1.14	DE - Intake & Water Treatment RCA	-	238	15	34	891	-	-	200	1,378	1,378	-	-	11,923	-	-	-	-	484,206	4,993	-
2b.1.1.15	EA - Service Water	-	130	-	-	-	-	-	19	149	-	-	149	-	-	-	-	-	-	3,145	-
2b.1.1.16	EA - Service Water RCA	-	41	2	4	93	-	-	25	165	165	-	-	1,248	-	-	-	-	50,693	829	-
2b.1.1.17	EB - Closed Cooling Water	-	52	-	-	-	-	-	8	60	-	-	60	-	-	-	-	-	-	1,267	-
2b.1.1.18	EF - Essential Service Water	-	301	-	-	-	-	-	45	346	-	-	346	-	-	-	-	-	-	7,244	-
2b.1.1.19	EF - Essential Service Water RCA	-	184	7	15	398	-	-	109	713	713	-	-	5,326	-	-	-	-	216,287	3,802	-
2b.1.1.20	EG - Component Cooling Water RCA	-	220	-	-	-	-	-	33	253	-	-	253	-	-	-	-	-	-	5,335	-
2b.1.1.21	GA - Plant Heating	-	78	-	-	-	-	-	12	90	-	-	90	-	-	-	-	-	-	1,912	-
2b.1.1.22	GA - Plant Heating RCA	-	85	1	2	48	-	-	29	165	165	-	-	638	-	-	-	-	25,924	1,698	-
2b.1.1.23	GB - Central Chilled Water	-	74	-	-	-	-	-	11	85	-	-	85	-	-	-	-	-	-	1,803	-
2b.1.1.24	GB - Central Chilled Water RCA	-	23	0	1	14	-	-	8	46	46	-	-	187	-	-	-	-	7,591	463	-
2b.1.1.25	GD - Essential Serv Wtr Pumphouse HVAC	-	16	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	414	-
2b.1.1.26	GF - Miscellaneous Building HVAC	-	117	3	6	152	-	-	53	331	331	-	-	2,034	-	-	-	-	82,602	2,026	-
2b.1.1.27	GH - Radwaste Building HVAC	-	181	4	8	181	19	-	79	472	472	-	-	2,425	69	-	-	-	104,668	3,445	-
2b.1.1.28	GK - Control Building HVAC	-	151	-	-	-	-	-	23	174	-	-	174	-	-	-	-	-	-	3,900	-
2b.1.1.29	GL - Auxiliary Building HVAC	-	450	9	17	378	43	-	183	1,081	1,081	-	-	5,064	161	-	-	-	220,066	8,474	-
2b.1.1.30	GM - Diesel Generator Building HVAC	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	692	-
2b.1.1.31	GN - Containment Cooling	-	484	16	29	550	122	-	240	1,442	1,442	-	-	7,367	454	-	-	-	339,907	9,410	-
2b.1.1.32	GP - Containment Intgratd Leak Rate Test	-	36	1	2	43	-	-	16	98	98	-	-	580	-	-	-	-	23,570	737	-
2b.1.1.33	GR - Containment Atmospheric Control	-	19	2	4	81	8	-	20	133	133	-	-	1,086	29	-	-	-	46,679	392	-
2b.1.1.34	GT - Containment Purge HVAC	-	115	4	8	146	32	-	60	365	365	-	-	1,948	120	-	-	-	89,887	2,239	-
2b.1.1.35	HA - Gaseous Radwaste	-	320	15	16	208	126	-	147	832	832	-	-	2,782	486	-	-	-	155,095	6,500	-
2b.1.1.36	HB - Liquid Radwaste	740	788	51	50	415	519	-	772	3,335	3,335	-	-	5,560	2,205	-	-	-	399,479	29,834	-
2b.1.1.37	HC - Solid Radwaste	-	326	22	24	158	282	-	181	993	993	-	-	2,114	1,099	-	-	-	180,002	6,786	-
2b.1.1.38	HD - Decontamination	-	97	4	5	73	32	-	44	256	256	-	-	983	125	-	-	-	50,772	1,983	-
2b.1.1.39	JE - Emergency Fuel Oil	-	56	-	-	-	-	-	8	65	-	-	65	-	-	-	-	-	-	1,260	-

Attachment 1

Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(thousands of 2008 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.1.1.40	KA - Compressed Air	-	171	-	-	-	-	-	26	196	-	-	196	-	-	-	-	-	-	4,187	-
2b.1.1.41	KA - Compressed Air RCA	-	115	1	2	60	-	-	38	216	216	-	-	801	-	-	-	-	32,538	2,242	-
2b.1.1.42	KB - Breathing Air	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	516	-
2b.1.1.43	KB - Breathing Air RCA	-	17	0	0	5	-	-	5	28	28	-	-	71	-	-	-	-	2,874	376	-
2b.1.1.44	KC - Fire Protection	-	338	-	-	-	-	-	51	389	-	-	389	-	-	-	-	-	-	8,376	-
2b.1.1.45	KC - Fire Protection RCA	-	365	6	13	330	-	-	143	857	857	-	-	4,411	-	-	-	-	179,151	6,953	-
2b.1.1.46	KD - Domestic Water	-	157	-	-	-	-	-	24	181	-	-	181	-	-	-	-	-	-	3,837	-
2b.1.1.47	KD - Domestic Water RCA	-	23	0	1	18	-	-	9	52	52	-	-	247	-	-	-	-	10,039	448	-
2b.1.1.48	KE - Fuel Handling & Storage Rctor vssl	-	18	3	4	49	30	-	20	124	124	-	-	661	111	-	-	-	36,859	374	-
2b.1.1.49	KH - Service Gas (CO2 N2 H2 & O2)	-	50	-	-	-	-	-	7	57	-	-	57	-	-	-	-	-	-	1,226	-
2b.1.1.50	KH - Service Gas (CO2 N2 H2 & O2) RCA	-	229	3	7	182	-	-	86	507	507	-	-	2,433	-	-	-	-	98,813	4,378	-
2b.1.1.51	KJ - Standby Diesel Engine	-	298	-	-	-	-	-	45	343	-	-	343	-	-	-	-	-	-	6,749	-
2b.1.1.52	LA - Sanitary Drains	-	40	-	-	-	-	-	6	46	-	-	46	-	-	-	-	-	-	972	-
2b.1.1.53	LA - Sanitary Drains RCA	-	98	2	4	95	-	-	39	238	238	-	-	1,273	-	-	-	-	51,684	1,811	-
2b.1.1.54	LB - Roof Drains	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	1,276	-
2b.1.1.55	LB - Roof Drains RCA	-	131	3	6	160	-	-	58	358	358	-	-	2,139	-	-	-	-	86,858	2,628	-
2b.1.1.56	LD - Chemical & Detergent Waste	63	102	3	4	38	40	-	74	323	323	-	-	504	150	-	-	-	33,812	3,234	-
2b.1.1.57	LF - Floor & Equipment Drains	-	1,306	72	82	279	1,084	-	659	3,482	3,482	-	-	3,739	4,073	-	-	-	514,287	27,095	-
2b.1.1.58	RM - Process Sampling & Analysis	-	130	6	5	49	45	-	53	288	288	-	-	661	169	-	-	-	42,010	2,724	-
2b.1.1.59	SJ - Nuclear Sampling	-	73	4	3	32	35	-	33	179	179	-	-	423	130	-	-	-	28,862	1,539	-
2b.1.1.60	UB - Servces Stores Site Security Bldg	-	151	-	-	-	-	-	23	174	-	-	174	-	-	-	-	-	-	3,571	-
2b.1.1.61	Yard Non-System Specific	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	603	-
2b.1.1	Totals	1,508	13,657	404	540	7,336	3,958	-	5,970	33,374	28,663	-	4,711	98,179	15,523	-	-	-	5,310,975	312,263	-
2b.1.2	Scaffolding in support of decommissioning	-	1,862	26	6	128	15	-	492	2,530	2,530	-	-	1,541	86	-	-	-	77,513	44,853	-
Decontamination of Site Buildings																					
2b.1.3.1	Reactor	1,184	1,076	129	164	448	1,169	-	1,258	5,428	5,428	-	-	5,995	7,662	-	-	-	967,209	44,561	-
2b.1.3.2	Auxiliary	618	380	56	76	154	180	-	489	1,953	1,953	-	-	2,058	3,318	-	-	-	411,803	19,512	-
2b.1.3.3	Communication Corridor - Contaminated	14	7	1	2	1	4	-	10	38	38	-	-	17	72	-	-	-	7,852	397	-
2b.1.3.4	Hot Machine Shop	17	14	1	2	-	5	-	14	52	52	-	-	-	89	-	-	-	8,892	599	-
2b.1.3.5	RAM Storage Building	42	16	3	4	1	10	-	29	105	105	-	-	19	185	-	-	-	19,133	1,167	-
2b.1.3.6	Radioactive and Personnel Tunnel	6	12	1	1	-	3	-	7	29	29	-	-	-	50	-	-	-	5,022	336	-
2b.1.3.7	Radwaste	329	184	29	40	63	95	-	253	993	993	-	-	844	1,754	-	-	-	208,503	10,044	-
2b.1.3.8	Radwaste Drum Storage	37	19	3	4	5	11	-	28	107	107	-	-	66	196	-	-	-	22,234	1,097	-
2b.1.3.9	Steam Generator Replacement Bldgs	235	-	-	-	-	-	-	117	352	352	-	-	-	-	-	-	-	-	4,358	-
2b.1.3	Totals	2,481	1,708	224	293	672	1,475	-	2,204	9,057	9,057	-	-	8,999	13,326	-	-	-	1,650,649	82,070	-
2b.1	Subtotal Period 2b Activity Costs	3,990	17,227	655	839	8,136	5,449	-	8,666	44,961	40,250	-	4,711	108,720	28,936	-	-	-	7,039,137	439,186	-
Period 2b Additional Costs																					
2b.2.1	Sanitary Treatment Lagoon LLW	-	5	60	783	-	183	-	152	1,184	1,184	-	-	-	3,600	-	-	-	345,600	388	-
2b.2.2	Cooling Tower Asbestos Panel Removal	-	4,554	-	105	365	-	-	683	5,706	5,706	-	-	136,405	-	-	-	-	-	101,822	-
2b.2	Subtotal Period 2b Additional Costs	-	4,559	60	888	365	183	-	835	6,890	6,890	-	-	136,405	3,600	-	-	-	345,600	102,210	-
Period 2b Collateral Costs																					
2b.3.1	Process liquid waste	260	-	173	873	-	1,152	-	566	3,023	3,023	-	-	-	3,045	-	-	-	248,183	594	-
2b.3.2	Small tool allowance	-	403	-	-	-	-	-	60	463	463	-	-	-	-	-	-	-	-	-	-
2b.3.3	Spent Fuel Capital and Transfer	-	-	-	-	-	-	10,780	1,617	12,397	-	12,397	-	-	-	-	-	-	-	-	-
2b.3.4	Survey and Release of Scrap Metal	-	-	-	-	-	-	875	131	1,006	1,006	-	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	260	403	173	873	-	1,152	11,655	2,375	16,889	4,492	12,397	-	-	3,045	-	-	-	248,183	594	-
Period 2b Period-Dependent Costs																					
2b.4.1	Decon supplies	1,139	-	-	-	-	-	-	285	1,424	1,424	-	-	-	-	-	-	-	-	-	-
2b.4.2	Insurance	-	-	-	-	-	-	1,437	144	1,581	1,581	-	-	-	-	-	-	-	-	-	-
2b.4.3	Property taxes	-	-	-	-	-	-	755	75	830	830	-	-	-	-	-	-	-	-	-	-

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Table C
Callaway Plant
DECON Decommissioning Cost Estimate
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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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 2b Period-Dependent Costs (continued)																					
2b.4.4	Health physics supplies	-	3,267	-	-	-	-	-	817	4,083	4,083	-	-	-	-	-	-	-	-	-	-
2b.4.5	Heavy equipment rental	-	5,097	-	-	-	-	-	765	5,861	5,861	-	-	-	-	-	-	-	-	-	-
2b.4.6	Disposal of DAW generated	-	-	115	65	-	430	-	129	739	739	-	-	-	7,169	-	-	-	143,667	236	-
2b.4.7	Plant energy budget	-	-	-	-	-	-	2,557	384	2,940	2,940	-	-	-	-	-	-	-	-	-	-
2b.4.8	NRC Fees	-	-	-	-	-	-	1,657	166	1,823	1,823	-	-	-	-	-	-	-	-	-	-
2b.4.9	Emergency Planning Fees	-	-	-	-	-	-	503	50	554	-	554	-	-	-	-	-	-	-	-	-
2b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	2,368	355	2,723	-	2,723	-	-	-	-	-	-	-	-	-
2b.4.11	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	472	71	543	543	-	-	-	-	-	-	-	-	-	-
2b.4.12	Corporate Allocations	-	-	-	-	-	-	2,610	261	2,871	2,871	-	-	-	-	-	-	-	-	-	-
2b.4.13	Security Staff Cost	-	-	-	-	-	-	12,107	1,816	13,923	13,923	-	-	-	-	-	-	-	-	-	332,153
2b.4.14	DOC Staff Cost	-	-	-	-	-	-	31,940	4,791	36,731	36,731	-	-	-	-	-	-	-	-	-	383,354
2b.4.15	Utility Staff Cost	-	-	-	-	-	-	46,454	6,968	53,422	53,422	-	-	-	-	-	-	-	-	-	711,569
2b.4	Subtotal Period 2b Period-Dependent Costs	1,139	8,363	115	65	-	430	102,860	17,076	130,048	126,772	3,277	-	-	7,169	-	-	-	143,667	236	1,427,076
2b.0	TOTAL PERIOD 2b COST	5,388	30,552	1,004	2,664	8,501	7,214	114,515	28,951	198,789	178,404	15,674	4,711	245,125	42,750	-	-	-	7,776,586	542,225	1,427,076
PERIOD 2c - Decontamination Following Wet Fuel Storage																					
Period 2c Direct Decommissioning Activities																					
2c.1.1	Remove spent fuel racks	778	79	233	87	-	1,323	-	776	3,277	3,277	-	-	-	4,933	-	-	-	442,623	1,925	-
Disposal of Plant Systems																					
2c.1.2.1	600 Fuel Bldg Non-Specific Systems RCA	-	289	4	9	239	-	-	110	651	651	-	-	3,200	-	-	-	-	129,974	5,859	-
2c.1.2.2	600 Fuel Bldg Non-System Specific	-	46	2	2	13	23	-	20	104	104	-	-	170	85	-	-	-	14,545	953	-
2c.1.2.3	EC - Fuel Pool Cooling & Cleanup	-	355	17	21	194	206	-	174	967	967	-	-	2,602	770	-	-	-	174,682	7,394	-
2c.1.2.4	GA- Plant Heating Fuel Building	-	19	1	1	4	8	-	7	39	39	-	-	50	29	-	-	-	4,646	395	-
2c.1.2.5	GG - Fuel Building HVAC	-	248	6	13	279	29	-	114	688	688	-	-	3,729	109	-	-	-	161,237	4,671	-
2c.1.2.6	KC- Fire Protection Fuel Building	-	108	2	4	93	-	-	42	248	248	-	-	1,239	-	-	-	-	50,329	2,084	-
2c.1.2	Totals	-	1,065	31	49	821	266	-	466	2,698	2,698	-	-	10,991	994	-	-	-	535,413	21,356	-
Decontamination of Site Buildings																					
2c.1.3.1	Fuel Building	764	833	19	26	202	55	-	640	2,540	2,540	-	-	2,705	902	-	-	-	199,149	31,582	-
2c.1.3	Totals	764	833	19	26	202	55	-	640	2,540	2,540	-	-	2,705	902	-	-	-	199,149	31,582	-
2c.1.4	Scaffolding in support of decommissioning	-	372	5	1	26	3	-	98	506	506	-	-	308	17	-	-	-	15,503	8,971	-
2c.1	Subtotal Period 2c Activity Costs	1,542	2,349	288	163	1,049	1,648	-	1,981	9,021	9,021	-	-	14,004	6,846	-	-	-	1,192,688	63,833	-
Period 2c Additional Costs																					
2c.2.1	License Termination Survey Program Management	-	-	-	-	-	-	1,467	440	1,907	1,907	-	-	-	-	-	-	-	-	-	12,480
2c.2	Subtotal Period 2c Additional Costs	-	-	-	-	-	-	1,467	440	1,907	1,907	-	-	-	-	-	-	-	-	-	12,480
Period 2c Collateral Costs																					
2c.3.1	Process liquid waste	146	-	57	283	-	280	-	191	957	957	-	-	-	1,004	-	-	-	60,265	196	-
2c.3.2	Small tool allowance	-	65	-	-	-	-	-	10	75	75	-	-	-	-	-	-	-	-	-	-
2c.3.3	Decommissioning Equipment Disposition	-	-	103	30	497	100	-	114	844	844	-	-	6,000	373	-	-	-	303,507	88	-
2c.3.4	Survey and Release of Scrap Metal	-	-	-	-	-	-	173	26	199	199	-	-	-	-	-	-	-	-	-	-
2c.3	Subtotal Period 2c Collateral Costs	146	65	160	313	497	380	173	341	2,076	2,076	-	-	6,000	1,378	-	-	-	363,772	284	-
Period 2c Period-Dependent Costs																					
2c.4.1	Decon supplies	164	-	-	-	-	-	-	41	206	206	-	-	-	-	-	-	-	-	-	-
2c.4.2	Insurance	-	-	-	-	-	-	332	33	366	366	-	-	-	-	-	-	-	-	-	-
2c.4.3	Property taxes	-	-	-	-	-	-	200	20	220	220	-	-	-	-	-	-	-	-	-	-
2c.4.4	Health physics supplies	-	517	-	-	-	-	-	129	647	647	-	-	-	-	-	-	-	-	-	-
2c.4.5	Heavy equipment rental	-	1,348	-	-	-	-	-	202	1,550	1,550	-	-	-	-	-	-	-	-	-	-
2c.4.6	Disposal of DAW generated	-	-	37	21	-	138	-	41	236	236	-	-	-	2,294	-	-	-	45,975	75	-

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Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 2c Period-Dependent Costs (continued)																					
2c.4.7	Plant energy budget	-	-	-	-	-	-	361	54	415	415	-	-	-	-	-	-	-	-	-	-
2c.4.8	NRC Fees	-	-	-	-	-	-	438	44	482	482	-	-	-	-	-	-	-	-	-	-
2c.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	250	37	287	287	-	-	-	-	-	-	-	-	-	-
2c.4.10	Corporate Allocations	-	-	-	-	-	-	450	45	495	495	-	-	-	-	-	-	-	-	-	-
2c.4.11	Security Staff Cost	-	-	-	-	-	-	974	146	1,120	1,120	-	-	-	-	-	-	-	-	-	20,829
2c.4.12	DOC Staff Cost	-	-	-	-	-	-	5,791	869	6,659	6,659	-	-	-	-	-	-	-	-	-	69,429
2c.4.13	Utility Staff Cost	-	-	-	-	-	-	8,807	1,321	10,128	10,128	-	-	-	-	-	-	-	-	-	131,220
2c.4	Subtotal Period 2c Period-Dependent Costs	164	1,865	37	21	-	138	17,602	2,983	22,810	22,810	-	-	-	2,294	-	-	-	45,975	75	221,477
2c.0	TOTAL PERIOD 2c COST	1,853	4,280	486	496	1,546	2,166	19,242	5,746	35,813	35,813	-	-	20,004	10,518	-	-	-	1,602,435	64,193	233,957
PERIOD 2e - License Termination																					
Period 2e Direct Decommissioning Activities																					
2e.1.1	ORISE confirmatory survey	-	-	-	-	-	-	156	47	203	203	-	-	-	-	-	-	-	-	-	-
2e.1.2	Terminate license									a											
2e.1	Subtotal Period 2e Activity Costs	-	-	-	-	-	-	156	47	203	203	-	-	-	-	-	-	-	-	-	-
Period 2e Additional Costs																					
2e.2.1	License Termination Survey	-	-	-	-	-	-	8,311	2,493	10,804	10,804	-	-	-	-	-	-	-	152,357	6,240	
2e.2	Subtotal Period 2e Additional Costs	-	-	-	-	-	-	8,311	2,493	10,804	10,804	-	-	-	-	-	-	-	-	152,357	6,240
Period 2e Collateral Costs																					
2e.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,423	213	1,636	1,636	-	-	-	-	-	-	-	-	-	-
2e.3	Subtotal Period 2e Collateral Costs	-	-	-	-	-	-	1,423	213	1,636	1,636	-	-	-	-	-	-	-	-	-	-
Period 2e Period-Dependent Costs																					
2e.4.1	Insurance	-	-	-	-	-	-	378	38	415	415	-	-	-	-	-	-	-	-	-	-
2e.4.2	Property taxes	-	-	-	-	-	-	227	23	249	249	-	-	-	-	-	-	-	-	-	-
2e.4.3	Health physics supplies	-	875	-	-	-	-	-	219	1,093	1,093	-	-	-	-	-	-	-	-	-	-
2e.4.4	Disposal of DAW generated	-	-	6	4	-	23	-	7	40	40	-	-	-	391	-	-	-	7,826	13	-
2e.4.5	Plant energy budget	-	-	-	-	-	-	205	31	235	235	-	-	-	-	-	-	-	-	-	-
2e.4.6	NRC Fees	-	-	-	-	-	-	534	53	587	587	-	-	-	-	-	-	-	-	-	-
2e.4.7	Corporate Allocations	-	-	-	-	-	-	360	36	396	396	-	-	-	-	-	-	-	-	-	-
2e.4.8	Security Staff Cost	-	-	-	-	-	-	1,103	165	1,268	1,268	-	-	-	-	-	-	-	-	-	18,926
2e.4.9	DOC Staff Cost	-	-	-	-	-	-	4,874	731	5,605	5,605	-	-	-	-	-	-	-	-	-	57,566
2e.4.10	Utility Staff Cost	-	-	-	-	-	-	5,510	826	6,336	6,336	-	-	-	-	-	-	-	-	-	74,914
2e.4	Subtotal Period 2e Period-Dependent Costs	-	875	6	4	-	23	13,188	2,129	16,225	16,225	-	-	-	391	-	-	-	7,826	13	151,406
2e.0	TOTAL PERIOD 2e COST	-	875	6	4	-	23	23,078	4,883	28,869	28,869	-	-	-	391	-	-	-	7,826	152,370	157,646
PERIOD 2 TOTALS		9,653	66,780	14,083	10,198	20,202	53,518	228,364	80,706	483,505	450,204	24,940	8,361	411,681	140,086	3,156	459	499	23,311,260	1,148,002	2,696,717
PERIOD 3b - Site Restoration																					
Period 3b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
3b.1.1.1	Reactor	-	4,769	-	-	-	-	-	715	5,484	-	-	5,484	-	-	-	-	-	-	60,047	-
3b.1.1.2	Auxiliary	-	3,801	-	-	-	-	-	570	4,371	-	-	4,371	-	-	-	-	-	-	49,968	-
3b.1.1.3	Auxiliary Boiler	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	619	-
3b.1.1.4	Barge Facility	-	1,423	-	-	-	-	-	214	1,637	-	-	1,637	-	-	-	-	-	-	18,771	-
3b.1.1.5	Circulating & Service Water Pumphouse	-	286	-	-	-	-	-	43	329	-	-	329	-	-	-	-	-	-	4,345	-
3b.1.1.6	Communication Corridor - Clean	-	1,227	-	-	-	-	-	184	1,411	-	-	1,411	-	-	-	-	-	-	17,215	-
3b.1.1.7	Communication Corridor - Contaminated	-	52	-	-	-	-	-	8	60	-	-	60	-	-	-	-	-	-	674	-
3b.1.1.8	Cooling Tower Basemat	-	812	-	-	-	-	-	122	933	-	-	933	-	-	-	-	-	-	13,472	-

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Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Demolition of Remaining Site Buildings (continued)																					
3b.1.1.9	Diesel Generator	-	454	-	-	-	-	-	68	522	-	-	522	-	-	-	-	-	-	5,492	-
3b.1.1.10	Essential Service Water Pumphouse	-	270	-	-	-	-	-	41	311	-	-	311	-	-	-	-	-	-	3,938	-
3b.1.1.11	Fire Water Pumphouse	-	25	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	382	-
3b.1.1.12	Hot Machine Shop	-	21	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	417	-
3b.1.1.13	Intake	-	342	-	-	-	-	-	51	393	-	-	393	-	-	-	-	-	-	4,224	-
3b.1.1.14	Misc. Structures	-	2,177	-	-	-	-	-	327	2,504	-	-	2,504	-	-	-	-	-	-	27,921	-
3b.1.1.15	Miscellaneous Site Foundations	-	337	-	-	-	-	-	51	388	-	-	388	-	-	-	-	-	-	5,478	-
3b.1.1.16	Outage Maintenance	-	167	-	-	-	-	-	25	192	-	-	192	-	-	-	-	-	-	3,190	-
3b.1.1.17	RAM Storage Building	-	62	-	-	-	-	-	9	72	-	-	72	-	-	-	-	-	-	1,081	-
3b.1.1.18	Radioactive and Personnel Tunnel	-	25	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	383	-
3b.1.1.19	Radwaste	-	1,696	-	-	-	-	-	254	1,951	-	-	1,951	-	-	-	-	-	-	21,798	-
3b.1.1.20	Radwaste Drum Storage	-	249	-	-	-	-	-	37	287	-	-	287	-	-	-	-	-	-	3,840	-
3b.1.1.21	Security Additions	-	2,076	-	-	-	-	-	311	2,387	-	-	2,387	-	-	-	-	-	-	20,977	-
3b.1.1.22	Service	-	462	-	-	-	-	-	69	531	-	-	531	-	-	-	-	-	-	6,045	-
3b.1.1.23	Sludge Pump Station & Lagoon	-	23	-	-	-	-	-	3	26	-	-	26	-	-	-	-	-	-	313	-
3b.1.1.24	Steam Generator Replacement Bldgs	-	1,080	-	-	-	-	-	162	1,242	-	-	1,242	-	-	-	-	-	-	15,693	-
3b.1.1.25	Turbine Building	-	3,407	-	-	-	-	-	511	3,918	-	-	3,918	-	-	-	-	-	-	55,694	-
3b.1.1.26	Turbine Pedestal	-	983	-	-	-	-	-	147	1,130	-	-	1,130	-	-	-	-	-	-	10,928	-
3b.1.1.27	U.H.S. Cooling Tower	-	595	-	-	-	-	-	89	685	-	-	685	-	-	-	-	-	-	6,681	-
3b.1.1.28	Water Treatment Plant	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	9	-
3b.1.1.29	Fuel Building	-	1,898	-	-	-	-	-	285	2,183	-	-	2,183	-	-	-	-	-	-	22,580	-
3b.1.1	Totals	-	28,754	-	-	-	-	-	4,313	33,068	-	-	33,068	-	-	-	-	-	-	382,172	-
Site Closeout Activities																					
3b.1.2	BackFill Site	-	4,694	-	-	-	-	-	704	5,398	-	-	5,398	-	-	-	-	-	-	17,928	-
3b.1.3	Grade & landscape site	-	121	-	-	-	-	-	18	139	-	-	139	-	-	-	-	-	-	592	-
3b.1.4	Final report to NRC	-	-	-	-	-	-	185	28	213	213	-	-	-	-	-	-	-	-	-	1,560
3b.1	Subtotal Period 3b Activity Costs	-	33,570	-	-	-	-	185	5,063	38,818	213	-	38,605	-	-	-	-	-	-	400,692	1,560
Period 3b Additional Costs																					
3b.2.1	Concrete Crushing	-	1,125	-	-	-	-	8	170	1,303	-	-	1,303	-	-	-	-	-	-	5,830	-
3b.2.2	Mine Area Backfill	-	4,179	-	-	-	-	-	627	4,806	-	-	4,806	-	-	-	-	-	-	15,960	-
3b.2.3	Cooling Tower Discharge & Intake Pipe Flow Fill	-	3,937	-	-	-	-	-	590	4,527	-	-	4,527	-	-	-	-	-	-	9,588	-
3b.2.4	Cooling Tower Demolition	-	3,706	-	-	-	-	-	556	4,262	-	-	4,262	-	-	-	-	-	-	19,680	-
3b.2	Subtotal Period 3b Additional Costs	-	12,946	-	-	-	-	8	1,943	14,897	-	-	14,897	-	-	-	-	-	-	51,058	-
Period 3b Collateral Costs																					
3b.3.1	Small tool allowance	-	374	-	-	-	-	-	56	430	-	-	430	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	-	374	-	-	-	-	-	56	430	-	-	430	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3b.4.2	Property taxes	-	-	-	-	-	-	451	45	496	-	-	496	-	-	-	-	-	-	-	-
3b.4.3	Heavy equipment rental	-	4,080	-	-	-	-	-	612	4,692	-	-	4,692	-	-	-	-	-	-	-	-
3b.4.4	Plant energy budget	-	-	-	-	-	-	204	31	234	-	-	234	-	-	-	-	-	-	-	-
3b.4.5	Corporate Allocations	-	-	-	-	-	-	990	99	1,089	1,089	-	-	-	-	-	-	-	-	-	-
3b.4.6	Security Staff Cost	-	-	-	-	-	-	1,625	244	1,869	-	-	1,869	-	-	-	-	-	-	-	37,646
3b.4.7	DOC Staff Cost	-	-	-	-	-	-	9,431	1,415	10,845	-	-	10,845	-	-	-	-	-	-	-	106,663
3b.4.8	Utility Staff Cost	-	-	-	-	-	-	4,458	669	5,127	-	-	5,127	-	-	-	-	-	-	-	61,174
3b.4	Subtotal Period 3b Period-Dependent Costs	-	4,080	-	-	-	-	17,158	3,114	24,352	1,089	-	23,263	-	-	-	-	-	-	-	205,483
3b.0	TOTAL PERIOD 3b COST	-	50,970	-	-	-	-	17,351	10,176	78,496	1,302	-	77,195	-	-	-	-	-	-	451,750	207,043
PERIOD 3 TOTALS		-	50,970	-	-	-	-	17,351	10,176	78,496	1,302	-	77,195	-	-	-	-	-	-	451,750	207,043
TOTAL COST TO DECOMMISSION		12,483	120,067	14,205	10,742	20,202	58,337	349,004	108,866	693,907	572,236	34,647	87,024	411,681	141,483	4,668	459	499	23,520,030	1,620,312	3,957,490

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Table C
Callaway Plant
DECON Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			

TOTAL COST TO DECOMMISSION WITH 18.61% CONTINGENCY:	$693,907	thousands of 2008	dollars
TOTAL NRC LICENSE TERMINATION COST IS 82.47% OR:	$572,236	thousands of 2008	dollars
SPENT FUEL MANAGEMENT COST IS 4.99% OR:	$34,647	thousands of 2008	dollars
NON-NUCLEAR DEMOLITION COST IS 12.54% OR:	$87,024	thousands of 2008	dollars
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	146,611	cubic feet	
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	499	cubic feet	
TOTAL SCRAP METAL REMOVED:	70,304	tons	
TOTAL CRAFT LABOR REQUIREMENTS:	1,601,212	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

Table D
Callaway Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	SAFSTOR site characterization survey	-	-	-	-	-	-	447	134	581	581	-	-	-	-	-	-	-	-	-	-
1a.1.2	Prepare preliminary decommissioning cost	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	237	36	273	273	-	-	-	-	-	-	-	-	-	2,000
1a.1.8	Review plant dwgs & specs.	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	1,300
1a.1.9	Perform detailed rad survey									a											
1a.1.10	Estimate by-product inventory	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	End product description	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
1a.1.12	Detailed by-product inventory	-	-	-	-	-	-	178	27	204	204	-	-	-	-	-	-	-	-	-	1,500
1a.1.13	Define major work sequence	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
1a.1.14	Perform SER and EA	-	-	-	-	-	-	367	55	422	422	-	-	-	-	-	-	-	-	-	3,100
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	592	89	681	681	-	-	-	-	-	-	-	-	-	5,000
Activity Specifications																					
1a.1.16.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	583	87	670	670	-	-	-	-	-	-	-	-	-	4,920
1a.1.16.2	Plant systems	-	-	-	-	-	-	494	74	568	568	-	-	-	-	-	-	-	-	-	4,167
1a.1.16.3	Plant structures and buildings	-	-	-	-	-	-	370	55	425	425	-	-	-	-	-	-	-	-	-	3,120
1a.1.16.4	Waste management	-	-	-	-	-	-	237	36	273	273	-	-	-	-	-	-	-	-	-	2,000
1a.1.16.5	Facility and site dormancy	-	-	-	-	-	-	237	36	273	273	-	-	-	-	-	-	-	-	-	2,000
1a.1.16	Total	-	-	-	-	-	-	1,920	288	2,208	2,208	-	-	-	-	-	-	-	-	-	16,207
Detailed Work Procedures																					
1a.1.17.1	Plant systems	-	-	-	-	-	-	140	21	161	161	-	-	-	-	-	-	-	-	-	1,183
1a.1.17.2	Facility closeout & dormancy	-	-	-	-	-	-	142	21	164	164	-	-	-	-	-	-	-	-	-	1,200
1a.1.17	Total	-	-	-	-	-	-	282	42	325	325	-	-	-	-	-	-	-	-	-	2,383
1a.1.18	Procure vacuum drying system	-	-	-	-	-	-	12	2	14	14	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	4,699	772	5,471	5,471	-	-	-	-	-	-	-	-	-	35,890
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	4,180	627	4,807	-	4,807	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	4,180	627	4,807	-	4,807	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	1,662	166	1,828	1,828	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	300	30	330	330	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	432	-	-	-	-	-	108	540	540	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	424	-	-	-	-	-	64	488	488	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	11	6	-	41	-	12	70	70	-	-	-	675	-	-	-	13,531	22	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,354	203	1,557	1,557	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	706	71	776	776	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	450	45	495	-	495	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	256	38	295	295	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	940	141	1,082	-	1,082	-	-	-	-	-	-	-	-	-
1a.4.11	Corporate Allocations	-	-	-	-	-	-	720	72	792	792	-	-	-	-	-	-	-	-	-	-
1a.4.12	Security Staff Cost	-	-	-	-	-	-	5,658	849	6,507	6,507	-	-	-	-	-	-	-	-	-	157,471
1a.4.13	Utility Staff Cost	-	-	-	-	-	-	26,966	4,045	31,011	31,011	-	-	-	-	-	-	-	-	-	423,400
1a.4	Subtotal Period 1a Period-Dependent Costs	-	856	11	6	-	41	39,012	5,844	45,769	44,193	1,576	-	-	675	-	-	-	13,531	22	580,871

Attachment 1

Table D
Callaway Plant
SAFSTOR Decommissioning Cost Estimate
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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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
1a.0	TOTAL PERIOD 1a COST	-	856	11	6	-	41	47,892	7,243	56,048	49,665	6,383	-	-	675	-	-	-	13,531	22	616,761
PERIOD 1b - SAFSTOR Limited DECON Activities																					
Period 1b Direct Decommissioning Activities																					
Decontamination of Site Buildings																					
1b.1.1.1	Reactor	1,166	-	-	-	-	-	-	583	1,749	1,749	-	-	-	-	-	-	-	-	24,102	-
1b.1.1.2	Auxiliary	582	-	-	-	-	-	-	291	872	872	-	-	-	-	-	-	-	-	12,527	-
1b.1.1.3	Communication Corridor - Contaminated	13	-	-	-	-	-	-	6	19	19	-	-	-	-	-	-	-	-	276	-
1b.1.1.4	Fuel Building	754	-	-	-	-	-	-	377	1,131	1,131	-	-	-	-	-	-	-	-	14,371	-
1b.1.1.5	Hot Machine Shop	16	-	-	-	-	-	-	8	24	24	-	-	-	-	-	-	-	-	344	-
1b.1.1.6	RAM Storage Building	40	-	-	-	-	-	-	20	60	60	-	-	-	-	-	-	-	-	865	-
1b.1.1.7	Radioactive and Personnel Tunnel	4	-	-	-	-	-	-	2	6	6	-	-	-	-	-	-	-	-	89	-
1b.1.1.8	Radwaste	273	-	-	-	-	-	-	137	410	410	-	-	-	-	-	-	-	-	5,831	-
1b.1.1.9	Radwaste Drum Storage	31	-	-	-	-	-	-	15	46	46	-	-	-	-	-	-	-	-	656	-
1b.1.1	Totals	2,879	-	-	-	-	-	-	1,440	4,319	4,319	-	-	-	-	-	-	-	-	59,062	-
1b.1	Subtotal Period 1b Activity Costs	2,879	-	-	-	-	-	-	1,440	4,319	4,319	-	-	-	-	-	-	-	-	59,062	-
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	831	-	-	-	-	-	-	125	956	956	-	-	-	-	-	-	-	-	-	-
1b.3.2	Process liquid waste	178	-	69	341	-	337	-	231	1,155	1,155	-	-	-	1,210	-	-	-	72,602	236	-
1b.3.3	Small tool allowance	-	48	-	-	-	-	-	7	56	56	-	-	-	-	-	-	-	-	-	-
1b.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	1,100	165	1,265	-	1,265	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	1,009	48	69	341	-	337	1,100	528	3,432	2,167	1,265	-	-	1,210	-	-	-	72,602	236	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	1,057	-	-	-	-	-	-	264	1,321	1,321	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	419	42	461	461	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	76	8	83	83	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	346	-	-	-	-	-	87	433	433	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	107	-	-	-	-	-	16	123	123	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	13	7	-	48	-	15	83	83	-	-	-	808	-	-	-	16,189	27	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	341	51	392	392	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	178	18	196	196	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	113	11	125	-	125	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	237	36	273	-	273	-	-	-	-	-	-	-	-	-
1b.4.11	Corporate Allocations	-	-	-	-	-	-	270	27	297	297	-	-	-	-	-	-	-	-	-	-
1b.4.12	Security Staff Cost	-	-	-	-	-	-	1,426	214	1,640	1,640	-	-	-	-	-	-	-	-	-	39,691
1b.4.13	Utility Staff Cost	-	-	-	-	-	-	6,797	1,020	7,817	7,817	-	-	-	-	-	-	-	-	-	106,720
1b.4	Subtotal Period 1b Period-Dependent Costs	1,057	453	13	7	-	48	9,857	1,807	13,243	12,846	397	-	-	808	-	-	-	16,189	27	146,411
1b.0	TOTAL PERIOD 1b COST	4,945	502	82	348	-	385	10,957	3,775	20,994	19,332	1,662	-	-	2,018	-	-	-	88,791	59,324	146,411
PERIOD 1c - Preparations for SAFSTOR Dormancy																					
Period 1c Direct Decommissioning Activities																					
1c.1.1	Prepare support equipment for storage	-	410	-	-	-	-	-	61	471	471	-	-	-	-	-	-	-	-	3,000	-
1c.1.2	Install containment pressure equal. lines	-	37	-	-	-	-	-	5	42	42	-	-	-	-	-	-	-	-	700	-
1c.1.3	Interim survey prior to dormancy	-	-	-	-	-	-	733	220	953	953	-	-	-	-	-	-	-	-	11,778	-
1c.1.4	Secure building accesses									a											
1c.1.5	Prepare & submit interim report	-	-	-	-	-	-	69	10	79	79	-	-	-	-	-	-	-	-	-	583
1c.1	Subtotal Period 1c Activity Costs	-	446	-	-	-	-	802	297	1,546	1,546	-	-	-	-	-	-	-	-	15,478	583
Period 1c Additional Costs																					
1c.2.1	Spent Fuel Pool Isolation	-	-	-	-	-	-	9,407	1,411	10,819	10,819	-	-	-	-	-	-	-	-	-	-

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Table D
Callaway Plant
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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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
1c.2	Subtotal Period 1c Additional Costs	-	-	-	-	-	-	9,407	1,411	10,819	10,819	-	-	-	-	-	-	-	-	-	-
Period 1c Collateral Costs																					
1c.3.1	Process liquid waste	198	-	77	380	-	376	-	258	1,289	1,289	-	-	-	1,351	-	-	-	81,050	263	-
1c.3.2	Small tool allowance	-	3	-	-	-	-	-	1	4	4	-	-	-	-	-	-	-	-	-	-
1c.3.3	Spent Fuel Capital and Transfer	-	-	-	-	-	-	1,100	165	1,265	-	1,265	-	-	-	-	-	-	-	-	-
1c.3	Subtotal Period 1c Collateral Costs	198	3	77	380	-	376	1,100	423	2,558	1,293	1,265	-	-	1,351	-	-	-	81,050	263	-
Period 1c Period-Dependent Costs																					
1c.4.1	Insurance	-	-	-	-	-	-	419	42	461	461	-	-	-	-	-	-	-	-	-	-
1c.4.2	Property taxes	-	-	-	-	-	-	76	8	83	83	-	-	-	-	-	-	-	-	-	-
1c.4.3	Health physics supplies	-	172	-	-	-	-	-	43	215	215	-	-	-	-	-	-	-	-	-	-
1c.4.4	Heavy equipment rental	-	107	-	-	-	-	-	16	123	123	-	-	-	-	-	-	-	-	-	-
1c.4.5	Disposal of DAW generated	-	-	3	2	-	10	-	3	18	18	-	-	-	170	-	-	-	3,411	6	-
1c.4.6	Plant energy budget	-	-	-	-	-	-	341	51	392	392	-	-	-	-	-	-	-	-	-	-
1c.4.7	NRC Fees	-	-	-	-	-	-	178	18	196	196	-	-	-	-	-	-	-	-	-	-
1c.4.8	Emergency Planning Fees	-	-	-	-	-	-	113	11	125	-	125	-	-	-	-	-	-	-	-	-
1c.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	237	36	273	-	273	-	-	-	-	-	-	-	-	-
1c.4.10	Corporate Allocations	-	-	-	-	-	-	360	36	396	396	-	-	-	-	-	-	-	-	-	-
1c.4.11	Security Staff Cost	-	-	-	-	-	-	1,426	214	1,640	1,640	-	-	-	-	-	-	-	-	-	39,691
1c.4.12	Utility Staff Cost	-	-	-	-	-	-	6,797	1,020	7,817	7,817	-	-	-	-	-	-	-	-	-	106,720
1c.4	Subtotal Period 1c Period-Dependent Costs	-	279	3	2	-	10	9,947	1,497	11,737	11,340	397	-	-	170	-	-	-	3,411	6	146,411
1c.0	TOTAL PERIOD 1c COST	198	729	80	382	-	386	21,257	3,629	26,660	24,998	1,662	-	-	1,521	-	-	-	84,461	15,747	146,995
PERIOD 1 TOTALS		5,144	2,086	172	736	-	812	80,105	14,646	103,702	93,994	9,708	-	-	4,214	-	-	-	186,783	75,093	910,168
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	-	-	-	-	-	-	241	36	277	277	-	-	-	-	-	-	-	-	-	-
2a.1.5	Maintenance supplies	-	-	-	-	-	-	503	126	629	629	-	-	-	-	-	-	-	-	-	-
2a.1	Subtotal Period 2a Activity Costs	-	-	-	-	-	-	743	162	905	905	-	-	-	-	-	-	-	-	-	-
Period 2a Collateral Costs																					
2a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	17,160	2,574	19,734	-	19,734	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	-	-	-	-	-	-	17,160	2,574	19,734	-	19,734	-	-	-	-	-	-	-	-	-
Period 2a Period-Dependent Costs																					
2a.4.1	Insurance	-	-	-	-	-	-	2,283	228	2,511	2,197	314	-	-	-	-	-	-	-	-	-
2a.4.2	Property taxes	-	-	-	-	-	-	1,199	120	1,319	1,319	-	-	-	-	-	-	-	-	-	-
2a.4.3	Health physics supplies	-	401	-	-	-	-	-	100	501	501	-	-	-	-	-	-	-	-	-	-
2a.4.4	Disposal of DAW generated	-	-	29	16	-	110	-	33	188	188	-	-	-	1,828	-	-	-	36,637	60	-
2a.4.5	Plant energy budget	-	-	-	-	-	-	1,083	162	1,246	623	623	-	-	-	-	-	-	-	-	-
2a.4.6	NRC Fees	-	-	-	-	-	-	806	81	887	887	-	-	-	-	-	-	-	-	-	-
2a.4.7	Emergency Planning Fees	-	-	-	-	-	-	799	80	879	-	879	-	-	-	-	-	-	-	-	-
2a.4.8	Spent Fuel Pool O&M	-	-	-	-	-	-	3,762	564	4,326	-	4,326	-	-	-	-	-	-	-	-	-
2a.4.9	Corporate Allocations	-	-	-	-	-	-	990	99	1,089	270	819	-	-	-	-	-	-	-	-	-
2a.4.10	Security Staff Cost	-	-	-	-	-	-	16,460	2,469	18,929	6,727	12,203	-	-	-	-	-	-	-	-	444,257
2a.4.11	Utility Staff Cost	-	-	-	-	-	-	21,189	3,178	24,367	4,889	19,478	-	-	-	-	-	-	-	-	329,543
2a.4	Subtotal Period 2a Period-Dependent Costs	-	401	29	16	-	110	48,572	7,115	56,244	17,602	38,642	-	-	1,828	-	-	-	36,637	60	773,800
2a.0	TOTAL PERIOD 2a COST	-	401	29	16	-	110	66,476	9,851	76,883	18,507	58,376	-	-	1,828	-	-	-	36,637	60	773,800

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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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
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	-	-	-	-	-	-	2,908	436	3,344	3,344	-	-	-	-	-	-	-	-	-	-
2c.1.5	Maintenance supplies	-	-	-	-	-	-	6,076	1,519	7,595	7,595	-	-	-	-	-	-	-	-	-	-
2c.1	Subtotal Period 2c Activity Costs	-	-	-	-	-	-	8,984	1,955	10,939	10,939	-	-	-	-	-	-	-	-	-	-
Period 2c Period-Dependent Costs																					
2c.4.1	Insurance	-	-	-	-	-	-	24,136	2,414	26,549	26,549	-	-	-	-	-	-	-	-	-	-
2c.4.2	Property taxes	-	-	-	-	-	-	14,490	1,449	15,939	15,939	-	-	-	-	-	-	-	-	-	-
2c.4.3	Health physics supplies	-	3,822	-	-	-	-	-	956	4,778	4,778	-	-	-	-	-	-	-	-	-	-
2c.4.4	Disposal of DAW generated	-	-	323	181	-	1,207	-	361	2,072	2,072	-	-	-	20,108	-	-	-	402,961	661	-
2c.4.5	Plant energy budget	-	-	-	-	-	-	6,544	982	7,526	7,526	-	-	-	-	-	-	-	-	-	-
2c.4.6	NRC Fees	-	-	-	-	-	-	8,820	882	9,702	9,702	-	-	-	-	-	-	-	-	-	-
2c.4.7	Corporate Allocations	-	-	-	-	-	-	2,970	297	3,267	3,267	-	-	-	-	-	-	-	-	-	-
2c.4.8	Security Staff Cost	-	-	-	-	-	-	70,682	10,602	81,284	81,284	-	-	-	-	-	-	-	-	-	1,512,171
2c.4.9	Utility Staff Cost	-	-	-	-	-	-	51,374	7,706	59,080	59,080	-	-	-	-	-	-	-	-	-	882,100
2c.4	Subtotal Period 2c Period-Dependent Costs	-	3,822	323	181	-	1,207	179,016	25,648	210,197	210,197	-	-	-	20,108	-	-	-	402,961	661	2,394,271
2c.0	TOTAL PERIOD 2c COST	-	3,822	323	181	-	1,207	187,999	27,603	221,136	221,136	-	-	-	20,108	-	-	-	402,961	661	2,394,271
PERIOD 2 TOTALS		-	4,223	352	198	-	1,316	254,475	37,454	298,018	239,643	58,376	-	-	21,937	-	-	-	439,598	721	3,168,071
PERIOD 3a - Reactivate Site Following SAFSTOR Dormancy																					
Period 3a Direct Decommissioning Activities																					
3a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	1,300
3a.1.2	Review plant dwgs & specs.	-	-	-	-	-	-	545	82	627	627	-	-	-	-	-	-	-	-	-	4,600
3a.1.3	Perform detailed rad survey									a											
3a.1.4	End product description	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
3a.1.5	Detailed by-product inventory	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	1,300
3a.1.6	Define major work sequence	-	-	-	-	-	-	889	133	1,022	1,022	-	-	-	-	-	-	-	-	-	7,500
3a.1.7	Perform SER and EA	-	-	-	-	-	-	367	55	422	422	-	-	-	-	-	-	-	-	-	3,100
3a.1.8	Perform Site-Specific Cost Study	-	-	-	-	-	-	592	89	681	681	-	-	-	-	-	-	-	-	-	5,000
3a.1.9	Prepare/submit License Termination Plan	-	-	-	-	-	-	485	73	558	558	-	-	-	-	-	-	-	-	-	4,096
3a.1.10	Receive NRC approval of termination plan									a											
Activity Specifications																					
3a.1.11.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	873	131	1,004	904	-	100	-	-	-	-	-	-	-	7,370
3a.1.11.2	Plant systems	-	-	-	-	-	-	494	74	568	511	-	57	-	-	-	-	-	-	-	4,167
3a.1.11.3	Reactor internals	-	-	-	-	-	-	841	126	967	967	-	-	-	-	-	-	-	-	-	7,100
3a.1.11.4	Reactor vessel	-	-	-	-	-	-	770	116	886	886	-	-	-	-	-	-	-	-	-	6,500
3a.1.11.5	Biological shield	-	-	-	-	-	-	59	9	68	68	-	-	-	-	-	-	-	-	-	500
3a.1.11.6	Steam generators	-	-	-	-	-	-	370	55	425	425	-	-	-	-	-	-	-	-	-	3,120
3a.1.11.7	Reinforced concrete	-	-	-	-	-	-	190	28	218	109	-	109	-	-	-	-	-	-	-	1,600
3a.1.11.8	Main Turbine	-	-	-	-	-	-	47	7	55	-	-	55	-	-	-	-	-	-	-	400
3a.1.11.9	Main Condensers	-	-	-	-	-	-	47	7	55	-	-	55	-	-	-	-	-	-	-	400
3a.1.11.10	Plant structures & buildings	-	-	-	-	-	-	370	55	425	213	-	213	-	-	-	-	-	-	-	3,120
3a.1.11.11	Waste management	-	-	-	-	-	-	545	82	627	627	-	-	-	-	-	-	-	-	-	4,600
3a.1.11.12	Facility & site closeout	-	-	-	-	-	-	107	16	123	61	-	61	-	-	-	-	-	-	-	900
3a.1.11	Total	-	-	-	-	-	-	4,713	707	5,420	4,771	-	649	-	-	-	-	-	-	-	39,777
Planning & Site Preparations																					
3a.1.12	Prepare dismantling sequence	-	-	-	-	-	-	284	43	327	327	-	-	-	-	-	-	-	-	-	2,400
3a.1.13	Plant prep. & temp. svces	-	-	-	-	-	-	2,700	405	3,105	3,105	-	-	-	-	-	-	-	-	-	-

Attachment 1

Table D
Callaway Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
3a.1.14	Design water clean-up system	-	-	-	-	-	-	166	25	191	191	-	-	-	-	-	-	-	-	-	1,400
3a.1.15	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,100	315	2,415	2,415	-	-	-	-	-	-	-	-	-	-
3a.1.16	Procure casks/liners & containers	-	-	-	-	-	-	146	22	168	168	-	-	-	-	-	-	-	-	-	1,230
3a.1	Subtotal Period 3a Activity Costs	-	-	-	-	-	-	13,414	2,012	15,426	14,777	-	649	-	-	-	-	-	-	-	72,703
Period 3a Period-Dependent Costs																					
3a.4.1	Insurance	-	-	-	-	-	-	252	25	277	277	-	-	-	-	-	-	-	-	-	-
3a.4.2	Property taxes	-	-	-	-	-	-	151	15	166	166	-	-	-	-	-	-	-	-	-	-
3a.4.3	Health physics supplies	-	190	-	-	-	-	-	48	238	238	-	-	-	-	-	-	-	-	-	-
3a.4.4	Heavy equipment rental	-	214	-	-	-	-	-	32	246	246	-	-	-	-	-	-	-	-	-	-
3a.4.5	Disposal of DAW generated	-	-	5	3	-	17	-	5	30	30	-	-	-	287	-	-	-	5,756	9	-
3a.4.6	Plant energy budget	-	-	-	-	-	-	683	102	785	785	-	-	-	-	-	-	-	-	-	-
3a.4.7	NRC Fees	-	-	-	-	-	-	126	13	138	138	-	-	-	-	-	-	-	-	-	-
3a.4.8	Corporate Allocations	-	-	-	-	-	-	360	36	396	396	-	-	-	-	-	-	-	-	-	-
3a.4.9	Security Staff Cost	-	-	-	-	-	-	1,305	196	1,501	1,501	-	-	-	-	-	-	-	-	-	32,857
3a.4.10	Utility Staff Cost	-	-	-	-	-	-	8,449	1,267	9,716	9,716	-	-	-	-	-	-	-	-	-	130,377
3a.4	Subtotal Period 3a Period-Dependent Costs	-	404	5	3	-	17	11,325	1,739	13,492	13,492	-	-	-	287	-	-	-	5,756	9	163,234
3a.0	TOTAL PERIOD 3a COST	-	404	5	3	-	17	24,739	3,751	28,918	28,269	-	649	-	287	-	-	-	5,756	9	235,937
PERIOD 3b - Decommissioning Preparations																					
Period 3b Direct Decommissioning Activities																					
Detailed Work Procedures																					
3b.1.1.1	Plant systems	-	-	-	-	-	-	561	84	645	580	-	64	-	-	-	-	-	-	-	4,733
3b.1.1.2	Reactor internals	-	-	-	-	-	-	296	44	341	341	-	-	-	-	-	-	-	-	-	2,500
3b.1.1.3	Remaining buildings	-	-	-	-	-	-	160	24	184	46	-	138	-	-	-	-	-	-	-	1,350
3b.1.1.4	CRD cooling assembly	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.5	CRD housings & ICI tubes	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.6	Incore instrumentation	-	-	-	-	-	-	118	18	136	136	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.7	Reactor vessel	-	-	-	-	-	-	430	65	495	495	-	-	-	-	-	-	-	-	-	3,630
3b.1.1.8	Facility closeout	-	-	-	-	-	-	142	21	164	82	-	82	-	-	-	-	-	-	-	1,200
3b.1.1.9	Missile shields	-	-	-	-	-	-	53	8	61	61	-	-	-	-	-	-	-	-	-	450
3b.1.1.10	Biological shield	-	-	-	-	-	-	142	21	164	164	-	-	-	-	-	-	-	-	-	1,200
3b.1.1.11	Steam generators	-	-	-	-	-	-	545	82	627	627	-	-	-	-	-	-	-	-	-	4,600
3b.1.1.12	Reinforced concrete	-	-	-	-	-	-	118	18	136	68	-	68	-	-	-	-	-	-	-	1,000
3b.1.1.13	Main Turbine	-	-	-	-	-	-	185	28	213	-	-	213	-	-	-	-	-	-	-	1,560
3b.1.1.14	Main Condensers	-	-	-	-	-	-	185	28	213	-	-	213	-	-	-	-	-	-	-	1,560
3b.1.1.15	Auxiliary building	-	-	-	-	-	-	323	49	372	335	-	37	-	-	-	-	-	-	-	2,730
3b.1.1.16	Reactor building	-	-	-	-	-	-	323	49	372	335	-	37	-	-	-	-	-	-	-	2,730
3b.1.1	Total	-	-	-	-	-	-	3,820	573	4,393	3,541	-	852	-	-	-	-	-	-	-	32,243
3b.1	Subtotal Period 3b Activity Costs	-	-	-	-	-	-	3,820	573	4,393	3,541	-	852	-	-	-	-	-	-	-	32,243
Period 3b Additional Costs																					
3b.2.1	Site Characterization	-	-	-	-	-	-	3,160	948	4,108	4,108	-	-	-	-	-	-	-	19,100	7,852	
3b.2	Subtotal Period 3b Additional Costs	-	-	-	-	-	-	3,160	948	4,108	4,108	-	-	-	-	-	-	-	19,100	7,852	
Period 3b Collateral Costs																					
3b.3.1	Decon equipment	831	-	-	-	-	-	-	125	956	956	-	-	-	-	-	-	-	-	-	-
3b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,423	213	1,636	1,636	-	-	-	-	-	-	-	-	-	-
3b.3.3	Pipe cutting equipment	-	1,000	-	-	-	-	-	150	1,150	1,150	-	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	831	1,000	-	-	-	-	1,423	488	3,742	3,742	-	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Decon supplies	51	-	-	-	-	-	-	13	64	64	-	-	-	-	-	-	-	-	-	-
3b.4.2	Insurance	-	-	-	-	-	-	499	50	549	549	-	-	-	-	-	-	-	-	-	-
3b.4.3	Property taxes	-	-	-	-	-	-	300	30	330	330	-	-	-	-	-	-	-	-	-	-

Attachment 1

Table D
Callaway Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 3b Period-Dependent Costs (continued)																					
3b.4.4	Health physics supplies	-	416	-	-	-	-	-	104	520	520	-	-	-	-	-	-	-	-	-	-
3b.4.5	Heavy equipment rental	-	424	-	-	-	-	-	64	488	488	-	-	-	-	-	-	-	-	-	-
3b.4.6	Disposal of DAW generated	-	-	10	6	-	39	-	12	66	66	-	-	-	645	-	-	-	12,916	21	-
3b.4.7	Plant energy budget	-	-	-	-	-	-	1,354	203	1,557	1,557	-	-	-	-	-	-	-	-	-	-
3b.4.8	NRC Fees	-	-	-	-	-	-	249	25	274	274	-	-	-	-	-	-	-	-	-	-
3b.4.9	Corporate Allocations	-	-	-	-	-	-	630	63	693	693	-	-	-	-	-	-	-	-	-	-
3b.4.10	Security Staff Cost	-	-	-	-	-	-	2,589	388	2,978	2,978	-	-	-	-	-	-	-	-	-	65,179
3b.4.11	DOC Staff Cost	-	-	-	-	-	-	9,835	1,475	11,310	11,310	-	-	-	-	-	-	-	-	-	116,800
3b.4.12	Utility Staff Cost	-	-	-	-	-	-	16,759	2,514	19,273	19,273	-	-	-	-	-	-	-	-	-	258,629
3b.4	Subtotal Period 3b Period-Dependent Costs	51	840	10	6	-	39	32,215	4,940	38,102	38,102	-	-	-	645	-	-	-	12,916	21	440,607
3b.0	TOTAL PERIOD 3b COST	882	1,840	10	6	-	39	40,619	6,949	50,345	49,493	-	852	-	645	-	-	-	12,916	19,121	480,702
PERIOD 3 TOTALS		882	2,244	15	8	-	56	65,357	10,701	79,263	77,763	-	1,501	-	932	-	-	-	18,672	19,131	716,639
PERIOD 4a - Large Component Removal																					
Period 4a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
4a.1.1.1	Reactor Coolant Piping	33	155	19	14	118	209	-	129	677	677	-	-	579	579	-	-	-	134,210	3,867	-
4a.1.1.2	Pressurizer Relief Tank	6	22	5	4	33	54	-	28	152	152	-	-	164	164	-	-	-	36,395	581	-
4a.1.1.3	Reactor Coolant Pumps & Motors	19	84	41	151	119	914	-	304	1,632	1,632	-	-	198	3,386	-	-	-	897,754	3,464	-
4a.1.1.4	Pressurizer	8	52	490	412	-	1,019	-	383	2,365	2,365	-	-	-	3,882	-	-	-	240,508	1,866	1,500
4a.1.1.5	Steam Generators	69	4,634	1,961	2,135	2,322	5,893	-	3,531	20,545	20,545	-	-	40,262	22,448	-	-	-	3,346,591	20,508	2,250
4a.1.1.6	Retired Steam Generator Units	-	-	2,017	1,530	2,322	5,893	-	2,253	14,013	14,013	-	-	40,262	22,448	-	-	-	3,346,591	10,800	2,250
4a.1.1.7	CRDMs/ICIs/Service Structure Removal	28	82	190	33	51	161	-	106	651	651	-	-	753	2,947	-	-	-	81,666	2,120	-
4a.1.1.8	Reactor Vessel Internals	48	2,147	3,844	492	-	3,381	163	4,433	14,507	14,507	-	-	-	2,312	376	470	-	326,129	18,767	883
4a.1.1.9	Vessel & Internals GTCC Disposal	-	-	-	-	-	10,634	-	1,595	12,229	12,229	-	-	-	-	-	-	499	104,146	-	-
4a.1.1.10	Reactor Vessel	-	4,873	959	278	-	3,718	163	5,848	15,839	15,839	-	-	-	6,481	2,955	-	-	954,563	18,767	883
4a.1.1	Totals	210	12,050	9,525	5,050	4,966	31,876	326	18,609	82,612	82,612	-	-	82,217	64,646	3,330	470	499	9,468,553	80,740	7,765
Removal of Major Equipment																					
4a.1.2	Main Turbine/Generator	-	408	316	36	770	696	-	429	2,656	2,656	-	-	4,921	2,740	-	-	-	664,183	8,457	-
4a.1.3	Main Condensers	-	1,141	163	64	638	609	-	559	3,174	3,174	-	-	7,701	2,270	-	-	-	550,231	24,132	-
Cascading Costs from Clean Building Demolition																					
4a.1.4.1	Reactor	-	840	-	-	-	-	-	126	966	966	-	-	-	-	-	-	-	-	10,575	-
4a.1.4.2	Auxiliary	-	422	-	-	-	-	-	63	486	486	-	-	-	-	-	-	-	-	5,551	-
4a.1.4.3	Fuel Building	-	206	-	-	-	-	-	31	236	236	-	-	-	-	-	-	-	-	2,395	-
4a.1.4.4	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	16	-
4a.1.4.5	Radwaste	-	88	-	-	-	-	-	13	101	101	-	-	-	-	-	-	-	-	1,108	-
4a.1.4	Totals	-	1,557	-	-	-	-	-	233	1,790	1,790	-	-	-	-	-	-	-	-	19,645	-
Disposal of Plant Systems																					
4a.1.5.1	100 Aux.Bldg Non-System Specific RCA	-	655	10	22	570	-	-	253	1,510	1,510	-	-	7,629	-	-	-	-	309,812	13,471	-
4a.1.5.2	100 Auxiliary Bldg Non-System Specific	-	95	1	3	62	6	-	35	201	201	-	-	824	22	-	-	-	35,448	1,970	-
4a.1.5.3	AB - Main Steam	-	241	-	-	-	-	-	36	277	-	-	277	-	-	-	-	-	-	5,833	-
4a.1.5.4	AB - Main Steam RCA	-	73	3	6	161	-	-	44	286	286	-	-	2,156	-	-	-	-	87,550	1,495	-
4a.1.5.5	AC - Main Turbine	-	237	-	-	-	-	-	36	273	-	-	273	-	-	-	-	-	-	5,641	-
4a.1.5.6	AD - Condensate	-	264	-	-	-	-	-	40	303	-	-	303	-	-	-	-	-	-	6,144	-
4a.1.5.7	AE - Feedwater	-	181	-	-	-	-	-	27	208	-	-	208	-	-	-	-	-	-	4,271	-
4a.1.5.8	AF - Feedwater Heater Extraction	-	221	-	-	-	-	-	33	255	-	-	255	-	-	-	-	-	-	5,352	-
4a.1.5.9	AK - Condensate Demineralizer	-	82	-	-	-	-	-	12	94	-	-	94	-	-	-	-	-	-	1,944	-
4a.1.5.10	AL - Auxiliary Feedwater	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	852	-
4a.1.5.11	AQ - Condensate & Feedwater Chem Addtn	-	20	-	-	-	-	-	3	23	-	-	23	-	-	-	-	-	-	468	-
4a.1.5.12	BM - Steam Generator Blowdown	-	93	1	3	86	-	-	37	221	221	-	-	1,157	-	-	-	-	46,993	1,915	-
4a.1.5.13	BM - Steam Generator Blowdown - RCA	-	336	5	12	307	-	-	132	793	793	-	-	4,109	-	-	-	-	166,857	6,849	-

Attachment 1

Table D
Callaway Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Disposal of Plant Systems (continued)																					
4a.1.5.14	BN - Borated Refueling Water Storage	-	283	8	18	467	-	-	144	921	921	-	-	6,255	-	-	-	-	254,024	5,898	-
4a.1.5.15	CA - Steam Seal	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	455	-
4a.1.5.16	CB - Main Turbine Lube Oil	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	1,207	-
4a.1.5.17	CC - Generator Hydrogen Seal & CO2	-	9	-	-	-	-	-	1	10	-	-	10	-	-	-	-	-	-	198	-
4a.1.5.18	CD - Generator Seal Oil	-	12	-	-	-	-	-	2	14	-	-	14	-	-	-	-	-	-	287	-
4a.1.5.19	CE - Stator Cooling Water	-	11	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	241	-
4a.1.5.20	CF - Lube Oil Storage Xfer & Prfication	-	34	-	-	-	-	-	5	40	-	-	40	-	-	-	-	-	-	812	-
4a.1.5.21	CG - Condenser Air Removal	-	28	-	-	-	-	-	4	32	-	-	32	-	-	-	-	-	-	657	-
4a.1.5.22	CH - Main Turbine Control Oil	-	55	-	-	-	-	-	8	64	-	-	64	-	-	-	-	-	-	1,219	-
4a.1.5.23	DA - Circulating Water	-	311	-	-	-	-	-	47	358	-	-	358	-	-	-	-	-	-	7,502	-
4a.1.5.24	DB - Cooling Tower Makeup & Blowdown	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	1,260	-
4a.1.5.25	DD - Cooling Water Chemical Control Sys	-	46	-	-	-	-	-	7	53	-	-	53	-	-	-	-	-	-	1,073	-
4a.1.5.26	DD - Cooling Wtr Chem Control RCA	-	251	5	10	266	-	-	105	636	636	-	-	3,555	-	-	-	-	144,376	4,866	-
4a.1.5.27	EJ - Residual Heat Removal	-	311	20	27	335	221	-	189	1,102	1,102	-	-	4,481	825	-	-	-	255,781	6,506	-
4a.1.5.28	EM - High Pressure Coolant Injection	-	242	3	6	165	-	-	86	502	502	-	-	2,214	-	-	-	-	89,903	4,932	-
4a.1.5.29	EN - Containment Spray	-	196	4	9	226	-	-	85	519	519	-	-	3,026	-	-	-	-	122,874	4,005	-
4a.1.5.30	EP - Accumulator Safety Injection	-	136	2	6	149	-	-	57	350	350	-	-	1,989	-	-	-	-	80,762	2,775	-
4a.1.5.31	FA - Auxiliary Steam Generator	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	521	-
4a.1.5.32	FB - Auxiliary Steam	-	87	-	-	-	-	-	13	100	-	-	100	-	-	-	-	-	-	2,106	-
4a.1.5.33	FB - Auxiliary Steam RCA	-	74	1	2	61	-	-	28	167	167	-	-	816	-	-	-	-	33,148	1,492	-
4a.1.5.34	FC - Auxiliary Turbines	-	57	-	-	-	-	-	9	65	-	-	65	-	-	-	-	-	-	1,320	-
4a.1.5.35	FE - Auxiliary Steam Chemical Addition	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	105	-
4a.1.5.36	GE - Turbine Building HVAC	-	152	-	-	-	-	-	23	174	-	-	174	-	-	-	-	-	-	3,792	-
4a.1.5.37	GS - Containment Hydrogen Control	-	61	1	2	60	-	-	25	149	149	-	-	801	-	-	-	-	32,539	1,265	-
4a.1.5.38	HE - Boron Recycle	-	389	16	20	259	150	-	178	1,012	1,012	-	-	3,460	583	-	-	-	190,724	7,930	-
4a.1.5.39	HF - Secondary Liquid Waste	-	784	33	44	630	301	-	375	2,166	2,166	-	-	8,431	1,173	-	-	-	442,934	16,163	-
4a.1.5.40	JA - Auxiliary Oil & Transfer	-	29	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	687	-
4a.1.5.41	KS - Bulk Chemical Storage	-	86	8	18	482	-	-	97	691	691	-	-	6,449	-	-	-	-	261,890	1,808	-
4a.1.5.42	LE - Oily Waste	-	161	-	-	-	-	-	24	186	-	-	186	-	-	-	-	-	-	3,865	-
4a.1.5.43	LE - Oily Waste RCA	-	213	3	6	169	-	-	80	471	471	-	-	2,256	-	-	-	-	91,628	4,181	-
4a.1.5.44	Turbine Bldg Non-System Specific	-	677	-	-	-	-	-	101	778	-	-	778	-	-	-	-	-	-	15,405	-
4a.1.5	Totals	-	7,376	124	215	4,454	677	-	2,416	15,263	11,697	-	3,566	59,608	2,604	-	-	-	2,647,241	160,738	-
4a.1.6	Scaffolding in support of decommissioning	-	1,320	21	5	102	12	-	351	1,811	1,811	-	-	1,233	69	-	-	-	62,010	31,913	-
4a.1	Subtotal Period 4a Activity Costs	210	23,853	10,149	5,370	10,929	33,871	326	22,598	107,306	103,741	-	3,566	155,680	72,330	3,330	470	499	13,392,220	325,624	7,765
Period 4a Collateral Costs																					
4a.3.1	Process liquid waste	31	-	14	70	-	69	-	45	230	230	-	-	-	249	-	-	-	14,949	49	-
4a.3.2	Small tool allowance	-	250	-	-	-	-	-	37	287	258	-	29	-	-	-	-	-	-	-	-
4a.3.3	Survey and Release of Scrap Metal	-	-	-	-	-	-	753	113	866	866	-	-	-	-	-	-	-	-	-	-
4a.3	Subtotal Period 4a Collateral Costs	31	250	14	70	-	69	753	195	1,383	1,354	-	29	-	249	-	-	-	14,949	49	-
Period 4a Period-Dependent Costs																					
4a.4.1	Decon supplies	56	-	-	-	-	-	-	14	70	70	-	-	-	-	-	-	-	-	-	-
4a.4.2	Insurance	-	-	-	-	-	-	549	55	603	603	-	-	-	-	-	-	-	-	-	-
4a.4.3	Property taxes	-	-	-	-	-	-	329	33	362	326	-	36	-	-	-	-	-	-	-	-
4a.4.4	Health physics supplies	-	1,771	-	-	-	-	-	443	2,214	2,214	-	-	-	-	-	-	-	-	-	-
4a.4.5	Heavy equipment rental	-	2,240	-	-	-	-	-	336	2,576	2,576	-	-	-	-	-	-	-	-	-	-
4a.4.6	Disposal of DAW generated	-	-	79	44	-	294	-	88	505	505	-	-	-	4,905	-	-	-	98,285	161	-
4a.4.7	Plant energy budget	-	-	-	-	-	-	1,413	212	1,625	1,625	-	-	-	-	-	-	-	-	-	-
4a.4.8	NRC Fees	-	-	-	-	-	-	723	72	795	795	-	-	-	-	-	-	-	-	-	-
4a.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	412	62	474	474	-	-	-	-	-	-	-	-	-	-
4a.4.10	Corporate Allocations	-	-	-	-	-	-	2,160	216	2,376	2,376	-	-	-	-	-	-	-	-	-	-
4a.4.11	Security Staff Cost	-	-	-	-	-	-	2,845	427	3,271	3,271	-	-	-	-	-	-	-	-	-	71,607
4a.4.12	DOC Staff Cost	-	-	-	-	-	-	12,947	1,942	14,890	14,890	-	-	-	-	-	-	-	-	-	158,109
4a.4.13	Utility Staff Cost	-	-	-	-	-	-	18,523	2,778	21,301	21,301	-	-	-	-	-	-	-	-	-	286,429
4a.4	Subtotal Period 4a Period-Dependent Costs	56	4,011	79	44	-	294	39,901	6,678	51,063	51,027	-	36	-	4,905	-	-	-	98,285	161	516,144

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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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
4a.0	TOTAL PERIOD 4a COST	297	28,114	10,242	5,485	10,929	34,235	40,980	29,471	159,753	156,122	-	3,631	155,680	77,484	3,330	470	499	13,505,450	325,834	523,910
PERIOD 4b - Site Decontamination																					
Period 4b Direct Decommissioning Activities																					
4b.1.1	Remove spent fuel racks	687	79	233	87	-	1,323	-	730	3,140	3,140	-	-	-	4,933	-	-	-	442,623	1,925	-
Disposal of Plant Systems																					
4b.1.2.1	200 Reactor Bldg Non-System Specific	-	75	1	2	38	4	-	26	144	144	-	-	502	13	-	-	-	21,587	1,521	-
4b.1.2.2	200 Reactor Bldg Non-System Specific RCA	-	521	6	14	356	-	-	186	1,084	1,084	-	-	4,768	-	-	-	-	193,612	10,425	-
4b.1.2.3	300 Control Bldg Non-System Specific	-	167	3	6	160	-	-	67	403	403	-	-	2,139	-	-	-	-	86,849	3,413	-
4b.1.2.4	300 Control Bldg Non-System Specific Cln	-	1,361	-	-	-	-	-	204	1,566	-	-	1,566	-	-	-	-	-	-	29,076	-
4b.1.2.5	600 Fuel Bldg Non-Specific Systems RCA	-	289	4	9	239	-	-	110	651	651	-	-	3,200	-	-	-	-	129,974	5,859	-
4b.1.2.6	600 Fuel Bldg Non-System Specific	-	40	1	1	24	2	-	14	82	82	-	-	322	9	-	-	-	13,827	825	-
4b.1.2.7	700 Radwaste Bldg Non-Sys Specific RCA	-	1,071	16	36	948	-	-	417	2,489	2,489	-	-	12,684	-	-	-	-	515,103	21,919	-
4b.1.2.8	700 Radwaste Bldg Non-System Specific	-	153	2	4	99	9	-	56	324	324	-	-	1,329	35	-	-	-	57,135	3,158	-
4b.1.2.9	AN - Demineralized Wtr Storage & Xfer	-	136	-	-	-	-	-	20	156	-	-	156	-	-	-	-	-	-	3,283	-
4b.1.2.10	AN - Demineralized Wtr Strg & Xfer RCA	-	36	0	1	23	-	-	13	73	73	-	-	314	-	-	-	-	12,759	711	-
4b.1.2.11	AP - Condensate Storage & Transfer	-	81	-	-	-	-	-	12	93	-	-	93	-	-	-	-	-	-	1,794	-
4b.1.2.12	BB - Reactor Coolant System	-	252	18	21	193	214	-	150	849	849	-	-	2,586	903	-	-	-	176,605	5,351	-
4b.1.2.13	BG - Chemical & Volume Control	-	721	45	55	612	490	-	407	2,330	2,330	-	-	8,192	1,842	-	-	-	496,399	14,848	-
4b.1.2.14	BL - Reactor Makeup Water	-	240	10	12	189	79	-	111	641	641	-	-	2,529	315	-	-	-	129,173	4,917	-
4b.1.2.15	DE - Intake & Water Treatment	-	107	-	-	-	-	-	16	123	-	-	123	-	-	-	-	-	-	2,478	-
4b.1.2.16	DE - Intake & Water Treatment RCA	-	238	15	34	891	-	-	200	1,378	1,378	-	-	11,923	-	-	-	-	484,206	4,993	-
4b.1.2.17	EA - Service Water	-	130	-	-	-	-	-	19	149	-	-	149	-	-	-	-	-	-	3,145	-
4b.1.2.18	EA - Service Water RCA	-	41	2	4	93	-	-	25	165	165	-	-	1,248	-	-	-	-	50,693	829	-
4b.1.2.19	EB - Closed Cooling Water	-	52	-	-	-	-	-	8	60	-	-	60	-	-	-	-	-	-	1,267	-
4b.1.2.20	EC - Fuel Pool Cooling & Cleanup	-	309	5	12	308	-	-	126	760	760	-	-	4,119	-	-	-	-	167,293	6,330	-
4b.1.2.21	EF - Essential Service Water	-	301	-	-	-	-	-	45	346	-	-	346	-	-	-	-	-	-	7,244	-
4b.1.2.22	EF - Essential Service Water RCA	-	184	7	15	398	-	-	109	713	713	-	-	5,326	-	-	-	-	216,287	3,802	-
4b.1.2.23	EG - Component Cooling Water RCA	-	220	-	-	-	-	-	33	253	-	-	253	-	-	-	-	-	-	5,335	-
4b.1.2.24	GA - Plant Heating	-	78	-	-	-	-	-	12	90	-	-	90	-	-	-	-	-	-	1,912	-
4b.1.2.25	GA - Plant Heating RCA	-	85	1	2	48	-	-	29	165	165	-	-	638	-	-	-	-	25,924	1,698	-
4b.1.2.26	GA- Plant Heating Fuel Building	-	17	0	0	8	-	-	5	31	31	-	-	107	-	-	-	-	4,351	338	-
4b.1.2.27	GB - Central Chilled Water	-	74	-	-	-	-	-	11	85	-	-	85	-	-	-	-	-	-	1,803	-
4b.1.2.28	GB - Central Chilled Water RCA	-	23	0	1	14	-	-	8	46	46	-	-	187	-	-	-	-	7,591	463	-
4b.1.2.29	GD - Essential Serv Wtr Pumphouse HVAC	-	16	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	414	-
4b.1.2.30	GF - Miscellaneous Building HVAC	-	117	3	6	152	-	-	53	331	331	-	-	2,034	-	-	-	-	82,602	2,026	-
4b.1.2.31	GG - Fuel Building HVAC	-	218	5	11	295	-	-	101	630	630	-	-	3,945	-	-	-	-	160,195	4,031	-
4b.1.2.32	GH - Radwaste Building HVAC	-	159	3	7	191	-	-	70	431	431	-	-	2,561	-	-	-	-	104,012	2,973	-
4b.1.2.33	GK - Control Building HVAC	-	151	-	-	-	-	-	23	174	-	-	174	-	-	-	-	-	-	3,900	-
4b.1.2.34	GL - Auxiliary Building HVAC	-	396	7	15	402	-	-	162	983	983	-	-	5,381	-	-	-	-	218,514	7,311	-
4b.1.2.35	GM - Diesel Generator Building HVAC	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	692	-
4b.1.2.36	GN - Containment Cooling	-	426	10	24	618	-	-	204	1,281	1,281	-	-	8,264	-	-	-	-	335,602	8,118	-
4b.1.2.37	GP - Containment Intgratd Leak Rate Test	-	36	1	2	43	-	-	16	98	98	-	-	580	-	-	-	-	23,570	737	-
4b.1.2.38	GR - Containment Atmospheric Control	-	16	1	3	85	-	-	18	124	124	-	-	1,143	-	-	-	-	46,407	341	-
4b.1.2.39	GT - Containment Purge HVAC	-	101	3	6	163	-	-	51	324	324	-	-	2,185	-	-	-	-	88,746	1,933	-
4b.1.2.40	HA - Gaseous Radwaste	-	282	5	11	276	-	-	114	688	688	-	-	3,699	-	-	-	-	150,219	5,633	-
4b.1.2.41	HB - Liquid Radwaste	-	694	33	39	550	274	-	334	1,924	1,924	-	-	7,362	1,077	-	-	-	390,669	14,095	-
4b.1.2.42	HC - Solid Radwaste	-	285	15	19	223	163	-	150	855	855	-	-	2,985	618	-	-	-	175,776	5,831	-
4b.1.2.43	HD - Decontamination	-	85	4	5	73	32	-	41	241	241	-	-	983	125	-	-	-	50,772	1,722	-
4b.1.2.44	JE - Emergency Fuel Oil	-	56	-	-	-	-	-	8	65	-	-	65	-	-	-	-	-	-	1,260	-
4b.1.2.45	KA - Compressed Air	-	171	-	-	-	-	-	26	196	-	-	196	-	-	-	-	-	-	4,187	-
4b.1.2.46	KA - Compressed Air RCA	-	115	1	2	60	-	-	38	216	216	-	-	801	-	-	-	-	32,538	2,242	-
4b.1.2.47	KB - Breathing Air	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	516	-
4b.1.2.48	KB - Breathing Air RCA	-	17	0	0	5	-	-	5	28	28	-	-	71	-	-	-	-	2,874	376	-
4b.1.2.49	KC - Fire Protection	-	338	-	-	-	-	-	51	389	-	-	389	-	-	-	-	-	-	8,376	-
4b.1.2.50	KC - Fire Protection RCA	-	365	6	13	330	-	-	143	857	857	-	-	4,411	-	-	-	-	179,151	6,953	-
4b.1.2.51	KC- Fire Protection Fuel Building	-	108	2	4	93	-	-	42	248	248	-	-	1,239	-	-	-	-	50,329	2,084	-

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															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Disposal of Plant Systems (continued)																					
4b.1.2.52	KD - Domestic Water	-	157	-	-	-	-	-	24	181	-	-	181	-	-	-	-	-	-	3,837	-
4b.1.2.53	KD - Domestic Water RCA	-	23	0	1	18	-	-	9	52	52	-	-	247	-	-	-	-	10,039	448	-
4b.1.2.54	KE - Fuel Handling & Storage Rctor vssl	-	16	1	3	66	-	-	14	100	100	-	-	882	-	-	-	-	35,813	323	-
4b.1.2.55	KH - Service Gas (CO2 N2 H2 & O2)	-	50	-	-	-	-	-	7	57	-	-	57	-	-	-	-	-	-	1,226	-
4b.1.2.56	KH - Service Gas (CO2 N2 H2 & O2) RCA	-	229	3	7	182	-	-	86	507	507	-	-	2,433	-	-	-	-	98,813	4,378	-
4b.1.2.57	KJ - Standby Diesel Engine	-	298	-	-	-	-	-	45	343	-	-	343	-	-	-	-	-	-	6,749	-
4b.1.2.58	LA - Sanitary Drains	-	40	-	-	-	-	-	6	46	-	-	46	-	-	-	-	-	-	972	-
4b.1.2.59	LA - Sanitary Drains RCA	-	98	2	4	95	-	-	39	238	238	-	-	1,273	-	-	-	-	51,684	1,811	-
4b.1.2.60	LB - Roof Drains	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	1,276	-
4b.1.2.61	LB - Roof Drains RCA	-	131	3	6	160	-	-	58	358	358	-	-	2,139	-	-	-	-	86,858	2,628	-
4b.1.2.62	LD - Chemical & Detergent Waste	-	89	1	2	60	-	-	32	183	183	-	-	797	-	-	-	-	32,369	1,828	-
4b.1.2.63	LF - Floor & Equipment Drains	-	1,141	50	64	498	687	-	546	2,985	2,985	-	-	6,660	2,567	-	-	-	500,138	23,236	-
4b.1.2.64	RM - Process Sampling & Analysis	-	113	1	3	74	-	-	40	231	231	-	-	990	-	-	-	-	40,200	2,335	-
4b.1.2.65	SJ - Nuclear Sampling	-	62	1	2	51	-	-	24	139	139	-	-	677	-	-	-	-	27,501	1,312	-
4b.1.2.66	UB - Servces Stores Site Security Bldg	-	151	-	-	-	-	-	23	174	-	-	174	-	-	-	-	-	-	3,571	-
4b.1.2.67	Yard Non-System Specific	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	603	-
4b.1.2	Totals	-	13,883	294	488	9,404	1,955	-	5,063	31,087	26,376	-	4,711	125,856	7,504	-	-	-	5,764,757	291,021	-
4b.1.3	Scaffolding in support of decommissioning	-	1,980	32	8	153	18	-	527	2,717	2,717	-	-	1,849	104	-	-	-	93,015	47,869	-
Decontamination of Site Buildings																					
4b.1.4.1	Reactor	1,034	865	119	152	448	1,138	-	1,120	4,875	4,875	-	-	5,995	7,069	-	-	-	907,911	37,506	-
4b.1.4.2	Auxiliary	530	217	30	41	154	94	-	375	1,441	1,441	-	-	2,058	1,700	-	-	-	250,031	14,928	-
4b.1.4.3	Communication Corridor - Contaminated	12	3	1	1	1	2	-	8	27	27	-	-	17	36	-	-	-	4,294	300	-
4b.1.4.4	Fuel Building	665	689	12	17	202	33	-	547	2,165	2,165	-	-	2,705	487	-	-	-	157,587	26,845	-
4b.1.4.5	Hot Machine Shop	15	6	1	1	-	2	-	10	34	34	-	-	-	44	-	-	-	4,446	412	-
4b.1.4.6	RAM Storage Building	36	8	2	2	1	5	-	22	76	76	-	-	19	93	-	-	-	9,971	901	-
4b.1.4.7	Radioactive and Personnel Tunnel	5	5	0	1	-	1	-	4	16	16	-	-	-	25	-	-	-	2,532	190	-
4b.1.4.8	Radwaste	282	100	15	21	63	49	-	193	723	723	-	-	844	893	-	-	-	122,355	7,650	-
4b.1.4.9	Radwaste Drum Storage	32	10	2	2	5	5	-	21	77	77	-	-	66	99	-	-	-	12,556	833	-
4b.1.4.10	Steam Generator Replacement Bldgs	204	-	-	-	-	-	-	102	306	306	-	-	-	-	-	-	-	-	3,780	-
4b.1.4	Totals	2,813	1,904	182	237	875	1,330	-	2,400	9,741	9,741	-	-	11,704	10,447	-	-	-	1,471,684	93,345	-
4b.1	Subtotal Period 4b Activity Costs	3,500	17,846	741	820	10,432	4,626	-	8,720	46,685	41,974	-	4,711	139,409	22,988	-	-	-	7,772,079	434,160	-
Period 4b Additional Costs																					
4b.2.1	Sanitary Treatment Lagoon LLW	-	5	60	783	-	183	-	152	1,184	1,184	-	-	-	3,600	-	-	-	345,600	388	-
4b.2.2	Cooling Tower Asbestos Panel Removal	-	4,554	-	105	365	-	-	683	5,706	5,706	-	-	136,405	-	-	-	-	-	101,822	-
4b.2.3	License Termination Survey Program Management	-	-	-	-	-	-	1,467	440	1,907	1,907	-	-	-	-	-	-	-	-	-	12,480
4b.2	Subtotal Period 4b Additional Costs	-	4,559	60	888	365	183	1,467	1,275	8,797	8,797	-	-	136,405	3,600	-	-	-	345,600	102,210	12,480
Period 4b Collateral Costs																					
4b.3.1	Process liquid waste	84	-	38	190	-	187	-	121	620	620	-	-	-	673	-	-	-	40,404	131	-
4b.3.2	Small tool allowance	-	410	-	-	-	-	-	61	471	471	-	-	-	-	-	-	-	-	-	-
4b.3.3	Decommissioning Equipment Disposition	-	-	103	30	497	100	-	114	844	844	-	-	6,000	373	-	-	-	303,507	88	-
4b.3.4	Survey and Release of Scrap Metal	-	-	-	-	-	-	1,048	157	1,205	1,205	-	-	-	-	-	-	-	-	-	-
4b.3	Subtotal Period 4b Collateral Costs	84	410	142	219	497	288	1,048	454	3,141	3,141	-	-	6,000	1,047	-	-	-	343,911	219	-
Period 4b Period-Dependent Costs																					
4b.4.1	Decon supplies	1,189	-	-	-	-	-	-	297	1,486	1,486	-	-	-	-	-	-	-	-	-	-
4b.4.2	Insurance	-	-	-	-	-	-	1,420	142	1,562	1,562	-	-	-	-	-	-	-	-	-	-
4b.4.3	Property taxes	-	-	-	-	-	-	853	85	938	938	-	-	-	-	-	-	-	-	-	-
4b.4.4	Health physics supplies	-	3,341	-	-	-	-	-	835	4,176	4,176	-	-	-	-	-	-	-	-	-	-
4b.4.5	Heavy equipment rental	-	5,757	-	-	-	-	-	863	6,620	6,620	-	-	-	-	-	-	-	-	-	-
4b.4.6	Disposal of DAW generated	-	-	116	65	-	435	-	130	747	747	-	-	-	7,248	-	-	-	145,249	238	-
4b.4.7	Plant energy budget	-	-	-	-	-	-	2,888	433	3,321	3,321	-	-	-	-	-	-	-	-	-	-
4b.4.8	NRC Fees	-	-	-	-	-	-	1,872	187	2,059	2,059	-	-	-	-	-	-	-	-	-	-
4b.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	1,067	160	1,227	1,227	-	-	-	-	-	-	-	-	-	-

Attachment 1

Table D
Callaway Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 4b Period-Dependent Costs (continued)																					
4b.4.10	Corporate Allocations	-	-	-	-	-	-	2,430	243	2,673	2,673	-	-	-	-	-	-	-	-	-	-
4b.4.11	Security Staff Cost	-	-	-	-	-	-	7,364	1,105	8,468	8,468	-	-	-	-	-	-	-	-	-	185,357
4b.4.12	DOC Staff Cost	-	-	-	-	-	-	32,688	4,903	37,591	37,591	-	-	-	-	-	-	-	-	-	397,406
4b.4.13	Utility Staff Cost	-	-	-	-	-	-	45,482	6,822	52,304	52,304	-	-	-	-	-	-	-	-	-	699,909
4b.4	Subtotal Period 4b Period-Dependent Costs	1,189	9,098	116	65	-	435	96,062	16,207	123,172	123,172	-	-	-	7,248	-	-	-	145,249	238	1,282,671
4b.0	TOTAL PERIOD 4b COST	4,772	31,912	1,060	1,992	11,293	5,532	98,577	26,656	181,795	177,084	-	4,711	281,814	34,883	-	-	-	8,606,838	536,828	1,295,151
PERIOD 4e - License Termination																					
Period 4e Direct Decommissioning Activities																					
4e.1.1	ORISE confirmatory survey	-	-	-	-	-	-	156	47	203	203	-	-	-	-	-	-	-	-	-	-
4e.1.2	Terminate license									a											
4e.1	Subtotal Period 4e Activity Costs	-	-	-	-	-	-	156	47	203	203	-	-	-	-	-	-	-	-	-	-
Period 4e Additional Costs																					
4e.2.1	License Termination Survey	-	-	-	-	-	-	8,311	2,493	10,804	10,804	-	-	-	-	-	-	-	-	152,357	6,240
4e.2	Subtotal Period 4e Additional Costs	-	-	-	-	-	-	8,311	2,493	10,804	10,804	-	-	-	-	-	-	-	-	152,357	6,240
Period 4e Collateral Costs																					
4e.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,423	213	1,636	1,636	-	-	-	-	-	-	-	-	-	-
4e.3	Subtotal Period 4e Collateral Costs	-	-	-	-	-	-	1,423	213	1,636	1,636	-	-	-	-	-	-	-	-	-	-
Period 4e Period-Dependent Costs																					
4e.4.1	Insurance	-	-	-	-	-	-	378	38	415	415	-	-	-	-	-	-	-	-	-	-
4e.4.2	Property taxes	-	-	-	-	-	-	227	23	249	249	-	-	-	-	-	-	-	-	-	-
4e.4.3	Health physics supplies	-	875	-	-	-	-	-	219	1,093	1,093	-	-	-	-	-	-	-	-	-	-
4e.4.4	Disposal of DAW generated	-	-	6	4	-	23	-	7	40	40	-	-	-	391	-	-	-	7,826	13	-
4e.4.5	Plant energy budget	-	-	-	-	-	-	205	31	235	235	-	-	-	-	-	-	-	-	-	-
4e.4.6	NRC Fees	-	-	-	-	-	-	534	53	587	587	-	-	-	-	-	-	-	-	-	-
4e.4.7	Corporate Allocations	-	-	-	-	-	-	360	36	396	396	-	-	-	-	-	-	-	-	-	-
4e.4.8	Security Staff Cost	-	-	-	-	-	-	817	123	939	939	-	-	-	-	-	-	-	-	-	18,926
4e.4.9	DOC Staff Cost	-	-	-	-	-	-	4,874	731	5,605	5,605	-	-	-	-	-	-	-	-	-	57,566
4e.4.10	Utility Staff Cost	-	-	-	-	-	-	5,510	826	6,336	6,336	-	-	-	-	-	-	-	-	-	74,914
4e.4	Subtotal Period 4e Period-Dependent Costs	-	875	6	4	-	23	12,903	2,086	15,897	15,897	-	-	-	391	-	-	-	7,826	13	151,406
4e.0	TOTAL PERIOD 4e COST	-	875	6	4	-	23	22,793	4,840	28,540	28,540	-	-	-	391	-	-	-	7,826	152,370	157,646
PERIOD 4 TOTALS		5,070	60,900	11,308	7,480	22,222	39,790	162,350	60,967	370,088	361,747	-	8,342	437,494	112,757	3,330	470	499	22,120,120	1,015,032	1,976,707
PERIOD 5b - Site Restoration																					
Period 5b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
5b.1.1.1	Reactor	-	4,769	-	-	-	-	-	715	5,484	-	-	5,484	-	-	-	-	-	-	60,047	-
5b.1.1.2	Auxiliary	-	3,801	-	-	-	-	-	570	4,371	-	-	4,371	-	-	-	-	-	-	49,968	-
5b.1.1.3	Auxiliary Boiler	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	619	-
5b.1.1.4	Barge Facility	-	1,423	-	-	-	-	-	214	1,637	-	-	1,637	-	-	-	-	-	-	18,771	-
5b.1.1.5	Circulating & Service Water Pumphouse	-	286	-	-	-	-	-	43	329	-	-	329	-	-	-	-	-	-	4,345	-
5b.1.1.6	Communication Corridor - Clean	-	1,227	-	-	-	-	-	184	1,411	-	-	1,411	-	-	-	-	-	-	17,215	-
5b.1.1.7	Communication Corridor - Contaminated	-	52	-	-	-	-	-	8	60	-	-	60	-	-	-	-	-	-	674	-
5b.1.1.8	Cooling Tower Basemat	-	812	-	-	-	-	-	122	933	-	-	933	-	-	-	-	-	-	13,472	-
5b.1.1.9	Diesel Generator	-	454	-	-	-	-	-	68	522	-	-	522	-	-	-	-	-	-	5,492	-
5b.1.1.10	Essential Service Water Pumphouse	-	270	-	-	-	-	-	41	311	-	-	311	-	-	-	-	-	-	3,938	-
5b.1.1.11	Fire Water Pumphouse	-	25	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	382	-
5b.1.1.12	Fuel Building	-	1,898	-	-	-	-	-	285	2,183	-	-	2,183	-	-	-	-	-	-	22,580	-
5b.1.1.13	Hot Machine Shop	-	21	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	417	-

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Table D
Callaway Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Demolition of Remaining Site Buildings (continued)																					
5b.1.1.14	Intake	-	342	-	-	-	-	-	51	393	-	-	393	-	-	-	-	-	-	4,224	-
5b.1.1.15	Misc. Structures	-	2,177	-	-	-	-	-	327	2,504	-	-	2,504	-	-	-	-	-	-	27,921	-
5b.1.1.16	Miscellaneous Site Foundations	-	337	-	-	-	-	-	51	388	-	-	388	-	-	-	-	-	-	5,478	-
5b.1.1.17	Outage Maintenance	-	167	-	-	-	-	-	25	192	-	-	192	-	-	-	-	-	-	3,190	-
5b.1.1.18	RAM Storage Building	-	62	-	-	-	-	-	9	72	-	-	72	-	-	-	-	-	-	1,081	-
5b.1.1.19	Radioactive and Personnel Tunnel	-	25	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	383	-
5b.1.1.20	Radwaste	-	1,696	-	-	-	-	-	254	1,951	-	-	1,951	-	-	-	-	-	-	21,798	-
5b.1.1.21	Radwaste Drum Storage	-	249	-	-	-	-	-	37	287	-	-	287	-	-	-	-	-	-	3,840	-
5b.1.1.22	Security Additions	-	2,076	-	-	-	-	-	311	2,387	-	-	2,387	-	-	-	-	-	-	20,977	-
5b.1.1.23	Service	-	462	-	-	-	-	-	69	531	-	-	531	-	-	-	-	-	-	6,045	-
5b.1.1.24	Sludge Pump Station & Lagoon	-	23	-	-	-	-	-	3	26	-	-	26	-	-	-	-	-	-	313	-
5b.1.1.25	Steam Generator Replacement Bldgs	-	1,080	-	-	-	-	-	162	1,242	-	-	1,242	-	-	-	-	-	-	15,693	-
5b.1.1.26	Turbine Building	-	3,407	-	-	-	-	-	511	3,918	-	-	3,918	-	-	-	-	-	-	55,694	-
5b.1.1.27	Turbine Pedestal	-	983	-	-	-	-	-	147	1,130	-	-	1,130	-	-	-	-	-	-	10,928	-
5b.1.1.28	U.H.S. Cooling Tower	-	595	-	-	-	-	-	89	685	-	-	685	-	-	-	-	-	-	6,681	-
5b.1.1.29	Water Treatment Plant	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	9	-
5b.1.1	Totals	-	28,754	-	-	-	-	-	4,313	33,068	-	-	33,068	-	-	-	-	-	-	382,172	-
Site Closeout Activities																					
5b.1.2	BackFill Site	-	4,694	-	-	-	-	-	704	5,398	-	-	5,398	-	-	-	-	-	-	17,928	-
5b.1.3	Grade & landscape site	-	121	-	-	-	-	-	18	139	-	-	139	-	-	-	-	-	-	592	-
5b.1.4	Final report to NRC	-	-	-	-	-	-	185	28	213	213	-	-	-	-	-	-	-	-	-	1,560
5b.1	Subtotal Period 5b Activity Costs	-	33,570	-	-	-	-	185	5,063	38,818	213	-	38,605	-	-	-	-	-	-	400,692	1,560
Period 5b Additional Costs																					
5b.2.1	Concrete Crushing	-	1,125	-	-	-	-	8	170	1,303	-	-	1,303	-	-	-	-	-	-	5,830	-
5b.2.2	Mine Area Backfill	-	4,179	-	-	-	-	-	627	4,806	-	-	4,806	-	-	-	-	-	-	15,960	-
5b.2.3	Cooling Tower Discharge & Intake Pipe Flow Fill	-	3,937	-	-	-	-	-	590	4,527	-	-	4,527	-	-	-	-	-	-	9,588	-
5b.2.4	Cooling Tower Demolition	-	3,706	-	-	-	-	-	556	4,262	-	-	4,262	-	-	-	-	-	-	19,680	-
5b.2	Subtotal Period 5b Additional Costs	-	12,946	-	-	-	-	8	1,943	14,897	-	-	14,897	-	-	-	-	-	-	51,058	-
Period 5b Collateral Costs																					
5b.3.1	Small tool allowance	-	374	-	-	-	-	-	56	430	-	-	430	-	-	-	-	-	-	-	-
5b.3	Subtotal Period 5b Collateral Costs	-	374	-	-	-	-	-	56	430	-	-	430	-	-	-	-	-	-	-	-
Period 5b Period-Dependent Costs																					
5b.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5b.4.2	Property taxes	-	-	-	-	-	-	451	45	496	-	-	496	-	-	-	-	-	-	-	-
5b.4.3	Heavy equipment rental	-	4,080	-	-	-	-	-	612	4,692	-	-	4,692	-	-	-	-	-	-	-	-
5b.4.4	Plant energy budget	-	-	-	-	-	-	204	31	234	-	-	234	-	-	-	-	-	-	-	-
5b.4.5	Corporate Allocations	-	-	-	-	-	-	990	99	1,089	1,089	-	-	-	-	-	-	-	-	-	-
5b.4.6	Security Staff Cost	-	-	-	-	-	-	1,625	244	1,869	-	-	1,869	-	-	-	-	-	-	-	37,646
5b.4.7	DOC Staff Cost	-	-	-	-	-	-	9,431	1,415	10,845	-	-	10,845	-	-	-	-	-	-	-	106,663
5b.4.8	Utility Staff Cost	-	-	-	-	-	-	4,458	669	5,127	-	-	5,127	-	-	-	-	-	-	-	61,174
5b.4	Subtotal Period 5b Period-Dependent Costs	-	4,080	-	-	-	-	17,158	3,114	24,352	1,089	-	23,263	-	-	-	-	-	-	-	205,483
5b.0	TOTAL PERIOD 5b COST	-	50,970	-	-	-	-	17,351	10,176	78,496	1,302	-	77,195	-	-	-	-	-	-	451,750	207,043
PERIOD 5 TOTALS		-	50,970	-	-	-	-	17,351	10,176	78,496	1,302	-	77,195	-	-	-	-	-	-	451,750	207,043
TOTAL COST TO DECOMMISSION		11,096	120,424	11,848	8,422	22,222	41,974	579,638	133,944	929,568	774,447	68,084	87,037	437,494	139,840	3,330	470	499	22,765,170	1,561,727	6,978,627

Attachment 1

Table D
Callaway Plant
SAFSTOR Decommissioning Cost Estimate
(thousands of 2008 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				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			

TOTAL COST TO DECOMMISSION WITH 16.84% CONTINGENCY:	$929,568	thousands of 2008	dollars
TOTAL NRC LICENSE TERMINATION COST IS 83.31% OR:	$774,447	thousands of 2008	dollars
SPENT FUEL MANAGEMENT COST IS 7.32% OR:	$68,084	thousands of 2008	dollars
NON-NUCLEAR DEMOLITION COST IS 9.36% OR:	$87,037	thousands of 2008	dollars
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	143,640	cubic feet	
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	499	cubic feet	
TOTAL SCRAP METAL REMOVED:	70,304	tons	
TOTAL CRAFT LABOR REQUIREMENTS:	1,561,727	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