ATTACHMENT 2

Triennial Wolf Creek Decommissioning Cost Study

DECOMMISSIONING COST ANALYSIS

for the

WOLF CREEK GENERATING STATION

prepared for the

Wolf Creek Nuclear Operating Corporation

prepared by

TLG Services, Inc.
Bridgewater, Connecticut

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APPROVALS

Project Manager	William A. Cloutier, Jr.	08/21/2017 Date
Project Engineer	Timothy A. Arnold	8/21/17 Date
Technical Manager	Francis W. Seymore	8/21/17 Date

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REVISION LOG

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EXECUTIVE SUMMARY

This report presents estimates of the cost to decommission the Wolf Creek Generating Station (Wolf Creek) for the selected decommissioning alternatives following the scheduled and permanent cessation of plant operations. The estimates are designed to provide the Wolf Creek Nuclear Operating Corporation (WCNOC), the plant's operator, and its owners: Kansas Gas and Electric Company, a wholly owned subsidiary of Westar Energy, Inc., Kansas City Power & Light Company, a wholly owned subsidiary of Great Plains Energy Incorporated, and Kansas Electric Power Cooperative, Inc., with sufficient information to assess their financial obligations, as they pertain to the eventual decommissioning of the nuclear station.

The analysis relies upon site-specific, technical information from an evaluation prepared in 2014,[1] updated to reflect current assumptions pertaining to the disposition of the nuclear station and relevant industry experience in undertaking such projects. The costs are based on several key assumptions in areas of regulation, component characterization, high-level radioactive waste management, low-level radioactive waste disposal, performance uncertainties (contingency) and site restoration requirements.

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

The 2014 plant inventory, the basis for the decontamination and dismantling requirements and cost, and the decommissioning waste streams, was reviewed for this analysis. There were no substantive changes made to the plant inventory (that would impact decommissioning). The current analysis does include, however, the costs to decommission the structural changes made to the condensate storage tank (for missile projection) and the control building, the new refueling cavity elevator, the fire protection system and emergency service water system modifications, and other minor modifications identified by the site.

The costs to decommission Wolf Creek for the alternatives evaluated are tabulated at the end of this section. Costs are reported in 2017 dollars and include monies anticipated to be spent for radiological remediation and operating license termination, spent fuel management, and site restoration activities.

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1 "Decommissioning Cost Analysis for the Wolf Creek Generating Station," Document No. W11-1697-001, Rev. 0, TLG Services, Inc., August 2014

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

Consistent with the 2014 analysis, the current cost estimates assume that the shutdown of the nuclear station is a scheduled and pre-planned event (e.g., there is no delay in transitioning the plant and workforce from operations or in obtaining regulatory relief from operating requirements, etc.). The estimates include the continued operation of the fuel handling building as an interim wet fuel storage facility for approximately five and one-half years after operations cease (years 2045 through 2050). During this time period, it is assumed that the Department of Energy (DOE) will complete the transfer of the spent fuel from the site to a federal facility.

Alternatives and Regulations

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

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

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

3 Ibid. Page FR24022, Column 3

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, although longer time periods will also be considered when necessary to protect public health and safety.

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

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

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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

schedules presented in this analysis follow the general guidance and sequence 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]

In 2011, the NRC issued regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy site.[8] The regulations require licensees to report additional details in their decommissioning cost estimate, including a decommissioning estimate for any on-site Independent Spent Fuel Storage Installation (ISFSI). Since an ISFSI may be required to support continued operation at Wolf Creek, a representative decommissioning cost is included within the DECON and SAFSTOR estimates.

Decommissioning Scenarios

Two decommissioning scenarios were evaluated for the Wolf Creek nuclear unit. The scenarios selected are representative of alternatives currently available to the owners and are defined as follows:

1. The first scenario assumes that the nuclear unit is promptly decommissioned (DECON alternative) upon the expiration of the current operating license in 2045. Following the permanent cessation of operations, and over the first five and one-half years, the spent fuel is transferred directly from the wet storage pool to the DOE (the fuel stored on the ISFSI is also removed from the site during this time period). Concurrently, the majority of the plant components, including the nuclear steam supply system components, are removed. Once the spent fuel stored in the fuel handling building's pool has been transferred off-site, the remaining portions of the power block are decommissioned and the surrounding site remediated. Following the termination of the operating license, non-essential structures (not designated for reuse) are dismantled.

2. In the second scenario, the nuclear unit is placed into safe-storage (SAFSTOR alternative) upon the expiration of the current operating license in 2045. As with the first scenario, the spent fuel removed from the site (transferred to the DOE) during the first five and one-half years following the permanent cessation of operations. The facility is then placed into safe-storage (with non-essential systems de-energized and buildings secured).

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

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

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

Methodology

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

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

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

Contingency

Consistent with cost estimating practice, contingencies are applied to the decontamination and dismantling costs developed as "specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur."[10] The cost elements in the estimates are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a

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

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

line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

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

Low-Level Radioactive Waste Disposal

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

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

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

The WCS facility is able to receive the Class B and C waste. As such, for this analysis, Class B and C waste was assumed to be shipped to the WCS facility for disposal. Disposal costs were based upon preliminary and indicative information for the WCS site.

The dismantling of the components residing closest to the reactor core generates radioactive waste that may be considered unsuitable for shallow-land disposal (i.e.,

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

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

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

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

For purposes of this analysis only, the GTCC radioactive waste is assumed to be packaged and disposed of in a similar manner as high-level waste and at a cost equivalent to that envisioned for the spent fuel. The GTCC is packaged in the same canisters used for spent fuel and shipped directly to a DOE facility as it is generated.

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This material can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring 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 reflect the savings from waste recovery/volume reduction.

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

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

Today, the country is at an impasse on high-level waste disposal, despite DOE's submittal of its License Application for a geologic repository to the NRC in 2008. The Obama administration eliminated the budget for the repository program while promising to "conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle … and make recommendations for a new plan."[15] Towards this goal, the Obama administration appointed a Blue Ribbon Commission on

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

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

America's Nuclear Future (Blue Ribbon Commission) to make recommendations for a new plan for nuclear waste disposal. The Blue Ribbon Commission's charter included a requirement that it consider "[o]ptions for safe storage of used nuclear fuel while final disposition pathways are selected and deployed."[16]

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

- "[T]he United States [should] establish a program that leads to the timely development of one or more consolidated storage facilities"[17]
- "[T]he United States should undertake an integrated nuclear waste management program that leads to the timely development of one or more permanent deep geological facilities for the safe disposal of spent fuel and high-level nuclear waste."[18]

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

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

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

16 Ibid.

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

18 Ibid., p.27

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

- Makes demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository by 2048."[20]

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

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program assumed that spent fuel allocations would be accepted for disposal from the nation's commercial nuclear plants, with limited exceptions, in the order (the "queue") in which it was discharged from the reactor. The current spent fuel management plan for the Wolf Creek spent fuel is based in general upon: 1) a 2025 start date for DOE initiating transfer of commercial spent fuel to a federal facility, and 2) a 2032 start date for the transfer of spent fuel from the Wolf Creek site based on an oldest fuel first priority, and the DOE achieving an annual rate of transfer (3,000 metric tons of uranium per year) as reflected in DOE's latest Acceptance Priority Ranking and Annual Capacity Report.[22]

The estimates also assume that the DOE would give priority to fuel at shutdown sites, i.e., it is assumed that Congress would "(1)…direct the Department to take spent nuclear fuel from decommissioned commercial nuclear power reactors as soon as possible; (2) to establish an expedited siting process; and (3) to authorize the Department to construct and operate the facility under its regulatory authority, or, if the facility were to be constructed and operated under a U.S. Nuclear Regulatory Commission license, to provide for an expedited siting and licensing process."[23]

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20 Ibid., p.2

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

22 "Acceptance Priority Ranking and Annual Capacity Report," U.S. DOE, Office of Civilian Radioactive Waste Management, DOE/RW-0567, July 2004

23 "Report to Congress on the Demonstration of the Interim Storage of Spent Nuclear Fuel from Decommissioned Nuclear Power Reactor Sites" DOE/RW-0596, December 2008

It is generally necessary that spent fuel be cooled and stored for a minimum period at the generating site prior to transfer. As such, the NRC requires that licensees establish a program to manage and provide funding for the management of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE, pursuant to 10 CFR Part 50.54(bb).[24] The post-shutdown costs incurred to satisfy this requirement include the isolation and continued operation of the spent fuel pool and the ISFSI during the five and one-half years following the cessation of plant operations.

At shutdown, the spent fuel pool is expected to contain freshly discharged assemblies (from the most recent refueling cycles) as well as the final reactor core. Over the following five and one-half years 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.

Interim storage of the fuel, until the DOE has completed the transfer, will be in the wet storage pool located in the fuel building (as well as on the ISFSI). The pool will be isolated, allowing WCNOC to proceed with decommissioning (or safe-storage preparations) in the shortest time possible.

Sensitivity of Spent Fuel Management Assumptions

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

If DOE is unable to remove the spent fuel from the Wolf Creek site within this time period, wet storage pool operations would need to be extended (potentially delaying decommissioning) and/or the ISFSI would be used for the interim storage of the fuel so that decommissioning could proceed. Appendix E evaluates such a scenario (i.e., where spent fuel is accepted from generators in the order in which it was generated or oldest fuel first and the ISFSI is used for interim storage, similar to what has occurred at recently decommissioned reactor sites).

The resulting costs for long-term spent fuel management (summarized in Table E) are illustrative only and based upon current regulations and associated constraints that

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

may change as a result of actions taken on the Blue Ribbon Commission's recommendations. It should also be noted that the costs, while incurred by the licensee, may also be recoverable as a result of DOE's breech of its contract to take possession of the spent fuel in a timely manner. However, the analysis described in Appendix E may prove useful as a planning basis should delays continue in the development of a national solution for the disposition of spent fuel and high-level waste.

Site Restoration

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

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

Summary

The costs to decommission Wolf Creek assume the removal of all contaminated and activated plant components and structural materials such that the owners 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.

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 station's operating license, recognizing that there may be some additional cost impact from spent fuel management. The License Termination cost subcategory also includes costs to decommission the ISFSI (as required by 10 CFR §72.30). Section 3.4.1 provides the basis for the ISFSI decommissioning cost.

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 Obligations 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 2017 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 2017 dollars)

Cost Element	Cost
Decontamination	16,486
Removal	120,128
Packaging	24,544
Transportation	12,533
Waste Disposal	84,171
Off-site Waste Processing	24,134
Program Management [1]	273,568
Security	115,889
Corporate Allocations	2,002
Spent Fuel Pool Isolation	13,445
Spent Fuel Management - Direct Costs [2]	46,385
Insurance and Regulatory Fees	19,065
Energy	14,431
Characterization and Licensing Surveys	24,313
Property Taxes	15,363
Miscellaneous Equipment	7,279
Total [3]	813,733

Cost Element	Cost
License Termination	711,273
Spent Fuel Management	48,251
Site Restoration	54,208
Total [3]	813,733

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

SAFSTOR COST SUMMARY
DECOMMISSIONING COST ELEMENTS
(thousands of 2017 dollars)

Cost Element	Cost
Decontamination	14,346
Removal	123,154
Packaging	19,286
Transportation	9,751
Waste Disposal	62,163
Off-site Waste Processing	26,984
Program Management [1]	366,223
Security	224,686
Corporate Allocations	3,292
Spent Fuel Pool Isolation	13,445
Spent Fuel Management - Direct Costs [2]	46,385
Insurance and Regulatory Fees	71,272
Energy	29,815
Characterization and Licensing Surveys	24,929
Property Taxes	33,724
Miscellaneous Equipment	23,661
Total [3]	1,093,117

Cost Element	Cost
License Termination	980,846
Spent Fuel Management	58,028
Site Restoration	54,243
Total [3]	1,093,117

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

1. INTRODUCTION

This report presents estimates of the cost to decommission the Wolf Creek Generating Station (Wolf Creek) for the selected decommissioning scenarios following the scheduled cessation of plant operations. The estimates are designed to provide the Wolf Creek Nuclear Operating Corporation (WCNOC), the plant's operator, and its owners: Kansas Gas and Electric Company, a wholly owned subsidiary of Westar Energy, Inc., Kansas City Power & Light Company, a wholly owned subsidiary of Great Plains Energy Incorporated, and Kansas Electric Power Cooperative, Inc., with sufficient information to assess their financial obligations, as they pertain to the eventual decommissioning of the nuclear station.

The analysis relies upon site-specific, technical information from an earlier evaluation prepared in 2014,[1]* updated to reflect current assumptions pertaining to the disposition of the nuclear station and relevant industry experience in undertaking such projects. The costs are based on several key assumptions in areas of regulation, component characterization, high-level radioactive waste management, low-level radioactive waste disposal, performance uncertainties (contingency) and site restoration requirements.

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

The 2014 plant inventory, the basis for the decontamination and dismantling requirements and cost, and the decommissioning waste streams, were reviewed for this analysis. There were no substantive changes made to the plant inventory (that would impact decommissioning). The current analysis does include, however, the costs to decommission the structural changes made to the condensate storage tank (for missile projection) and the control building, the new refueling cavity elevator, the fire protection system and emergency service water system modifications, and other minor modifications identified by the site.

1.1 OBJECTIVES OF STUDY

The objectives of this study were to prepare comprehensive estimates of the costs to decommission Wolf Creek, to provide a sequence or schedule for the

* References provided in Section 7 of the document

associated activities, and to develop waste stream projections from the decontamination and dismantling activities.

An operating license was originally issued for Wolf Creek in June of 1985. A license renewal application was filed for the nuclear station in October 2006. The NRC approved the application and a renewed licensed was issued in November 2008. As such, this analysis is based upon a 60-year operating life, with a final shutdown date (license expiration) in March of 2045.

1.2 SITE DESCRIPTION

The Wolf Creek site is located approximately 3.5 miles northeast of the town of Burlington, in Coffey County, Kansas, approximately 75 miles southwest of Kansas City, Kansas. The site is on the east side of a man-made lake formed by impounding Wolf Creek. The station is an 1,170 MWe (nominal) pressurized water reactor with supporting facilities.

Westinghouse Electric Company designed the Nuclear Steam Supply System (NSSS). The system consists of a pressurized water reactor with four independent primary coolant loops, each of which contains a reactor coolant pump and a steam generator. An electrically heated pressurizer and connecting piping complete the system. The NSSS is rated at a thermal power level of 3,579 MWt (3,565 MWt reactor core plus 14 MWt for reactor coolant pumps), with a corresponding turbine-generator gross output of 1,267 MWe. The system is housed within a containment structure, a pre-stressed, post-tensioned concrete structure with cylindrical wall, a hemispherical dome, and a flat foundation slab. The wall and dome form a pre-stressed post-tensioned system. The inside surface of the structure is covered with a carbon steel liner, providing a leak tight membrane.

A power conversion system converts heat produced in the reactor to electrical energy. This system converts the thermal energy of the steam into mechanical shaft power and then into electrical energy. The turbine-generator is a tandem-compound, six-flow, four element, 1800-rpm unit. The unit consists of one high pressure and three low-pressure turbine elements driving a directly coupled generator. (The four turbine elements were replaced in 2010 with very similar equipment.) 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. A large cooling lake

provides the heat sink required for removal of waste heat in the power plant's thermal cycle.

1.3 REGULATORY GUIDANCE

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

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

The ENTOMB alternative has not been viewed as a viable option for power reactors due to the significant time required to isolate the long-lived radionuclides for decay to permissible levels. However, with rulemaking permitting the controlled release of a site,[4] the NRC has re-evaluated this alternative. The resulting feasibility study, based upon an assessment by Pacific Northwest National Laboratory, concluded that the method did have

conditional merit for some, if not most reactors. However, the staff also found that additional rulemaking would be needed before this option could be treated as a generic alternative. The NRC had considered rulemaking to alter the 60-year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments.[5]

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

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

Under the revised regulations, licensees will submit written certification to the NRC within 30 days after the decision to cease operations. Certification will also be required once the fuel is permanently removed from the reactor vessel. Submittal of these notices, along with related changes to Technical Specifications, 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 includes a license termination plan (LTP).

In 2011, the NRC issued regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy site.[7] The regulations require licensees to report additional details in their decommissioning cost estimate including a decommissioning estimate for any on-site Independent Spent Fuel Storage Installation (ISFSI). Since an ISFSI may be required to support continued operation at Wolf Creek, a representative decommissioning cost is included within the DECON and SAFSTOR estimates.

1.3.1 High-Level Radioactive Waste Management

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

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

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

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

> for the safe disposal of spent fuel and high-level nuclear waste."[10]

In January 2013, the DOE issued the "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," in response to the recommendations made by the Blue Ribbon Commission and as "a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel..."[11]

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

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

The NRC's review of DOE's license application to construct a geologic repository at Yucca Mountain was suspended in 2011 when the Obama administration significantly reduced the budget for completing that work. However, the US Court of Appeals for the District of Columbia Circuit issued a writ of mandamus (in August 2013)[12] ordering NRC to comply with federal law and resume its review of DOE's Yucca Mountain repository license application, to the extent allowed by previously appropriated funding for the review. That review is now complete with the publication of the five-volume safety evaluation report. A supplement to DOE's environmental impact statement and adjudicatory hearing on the contentions filed by interested parties must be completed before a licensing decision can be made.

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program assumed that spent fuel allocations would be accepted for disposal from the nation's commercial nuclear plants, with

limited exceptions, in the order (the "queue") in which it was discharged from the reactor. The current spent fuel management plan for the Wolf Creek spent fuel is based in general upon: 1) a 2025 start date for DOE initiating transfer of commercial spent fuel to a federal facility, and 2) a 2032 start date for the transfer of spent fuel from the Wolf Creek site based on an oldest fuel first priority, and the DOE achieving an annual rate of transfer (3,000 metric tons of uranium per year) as reflected in DOE's latest Acceptance Priority Ranking and Annual Capacity Report.[13]

The estimates also assume that the DOE would give priority to fuel at shutdown sites, i.e., it is assumed that Congress would "(1)…direct the Department to take spent nuclear fuel from decommissioned commercial nuclear power reactors as soon as possible; (2) to establish an expedited siting process; and (3) to authorize the Department to construct and operate the facility under its regulatory authority, or, if the facility were to be constructed and operated under a U.S. Nuclear Regulatory Commission license, to provide for an expedited siting and licensing process."[14]

It is generally necessary that spent fuel be cooled and stored for a minimum period at the generating site prior to transfer. As such, the NRC requires that licensees establish a program to manage and provide funding for the management of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE, pursuant to 10 CFR Part 50.54(bb).[15] The post-shutdown costs incurred to satisfy this requirement include the isolation and continued operation of the spent fuel pool and the ISFSI during the five and one-half years following the cessation of plant operations.

At shutdown, the spent fuel pool is expected to contain freshly discharged assemblies (from the most recent refueling cycles) as well as the final reactor core. Over the following five and one-half years 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.

Interim storage of the fuel, until the DOE has completed the transfer, will be in the wet storage pool located in the fuel building (as well as on the ISFSI). The pool will be isolated, allowing WCNOC to proceed with decommissioning (or safe-storage preparations) in the shortest time possible.

1.3.2 Low-Level Radioactive Waste Management

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,[16] and its Amendments of 1985,[17] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

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

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently available to WCNOC. The majority of the low-level radioactive waste designated for controlled disposal (Class A[18]) can be sent to Energy*Solutions*' facility in Clive, Utah. Therefore, disposal costs for Class A waste were based upon WCNOC's "Long Term Waste Disposal Agreement" with Energy*Solutions*. This facility is not licensed to receive the higher activity portion (Classes B and C) of the decommissioning waste stream.

The WCS facility is able to receive the Class B and C waste. As such, for this analysis, Class B and C waste was assumed to be shipped to the WCS facility for disposal. Disposal costs were based upon preliminary and indicative information for the WCS site.

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

However, to date, the federal government has not identified a cost for disposing of GTCC or a schedule for acceptance.

For purposes of this analysis only, the GTCC radioactive waste is assumed to be packaged and disposed of in a similar manner as high-level waste and at a cost equivalent to that envisioned for the spent fuel. The GTCC is packaged in the same canisters used for spent fuel and shipped directly to a DOE facility as it is generated.

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This material can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring 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 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,"[19] 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 Wolf Creek 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).[20] An additional and separate limit of 4 millirem per year, as defined in 40 CFR §141.66, is applied to drinking water.[21]

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)[22] 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 Wolf Creek 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.

Two decommissioning scenarios were evaluated for the Wolf Creek nuclear unit. The scenarios selected are representative of alternatives currently available to the owners and are defined as follows:

1. The first scenario assumes that the nuclear unit is promptly decommissioned (DECON alternative) upon the expiration of the current operating license in 2045. Following the permanent cessation of operations, and over the first five and one-half years, the spent fuel is transferred directly from the wet storage pool to the DOE (the fuel stored on the ISFSI is also removed from the site during this time period). Concurrently, the majority of the plant components, including the nuclear steam supply system components, are removed. Once the spent fuel stored in the fuel handling building's pool has been transferred off-site, the remaining portions of the power block are decommissioned and the surrounding site remediated. Following the termination of the operating license, non-essential structures (not designated for reuse) are dismantled.

2. In the second scenario, the nuclear unit is placed into safe-storage (SAFSTOR alternative) upon the expiration of the current operating license in 2045. As with the first scenario, the spent fuel removed from the site (transferred to the DOE) during the first five and one-half years following the permanent cessation of operations. The facility is then placed into safe-storage (with non-essential systems de-energized and buildings secured). The start of decontamination and dismantling activities is deferred to the maximum extent (approximately 50 years from the cessation of operations) such that the license is terminated within the required 60-year period.

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 Wolf Creek 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.

2.1.1 Period 1 - Preparations

In anticipation of the cessation of plant operations, detailed preparations are undertaken to provide a smooth transition from plant operations to site decommissioning. Through implementation of a staffing transition plan, the organization required to manage the intended decommissioning activities is assembled from available plant staff and outside resources. Preparations include the planning for permanent defueling of the reactor, revision of technical specifications applicable to the operating conditions and requirements, a characterization of the facility and major components, and the development of the PSDAR.

Engineering and Planning

The PSDAR, required prior to or within two years of permanent cessation of operations, provides a description of the licensee's planned decommissioning activities, a timetable, and the associated financial requirements of the intended decommissioning program. Upon receipt of the PSDAR, the NRC will make the document available to the public

for comment in a local hearing to be held in the vicinity of the reactor site. Ninety days following submittal and NRC receipt of the PSDAR, the licensee may begin to perform major decommissioning activities under a modified 10 CFR §50.59 procedure, i.e., without specific NRC approval. Major activities are defined as any activity that results in permanent removal of major radioactive components, permanently modifies the structure of the containment, or results in dismantling components (for shipment) containing GTCC, as defined by 10 CFR §61. Major components are further defined as comprising the reactor vessel and internals, large bore reactor coolant system piping, and other large components that are radioactive. The NRC includes the following additional criteria for use of the §50.59 process in decommissioning. The proposed activity must not:

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

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

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

Site Preparations

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

- Characterization of the site and surrounding environs. This includes radiation surveys of work areas, major components (including the reactor vessel and its internals), internal piping, and primary shield cores.
- Isolation of the spent fuel storage pool and fuel handling systems, such that decommissioning operations can commence on the balance of the plant. The pool will remain operational for approximately five and one-half years following the cessation of operations before the inventory resident at shutdown can be transferred to the 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)."[23] 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, radioactive waste, solidification facility and condensate polishing buildings. Under certain circumstances, verifying that subsurface radionuclide concentrations meet NRC site release requirements will require removal of grade slabs and lower floors, potentially weakening footings and structural supports. This removal

activity will be necessary for those facilities and plant areas where historical records, when available, indicate the potential for radionuclides having been present in the soil, where system failures have been recorded, or where it is required to confirm that subsurface process and drain lines were not breached over the operating life of the station.

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

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

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

2.2 SAFSTOR

The NRC defines SAFSTOR as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use." The facility is left intact (during the dormancy period), with structures maintained in a sound condition. Systems that are not required to support the spent fuel pool or site surveillance and security are drained, de-energized, and secured. Minimal cleaning/removal of loose contamination and/or fixation and sealing of remaining contamination are 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 (any spent fuel stored at the ISFSI is also removed from the site during this time period).
- Draining and de-energizing of the non-contaminated systems not required to support continued site operations or maintenance.
- Disposing of contaminated filter elements and resin beds not required for processing wastes from layup activities for future operations.
- Draining of the reactor vessel, with the internals left in place and the vessel head secured.
- Draining and de-energizing non-essential, contaminated systems with decontamination as required for future maintenance and inspection.
- Preparing lighting and alarm systems whose continued use is required; de-energizing portions of fire protection, electric power, and HVAC systems whose continued use is not required.
- Cleaning of the loose surface contamination from building access pathways.

- Performing an interim radiation survey of plant, posting warning signs where appropriate.
- Erecting physical barriers and/or securing all access to radioactive or contaminated areas, except as required for inspection and maintenance.
- Installing security and surveillance monitoring equipment and relocating security fence around secured structures, as required.

2.2.2 Period 2 - Dormancy

The second phase identified by the NRC in its rule addresses licensed activities during a storage period and is applicable to the dormancy phases of the deferred decommissioning 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 and the ISFSI are emptied within five and one-half years of the cessation of operations. The pool is secured for storage and decommissioned along with the power block structures in Period 4.

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

2.2.3 Periods 3 and 4 - Delayed Decommissioning

Prior to the commencement of decommissioning operations, preparations are undertaken to reactivate site services and prepare for decommissioning. Preparations include engineering and planning, a detailed site characterization, and the assembly of a decommissioning management organization. Final planning for activities and the writing of activity specifications and detailed procedures are also initiated at this time.

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

Variations in the length of the dormancy period are expected to have little effect upon the quantities of radioactive wastes generated from system and structure removal operations. Given the levels of radioactivity and spectrum of radionuclides expected from sixty years of plant operation, no plant process system identified as being contaminated upon final shutdown will become releasable due to the decay period alone, i.e., there is no significant reduction in the waste generated from the decommissioning activities. However, due to the lower activity levels, a greater percentage of the waste volume can be designated for off-site processing and recovery.

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

Although the initial radiation levels due to ^{60}Co will decrease during the dormancy period, the internal components of the reactor vessel will still exhibit sufficiently high radiation dose rates to require remote sectioning under water due to the presence of long-lived radionuclides

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

2.2.4 Period 5 - Site Restoration

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

3. COST ESTIMATE

The cost estimates prepared for decommissioning Wolf Creek consider the unique features of the site, including the nuclear steam supply system, electric power generating systems, structures and supporting facilities. The basis of the estimates, including the sources of information relied upon, the estimating methodology employed, site-specific considerations, and other pertinent assumptions, is described in this section.

3.1 BASIS OF ESTIMATE

The current estimates were developed using the site-specific, technical information relied upon in the decommissioning analysis prepared in 2014. 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,"[24] and the DOE "Decommissioning Handbook."[25] These documents present a unit factor method for estimating decommissioning activity costs, which simplifies the estimating calculations. Unit factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/inch) are developed using local labor rates. The activity-dependent costs are estimated with the item quantities (cubic yards and tons), developed from plant drawings and inventory documents. Removal rates and material costs for the conventional disposition of components and structures rely upon information available in the industry publication, "Building Construction Cost Data," published by RSMeans.[26]

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

Regulatory Guide 1.184[27] Revision 1, issued in October 2013, describes the methods and procedures that are acceptable to the NRC staff for implementing the requirements that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and sequence in the regulations. The format and content of the estimates is also consistent with the recommendations of Regulatory Guide 1.202,[28] issued February 2005.

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

Work Difficulty Factors

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

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

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

Scheduling Program Durations

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

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

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

3.3 FINANCIAL COMPONENTS OF THE COST MODEL

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

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

3.3.1 Contingency

The activity- and period-dependent costs are combined to develop the total decommissioning cost. A contingency is then applied on a line-item basis, using one or more of the contingency types listed in the AIF/NESP-036 study. "Contingencies" are defined in the American Association of Cost Engineers "Project and Cost Engineers' Handbook"[29] as "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." The cost elements in this analysis are based upon ideal conditions and maximum efficiency; therefore, consistent with industry practice, contingency is included. In the AIF/NESP-036 study, the types of

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

Contingency funds are an integral part of the total cost to complete the decommissioning process. Exclusion of this component puts at risk a successful completion of the intended tasks and, potentially, subsequent related activities. For this study, TLG examined the major activity-related problems (decontamination, segmentation, equipment handling, packaging, transport, and waste disposal) that necessitate a contingency. Individual activity contingencies ranged from 10% to 75%, depending on the degree of difficulty judged to be appropriate from TLG's actual decommissioning experience. The contingency values used in this study are as follows:

- Decontamination 50%
- Contaminated Component Removal 25%
- Contaminated Component Packaging 10%
- Contaminated Component Transport 15%
- Low-Level Radioactive Waste Disposal 25%

- Low-Level Radioactive Waste Processing 15%
- Reactor Segmentation 75%
- NSSS Component Removal 25%
- Reactor Waste Packaging 25%
- Reactor Waste Transport 25%

- Reactor Vessel Component Disposal 50%
- GTCC Disposal 15%
- Non-Radioactive Component Removal 15%
- Heavy Equipment and Tooling 15%
- Supplies 25%

- Engineering 15%
- Energy 15%
- Insurance, Taxes and Fees 10%
- Staffing 15%
- Characterization and Termination Surveys 30%
- Operations and Maintenance Expense 15%
- ISFSI Decommissioning 25%

The contingency values are applied to the appropriate components of the estimates on a line item basis. A composite value is then reported at the end of each detailed estimate (as provided in Appendix C and D). A contingency of 25% is applied to the subtotal of the ISFSI decommissioning costs.

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.

This cost study does not add any additional costs to the estimate for financial risk, since there is insufficient historical data from which to project future liabilities. Consequently, the areas of uncertainty or risk are revisited periodically and addressed through repeated revisions or updates of the 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 Wolf Creek. Ultimate disposition of the spent fuel is within the province of the DOE's Waste Management System, as defined by the Nuclear Waste Policy Act. As such, until recently, the disposal cost was being financed by a 1 mill/kWhr surcharge on nuclear generated energy delivered to customers, the fee being paid into the DOE's waste fund during operations. The D.C. Circuit ruling on November 19, 2013, ordered the DOE to submit a proposal to Congress to suspend the Nuclear Waste Fund fee "until such time as either the Secretary chooses to comply with the Act as it is currently written, or until Congress enacts an alternative waste management plan." The fee was reduced to 0.0 mill/kWh as of May 16, 2014. The fee is expected to be reinstated in the future.

Nonetheless, the NRC does requires licensees to establish a program to manage and provide funding for the management of all irradiated fuel at the reactor until title of the fuel is transferred to the Secretary of Energy. This funding requirement is fulfilled through inclusion of certain high-level waste cost elements within the estimates, as described below.

For estimating purposes, WCNOC has assumed that all spent fuel will be removed to a DOE facility within five and one-half 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 (as well as on the ISFSI). The spent fuel storage pool and fuel handling systems will be isolated (i.e., a spent fuel island created). This will allow WCNOC to proceed with decommissioning (or safe-storage) operations in the shortest time possible. A delay in the start of fuel pickup, or a decrease in the spent fuel acceptance rate, will correspondingly prolong the transfer process and result in the fuel remaining at the Wolf Creek site longer.

It is assumed that the five and one-half 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.

Supplemental Storage

It is likely that supplemental spent fuel storage will be required to support continued plant operations (i.e., maintain full core off-load capability). This analysis assumes that an ISFSI is constructed during operations and that 592 spent fuel assemblies (16 equivalent dry storage system modules) are transferred to the ISFSI during plant operations (assuming that the DOE begins removing fuel from the Wolf Creek site in 2032). The fuel will remain in storage until it is off-loaded into a DOE-provided transport cask. The transfer is assumed to occur once the spent fuel pool has been emptied. The estimates include the cost for the transfer only.

Canister Loading and Transfer

The estimates include the cost to load the spent fuel in the wet storage pool into a DOE-provided multi-purpose canister (e.g., Transport, Aging and Disposal or TAD canister), seal the canisters and place the canister into the DOE transport vehicle. The estimates also include the cost to transfer each canister stored at the ISFSI into the DOE transport vehicle.

Operations and Maintenance

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

ISFSI Decommissioning

In accordance with 10 CFR §72.30, licensees must have a proposed decommissioning plan for the ISFSI site and facilities that includes a cost estimate for the plan. The plan needs to contain sufficient information on the proposed practices and procedures for the decontamination of the ISFSI and for the disposal of residual radioactive materials after the spent fuel has been removed.

For purposes of this study only, the decommissioning cost for a future ISFSI was included in the DECON and SAFSTOR estimates. The decommissioning estimate is based on the premise that some of the storage casks will contain low levels of neutron-induced residual radioactivity that would necessitate remediation at the time of decommissioning. As an allowance, 6 casks are assumed to be affected, i.e., contain residual radioactivity. The allowance is based upon the number of casks required for the final core off-load (i.e., 193 offloaded assemblies, 37 assemblies per cask) which results in 6 storage modules. It is assumed that these are the final casks offloaded; consequently they have the least time for radioactive decay of any neutron activation products.

No contamination or activation of the ISFSI pad is assumed. It would be expected that this assumption would be confirmed as a result of good radiological practice of surveying potentially impacted areas after each spent fuel transfer campaign. As such, only verification surveys are included for the pad in the decommissioning estimate. The estimate is limited to costs necessary to terminate the ISFSI's NRC license and meet the §20.1402 criteria for unrestricted use.

In accordance with the specific requirements of 10 CFR §72.30 for the ISFSI work scope, the cost estimate for decommissioning the ISFSI reflects: 1) the cost of an independent contractor performing the decommissioning activities; 2) an adequate contingency factor; and 3) the cost of meeting the criteria for unrestricted use.

GTCC

The dismantling of the reactor internals is expected to generate radioactive waste considered unsuitable for shallow land disposal (i.e., low-level radioactive waste with concentrations of radionuclides that exceed the limits established by the NRC for Class C radioactive waste (GTCC)). The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigned the federal government the responsibility for the disposal of this material. The Act also stated that the beneficiaries of the activities resulting in the generation of such radioactive waste bear all reasonable costs of disposing of such waste. Although the DOE is responsible for disposing of GTCC waste, any costs for that service have not been determined.

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

3.4.2 Reactor Vessel and Internal Components

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

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

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

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

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

3.4.3 Primary System Components

In the DECON scenario, the reactor coolant system components are assumed to be decontaminated using chemical agents prior to the start of dismantling operations. This type of decontamination can be expected to have a significant ALARA impact, since in this scenario the removal work is done within the first few years of shutdown. 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 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.

3.4.5 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.[30] 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 10 CFR Part 71, as Type B. It is conceivable that the reactor, due to its limited specific activity, could qualify as LSA II or III. However, the high radiation levels on the outer surface would require that additional shielding be incorporated within the packaging so as to attenuate the dose to levels acceptable for transport.

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

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

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

Transportation costs for Class A radioactive material requiring controlled disposal are based upon the mileage to the Energy*Solutions* facility in Clive, Utah. Transportation costs for the higher activity Class B and C radioactive material are based upon the mileage to the WCS facility in Andrews County, Texas. The transportation cost for the GTCC material is assumed to be contained within the disposal cost. Transportation costs for off-site waste processing are based upon the mileage to Oak Ridge, Tennessee. Truck transport costs are estimated using published tariffs from Tri-State Motor Transit.[31]

3.4.6 Low-Level Radioactive Waste Disposal

To the greatest extent practical, metallic material generated in the decontamination and dismantling processes is processed to reduce the

total cost of controlled disposal. Material meeting the regulatory and/or site release criterion, is released as scrap, requiring no further cost consideration. Conditioning (preparing the material to meet the waste acceptance criteria of the disposal site) and recovery of the waste stream is performed off site at a licensed processing center. Any material leaving the site is subject to a survey and release charge, at a minimum. The mass of radioactive waste generated during the various decommissioning activities at the site is shown on a line-item basis in the appendices and summarized in Section 5. The quantified waste summaries shown in these tables are consistent with 10 CFR Part 61 classifications. Commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations. The volumes are calculated based on the exterior package dimensions for containerized material or a specific calculation for components serving as their own waste containers.

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

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

3.4.7 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 regrading such that the site upon which the power block and supplemental structures are located is transformed into a "grassy plain."

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

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

The existing electrical switchyard and access roads will remain in support of the electrical transmission and distribution system. Other structures that will remain are the main dam, cooling lake, makeup water discharge structure (west side of lake), makeup water screen house (located below the John Redmond Dam) and associated underground piping, the Eisenhower Learning Center, and a railroad spur running about 11.5 miles from the plant southeast to near Aliceville, Kansas, where it connects to a Union Pacific Railroad line.

The estimates do not assume the remediation of any significant volume of contaminated soil. Costs are included, however, for the remediation of the firing range, i.e., removal of soil containing lead residue. This assumption may be affected by continued plant operations and/or future regulatory actions, such as the development of site-specific release criteria.

3.5 ASSUMPTIONS

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

3.5.1 Estimating Basis

Decommissioning costs are reported in the year of projected expenditure; however, the values are provided in 2017 dollars. Costs are not inflated, escalated, or discounted over the periods of performance.

The estimates rely upon the physical plant inventory that was the basis for the 2014 analysis.

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

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

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

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

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

3.5.3 Design Conditions

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

The curie contents of the vessel and internals at final shutdown are derived from those listed in NUREG/CR-3474.[32] Actual estimates are derived from the curie/gram values contained therein and adjusted for the different mass of the Wolf Creek components, projected operating life, and different periods of decay. Additional short-lived isotopes were derived from CR-0130[33] and CR-0672,[34] and benchmarked to the long-lived values from CR-3474.

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

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

3.5.4 General

Transition Activities

Existing warehouses are cleared of non-essential material and remain for use by WCNOC 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. WCNOC 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.

Emergency Planning

FEMA and state fees associated with emergency planning are assumed to continue for approximately 18 months following the cessation of operations. At this time, the fees are discontinued. The timing is based upon the anticipated condition of the spent fuel (i.e., the hottest spent fuel assemblies are assumed to be cool enough that no substantial Zircaloy oxidation and off-site event would occur with the loss of spent fuel pool water). State and local fees continue until all fuel has been removed from the site (approximately five and one-half years following the cessation of operations).

Insurance

Costs for continuing coverage (nuclear liability and property insurance) following cessation of plant operations and during decommissioning are included and based upon current operating premiums. Reductions in premiums, throughout the decommissioning process, are based upon the guidance provided in SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning"[35] The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

Taxes

Property tax payments are included for the land and those facilities that will continue to be used to support the decommissioning project. When the facilities are no longer needed, the taxes are reduced accordingly.

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 station's operating license, recognizing that there may be some additional cost impact from spent fuel management. These costs are identified in Tables 3.1a and 3.2a.

The License Termination cost subcategory also includes costs to decommission the ISFSI (as required by 10 CFR §72.30). The basis for the ISFSI decommissioning cost that is included in both Appendices C and D is described in Section 3.4.1.

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

"Site Restoration" is used to capture costs associated with the dismantling and demolition of buildings and facilities demonstrated to be free from contamination. This includes structures never exposed to radioactive materials, as well as those facilities that have been decontaminated to appropriate levels. Structures are removed to a depth of three feet and backfilled to conform to local grade. These costs are identified in Tables 3.1c and 3.2c.

It should be noted that the costs assigned to these subcategories are allocations. Delegation of cost elements is for the purposes of comparison (e.g., with NRC financial guidelines) or to permit specific financial treatment (e.g., Asset Retirement Obligation determinations). In reality, there can be considerable interaction between the activities in the three subcategories. For example, an owner may decide to remove non-contaminated structures early in the project to improve access to highly contaminated facilities or plant components. In these instances, the non-contaminated removal costs could be reassigned from Site Restoration to an NRC License Termination support

activity. However, in general, the allocations represent a reasonable accounting of those costs that can be expected to be incurred for the specific subcomponents of the total estimated program cost, if executed as described.

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

The estimates were developed and costs are presented in 2017 dollars. As such, the estimates do not reflect the escalation of costs (due to inflationary and market forces) over the remaining operating life of the reactor or during the decommissioning period. The schedules are based upon the detailed activity costs reported in Appendices C and D, along with the timeline presented in Section 4.

TABLE 3.1
DECON ALTERNATIVE
TOTAL ANNUAL EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	58,361	2,378	1,969	33	9,446	72,188
2046	79,873	21,825	3,615	14,402	27,684	147,398
2047	76,699	32,056	2,307	32,769	20,185	164,016
2048	72,060	23,138	2,066	21,513	14,659	133,436
2049	67,183	14,384	1,821	10,505	9,232	103,125
2050	58,152	13,450	1,560	11,115	9,239	93,516
2051	33,150	5,285	664	4,607	4,793	48,499
2052	18,938	10,854	277	4	1,885	31,959
2053	10,625	7,677	152	0	1,142	19,595
Total	475,042	131,047	14,431	94,948	98,265	813,733

Note: Columns may not add due to rounding

TABLE 3.1a
DECON ALTERNATIVE
LICENSE TERMINATION EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	57,604	1,585	1,969	33	7,509	68,700
2046	77,006	17,414	3,615	14,402	25,472	137,908
2047	73,503	26,787	2,307	32,769	18,372	153,738
2048	68,660	17,316	2,066	21,513	12,841	122,396
2049	63,604	8,058	1,821	10,505	7,419	91,407
2050	55,274	9,065	1,560	11,115	7,982	84,997
2051	31,860	5,285	664	4,607	4,793	47,209
2052	4,201	248	68	4	308	4,829
2053	88	0	0	0	0	88
Total	431,800	85,759	14,069	94,948	84,697	711,273

Note: Columns may not add due to rounding

TABLE 3.1b
DECON ALTERNATIVE
SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	264	793	0	0	1,938	2,995
2046	1,460	4,380	0	0	2,212	8,053
2047	1,724	5,171	0	0	1,813	8,708
2048	1,911	5,733	0	0	1,818	9,461
2049	2,082	6,245	0	0	1,813	10,139
2050	1,840	4,329	0	0	1,257	7,425
2051	1,290	0	0	0	0	1,290
2052	180	0	0	0	0	180
2053	0	0	0	0	0	0
Total	10,751	26,651	0	0	10,850	48,251

Note: Columns may not add due to rounding

TABLE 3.1c
DECON ALTERNATIVE
SITE RESTORATION EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	493	0	0	0	0	493
2046	1,407	30	0	0	0	1,437
2047	1,472	98	0	0	0	1,570
2048	1,489	89	0	0	0	1,579
2049	1,498	81	0	0	0	1,578
2050	1,038	56	0	0	0	1,094
2051	0	0	0	0	0	0
2052	14,558	10,606	210	0	1,577	26,950
2053	10,537	7,677	152	0	1,142	19,507
Total	32,491	18,637	361	0	2,719	54,208

Note: Columns may not add due to rounding

TABLE 3.2
SAFSTOR ALTERNATIVE
TOTAL ANNUAL EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	50,301	1,936	1,969	33	9,446	63,686
2046	52,967	10,775	1,832	1,389	23,599	90,562
2047	28,085	6,228	486	15	6,065	40,878
2048	28,162	6,245	487	16	6,082	40,990
2049	28,085	6,228	486	15	6,065	40,878
2050	20,521	4,415	411	13	4,624	29,985
2051	3,437	322	243	7	1,370	5,378
2052	3,446	323	243	7	1,374	5,393
2053	3,437	322	243	7	1,370	5,378
2054	3,437	322	243	7	1,370	5,378
2055	3,437	322	243	7	1,370	5,378
2056	3,446	323	243	7	1,374	5,393
2057	3,437	322	243	7	1,370	5,378
2058	3,437	322	243	7	1,370	5,378
2059	3,437	322	243	7	1,370	5,378
2060	3,446	323	243	7	1,374	5,393
2061	3,437	322	243	7	1,370	5,378
2062	3,437	322	243	7	1,370	5,378
2063	3,437	322	243	7	1,370	5,378
2064	3,446	323	243	7	1,374	5,393
2065	3,437	322	243	7	1,370	5,378
2066	3,437	322	243	7	1,370	5,378
2067	3,437	322	243	7	1,370	5,378
2068	3,446	323	243	7	1,374	5,393
2069	3,437	322	243	7	1,370	5,378
2070	3,437	322	243	7	1,370	5,378
2071	3,437	322	243	7	1,370	5,378
2072	3,446	323	243	7	1,374	5,393
2073	3,437	322	243	7	1,370	5,378
2074	3,437	322	243	7	1,370	5,378
2075	3,437	322	243	7	1,370	5,378
2076	3,446	323	243	7	1,374	5,393
2077	3,437	322	243	7	1,370	5,378

TABLE 3.2 (continued)
SAFSTOR ALTERNATIVE
TOTAL ANNUAL EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2078	3,437	322	243	7	1,370	5,378
2079	3,437	322	243	7	1,370	5,378
2080	3,446	323	243	7	1,374	5,393
2081	3,437	322	243	7	1,370	5,378
2082	3,437	322	243	7	1,370	5,378
2083	3,437	322	243	7	1,370	5,378
2084	3,446	323	243	7	1,374	5,393
2085	3,437	322	243	7	1,370	5,378
2086	3,437	322	243	7	1,370	5,378
2087	3,437	322	243	7	1,370	5,378
2088	3,446	323	243	7	1,374	5,393
2089	3,437	322	243	7	1,370	5,378
2090	3,437	322	243	7	1,370	5,378
2091	3,437	322	243	7	1,370	5,378
2092	3,446	323	243	7	1,374	5,393
2093	3,437	322	243	7	1,370	5,378
2094	3,437	322	243	7	1,370	5,378
2095	3,437	322	243	7	1,370	5,378
2096	3,446	323	243	7	1,374	5,393
2097	3,437	322	243	7	1,370	5,378
2098	8,030	526	530	10	1,416	10,512
2099	39,843	3,003	2,428	35	1,725	47,034
2100	51,668	21,348	2,352	19,715	11,194	106,277
2101	52,224	26,356	2,272	29,879	16,007	126,738
2102	43,514	7,481	1,821	10,054	5,614	68,485
2103	43,514	7,481	1,821	10,054	5,614	68,485
2104	36,028	4,171	1,047	4,233	3,422	48,900
2105	19,989	11,805	289	6	1,828	33,916
2106	11,872	9,571	164	0	1,237	22,843
Total	676,430	142,714	29,815	75,790	168,367	1,093,117

TABLE 3.2a
SAFSTOR ALTERNATIVE
LICENSE TERMINATION EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	50,036	1,143	1,969	33	7,509	60,690
2046	50,641	6,213	1,758	1,389	21,375	81,375
2047	23,538	465	243	15	4,213	28,474
2048	23,602	467	243	16	4,224	28,552
2049	23,538	465	243	15	4,213	28,474
2050	17,370	421	243	13	3,340	21,387
2051	3,437	322	243	7	1,370	5,378
2052	3,446	323	243	7	1,374	5,393
2053	3,437	322	243	7	1,370	5,378
2054	3,437	322	243	7	1,370	5,378
2055	3,437	322	243	7	1,370	5,378
2056	3,446	323	243	7	1,374	5,393
2057	3,437	322	243	7	1,370	5,378
2058	3,437	322	243	7	1,370	5,378
2059	3,437	322	243	7	1,370	5,378
2060	3,446	323	243	7	1,374	5,393
2061	3,437	322	243	7	1,370	5,378
2062	3,437	322	243	7	1,370	5,378
2063	3,437	322	243	7	1,370	5,378
2064	3,446	323	243	7	1,374	5,393
2065	3,437	322	243	7	1,370	5,378
2066	3,437	322	243	7	1,370	5,378
2067	3,437	322	243	7	1,370	5,378
2068	3,446	323	243	7	1,374	5,393
2069	3,437	322	243	7	1,370	5,378
2070	3,437	322	243	7	1,370	5,378
2071	3,437	322	243	7	1,370	5,378
2072	3,446	323	243	7	1,374	5,393
2073	3,437	322	243	7	1,370	5,378
2074	3,437	322	243	7	1,370	5,378
2075	3,437	322	243	7	1,370	5,378
2076	3,446	323	243	7	1,374	5,393
2077	3,437	322	243	7	1,370	5,378

TABLE 3.2a (continued)
SAFSTOR ALTERNATIVE
LICENSE TERMINATION EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2078	3,437	322	243	7	1,370	5,378
2079	3,437	322	243	7	1,370	5,378
2080	3,446	323	243	7	1,374	5,393
2081	3,437	322	243	7	1,370	5,378
2082	3,437	322	243	7	1,370	5,378
2083	3,437	322	243	7	1,370	5,378
2084	3,446	323	243	7	1,374	5,393
2085	3,437	322	243	7	1,370	5,378
2086	3,437	322	243	7	1,370	5,378
2087	3,437	322	243	7	1,370	5,378
2088	3,446	323	243	7	1,374	5,393
2089	3,437	322	243	7	1,370	5,378
2090	3,437	322	243	7	1,370	5,378
2091	3,437	322	243	7	1,370	5,378
2092	3,446	323	243	7	1,374	5,393
2093	3,437	322	243	7	1,370	5,378
2094	3,437	322	243	7	1,370	5,378
2095	3,437	322	243	7	1,370	5,378
2096	3,446	323	243	7	1,374	5,393
2097	3,437	322	243	7	1,370	5,378
2098	7,946	526	530	10	1,416	10,428
2099	39,068	3,003	2,428	35	1,725	46,259
2100	49,978	21,279	2,352	19,715	11,194	104,518
2101	50,548	26,248	2,272	29,879	16,007	124,954
2102	42,190	7,410	1,821	10,054	5,614	67,089
2103	42,190	7,410	1,821	10,054	5,614	67,089
2104	35,472	4,141	1,047	4,233	3,422	48,315
2105	6,309	1,835	92	6	346	8,588
2106	457	1,251	0	0	0	1,708
Total	624,509	97,424	28,482	75,790	154,641	980,846

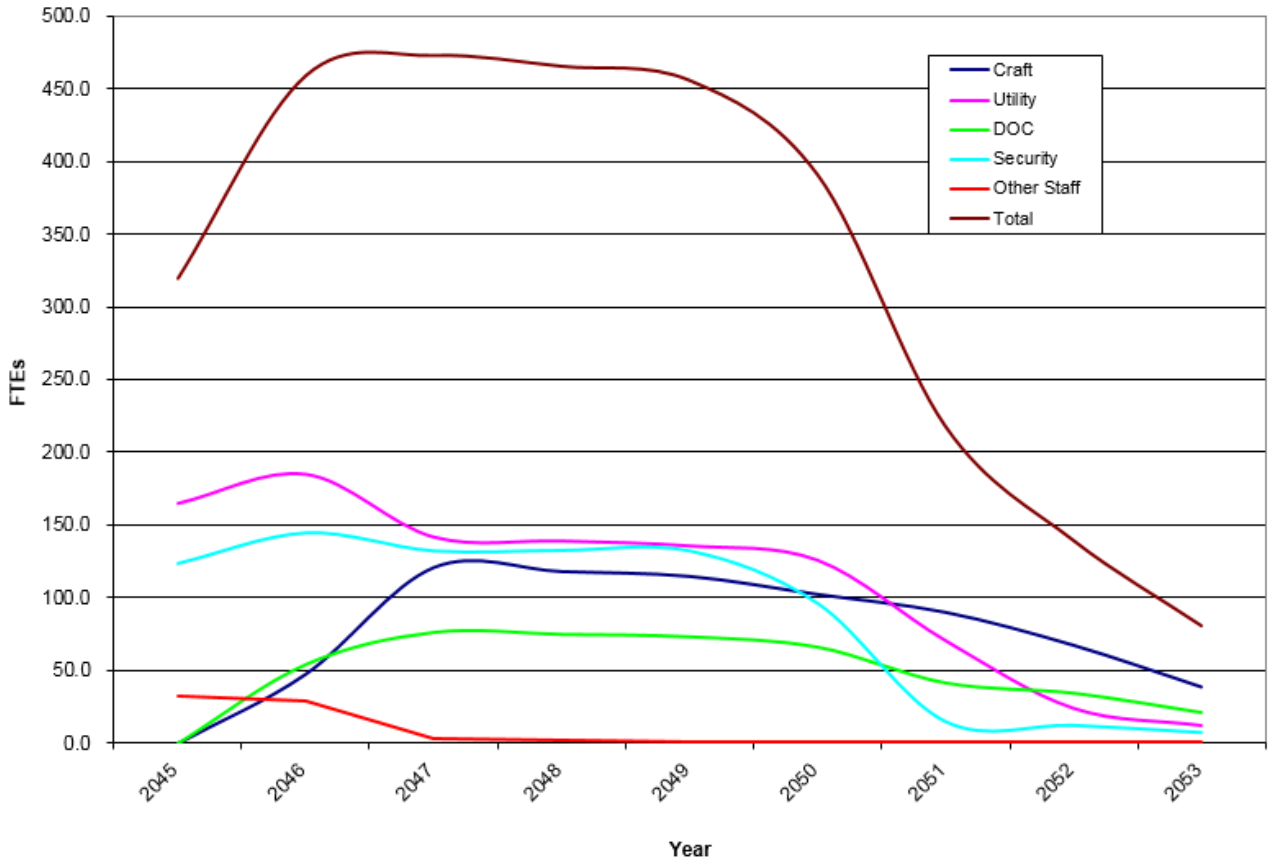
TABLE 3.2b
SAFSTOR ALTERNATIVE
SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	264	793	0	0	1,938	2,995
2046	2,327	4,562	75	0	2,224	9,187
2047	4,547	5,762	243	0	1,852	12,404
2048	4,560	5,778	243	0	1,857	12,438
2049	4,547	5,762	243	0	1,852	12,404
2050	3,152	3,994	168	0	1,284	8,598
2051-2106	0	0	0	0	0	0
Total	19,397	26,651	972	0	11,008	58,028

TABLE 3.2c
SAFSTOR ALTERNATIVE
SITE RESTORATION EXPENDITURES
(thousands, 2017 dollars)

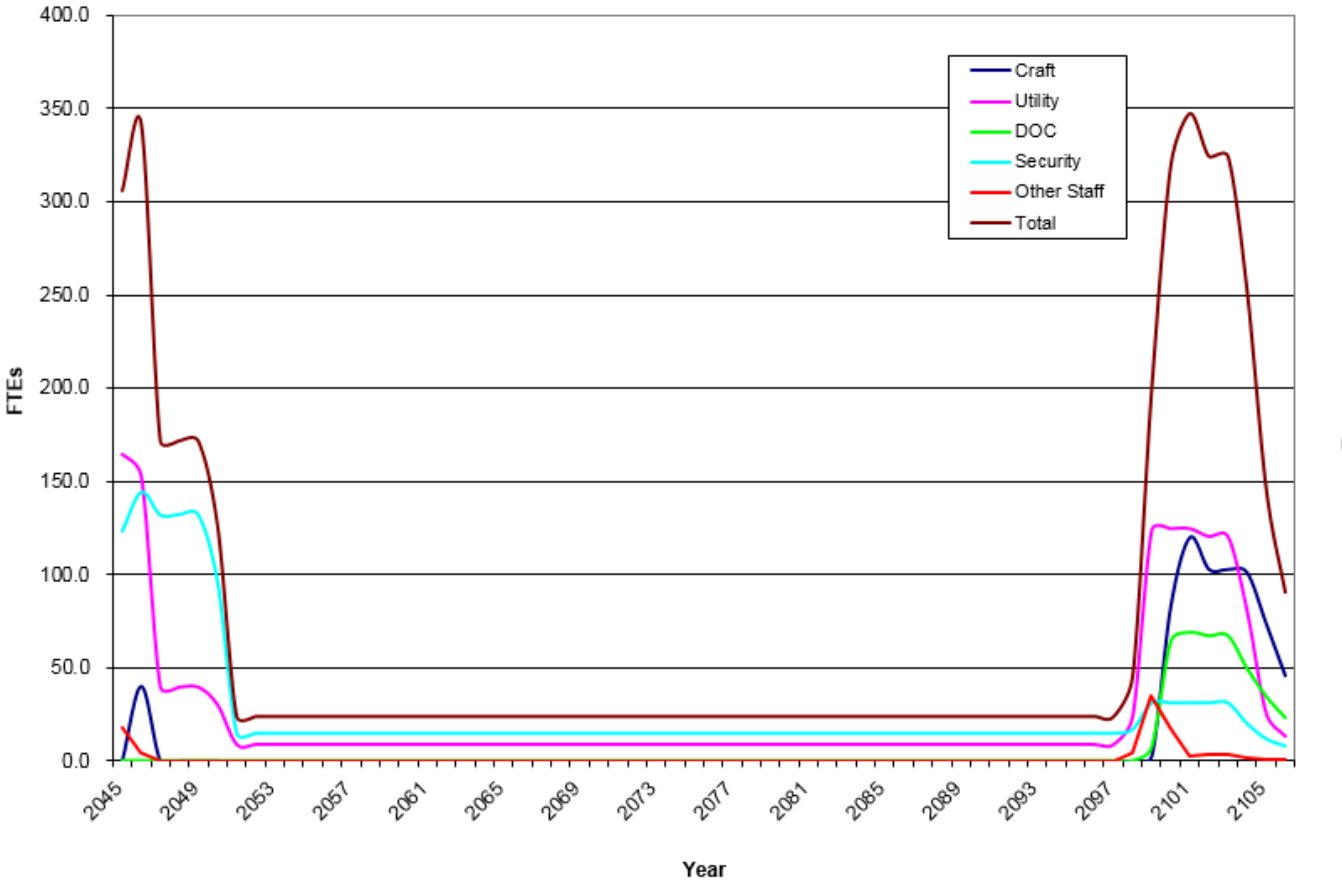
Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045-97	0	0	0	0	0	0
2098	84	0	0	0	0	84
2099	775	0	0	0	0	775
2100	1,690	69	0	0	0	1,759
2101	1,676	107	0	0	0	1,784
2102	1,325	71	0	0	0	1,396
2103	1,325	71	0	0	0	1,396
2104	555	30	0	0	0	585
2105	13,680	9,970	197	0	1,482	25,328
2106	11,415	8,319	164	0	1,237	21,135
Total	32,525	18,639	361	0	2,719	54,243

FIGURE 3.1
DECOMMISSIONING PERSONNEL LEVELS
DECON



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

FIGURE 3.2
DECOMMISSIONING PERSONNEL LEVELS
SAFSTOR



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

4. SCHEDULE ESTIMATE

The schedules for the decommissioning scenarios considered in this study follow the sequences presented in the AIF/NESP-036 study, with minor changes to reflect recent experience and site-specific constraints. In addition, the scheduling has been revised to reflect the spent fuel management plan described in Section 3.4.1.

A schedule or sequence of activities for the DECON alternative is presented in Figure 4.1. The scheduling sequence assumes that fuel is removed from the spent fuel pool within five and one-half years. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the cost tables, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project Professional" computer software.[36]

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.

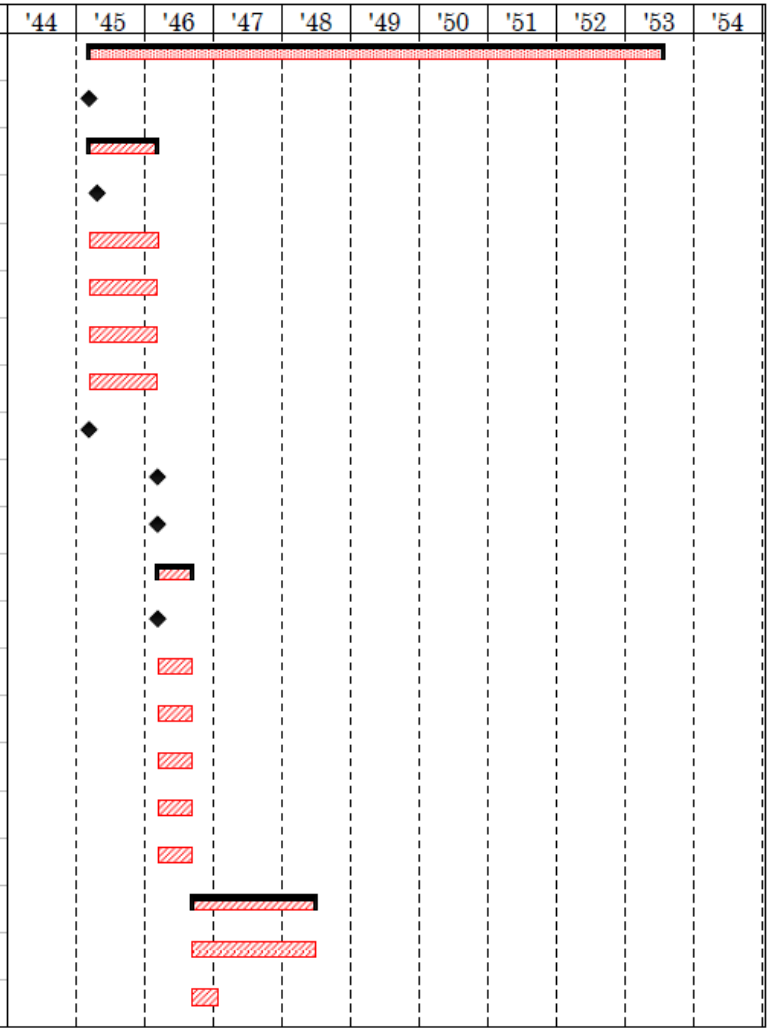
4.2 PROJECT SCHEDULE

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 2045 shutdown date. The fuel pool is emptied approximately five and one-half years after shutdown. Deferred decommissioning in the SAFSTOR scenarios is assumed to commence so that the operating license is terminated within a 60-year period from the cessation of plant operations.

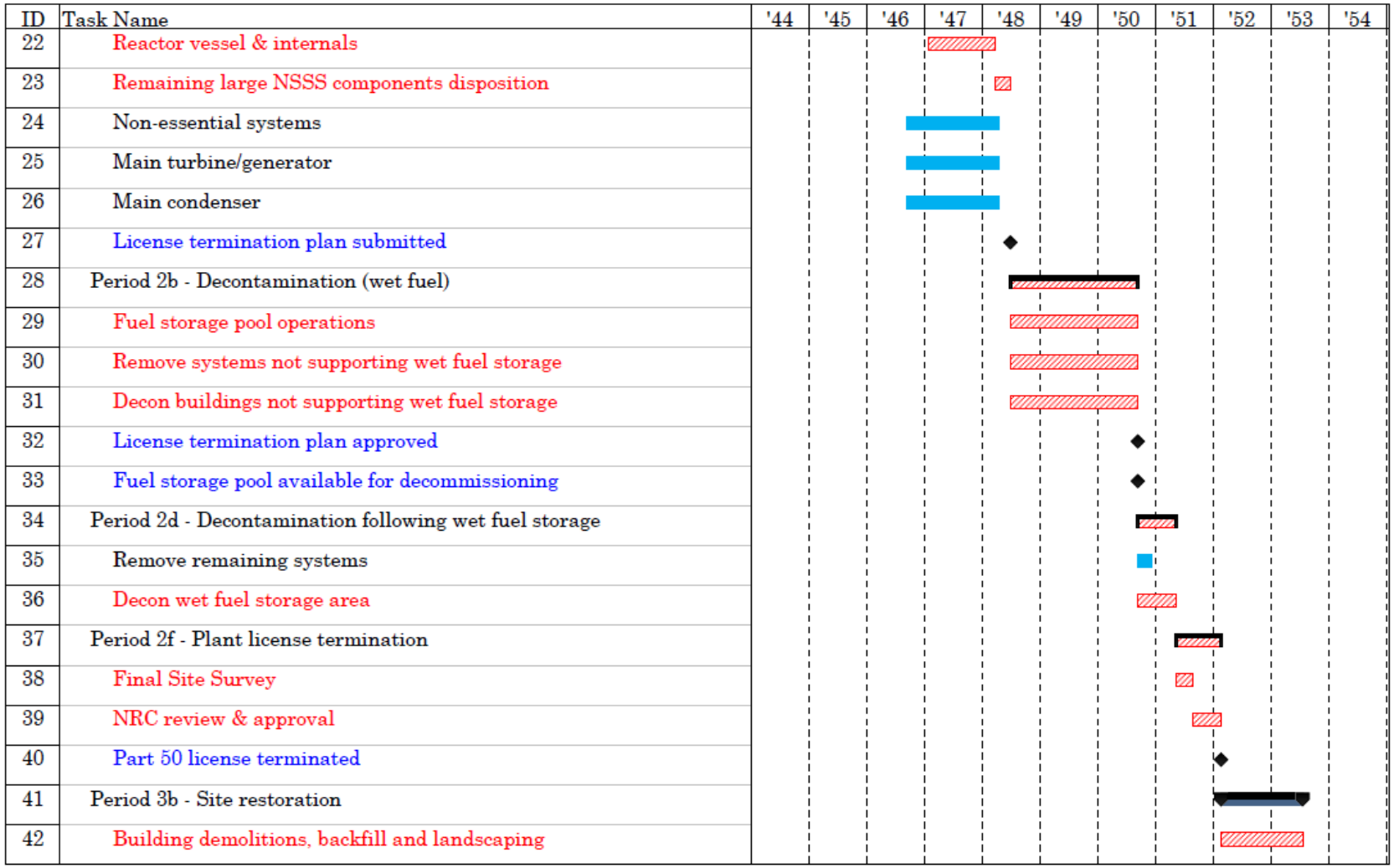
FIGURE 4.1
ACTIVITY SCHEDULE

ID	Task Name
1	Wolf Creek Decon Project Schedule
2	Shutdown plant
3	Period 1a - Shutdown through transition
4	Certificate of permanent cessation of operations submitted
5	Fuel storage pool operations
6	Reconfigure plant
7	Prepare activity specifications
8	Perform site characterization
9	Written certificate of permanent removal of fuel submitted
10	PSDAR submitted
11	Site specific decommissioning cost estimate submitted
12	Period 1b - Decommissioning preparations
13	DOC staff mobilized
14	Fuel storage pool operations
15	Reconfigure plant (continued)
16	Prepare detailed work procedures
17	Decon NSSS
18	Isolate spent fuel pool
19	Period 2a - Large component removal
20	Fuel storage pool operations
21	Preparation for reactor vessel removal



Red text indicates critical path activities
Blue text indicates milestones

FIGURE 4.1
ACTIVITY SCHEDULE
(continued)



Red text indicates critical path activities
Blue text indicates milestones

FIGURE 4.2
DECOMMISSIONING TIMELINE
DECON ALTERNATIVE
(not to scale)

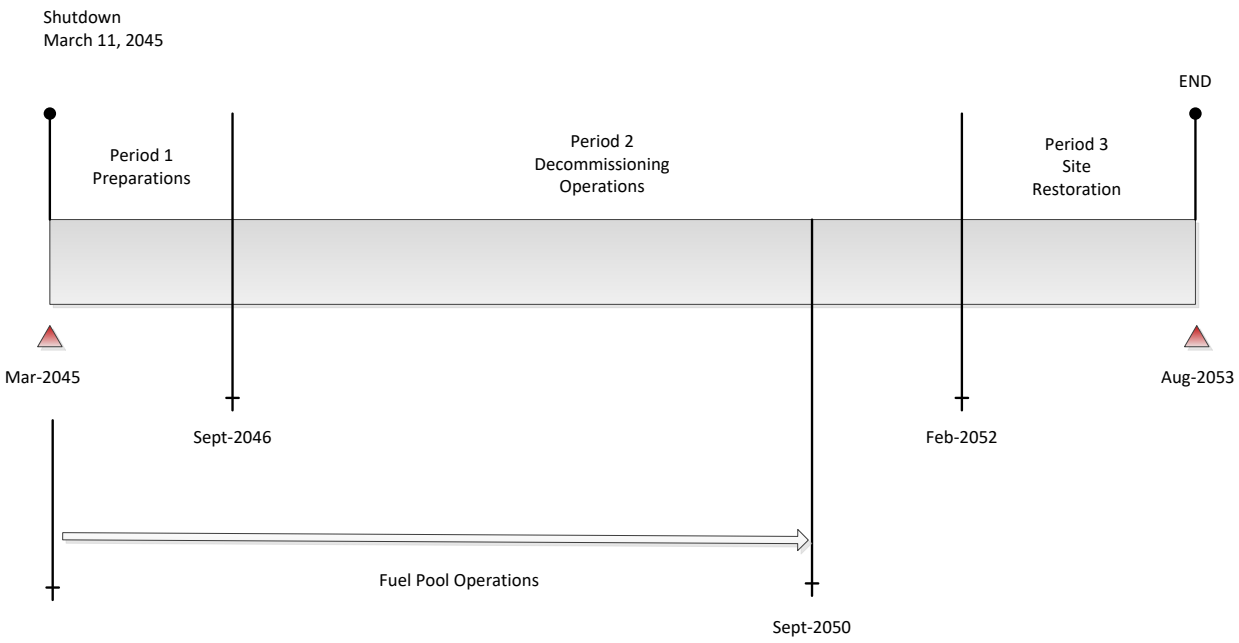
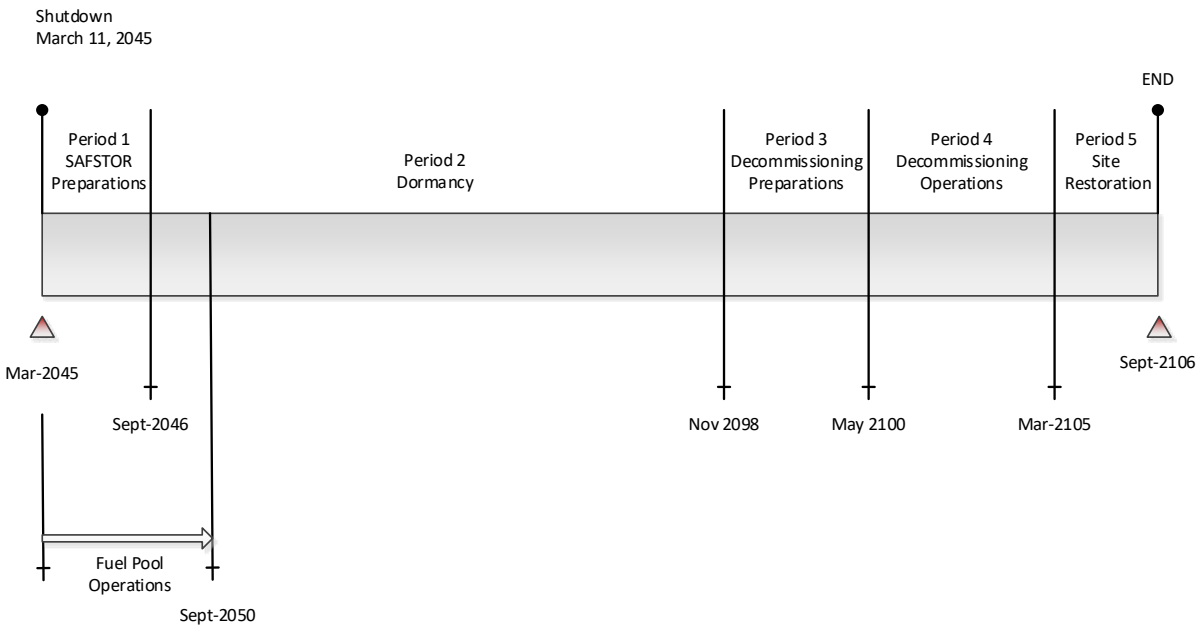


FIGURE 4.3
DECOMMISSIONING TIMELINE
SAFSTOR ALTERNATIVE
(not to scale)



5. RADIOACTIVE WASTES

The objectives of the decommissioning process are the removal of all radioactive material from the site that would restrict its future use and the termination of the NRC license. This currently requires the remediation of all radioactive material at the site in excess of applicable legal limits. Under the Atomic Energy Act,[37] 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 49 CFR §173.411). For this study, commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations.

The destinations for the various waste streams from decommissioning are identified in Figures 5.1 and 5.2. The volumes of radioactive waste generated during the various decommissioning activities at the site are shown on a line-item basis in Appendices 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 station is primarily generated during Period 2 of DECON and Period 4 of SAFSTOR. Material that is considered potentially contaminated when removed from the radiological controlled area is sent to processing facilities in Tennessee for conditioning and disposal. Heavily contaminated components and activated materials are routed for controlled disposal. The disposal volumes reported in the tables reflect the savings resulting from reprocessing and recycling.

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

Since Energy*Solutions* is not currently able to receive the more highly radioactive components generated in the decontamination and dismantling of the nuclear steam supply system, disposal costs for the Class B and C material were based preliminary and indicative rates for WCS's Andrews County disposal facility.

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

FIGURE 5.1
RADIOACTIVE WASTE DISPOSITION

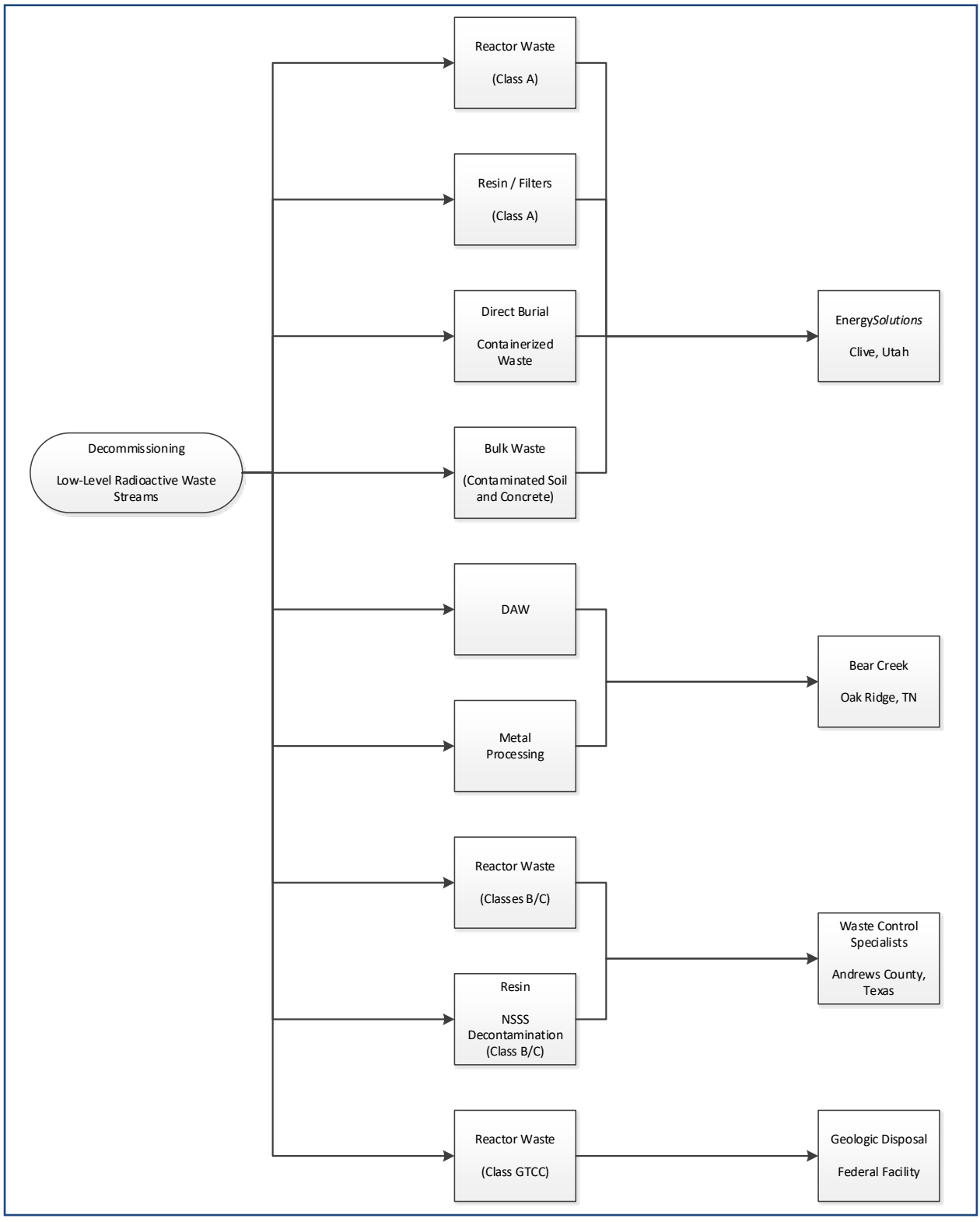


FIGURE 5.2
DECOMMISSIONING WASTE DESTINATIONS
RADIOLOGICAL

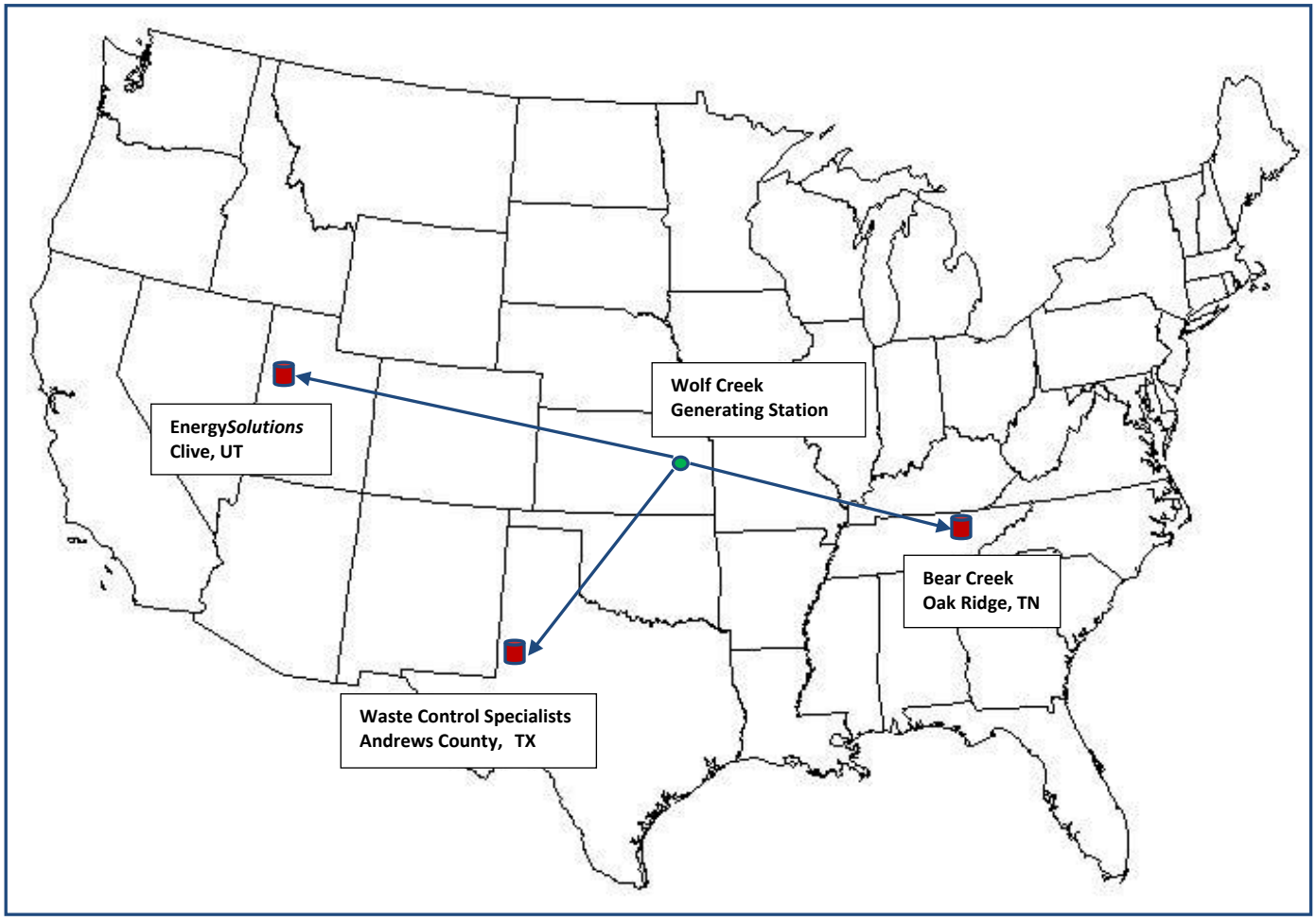


TABLE 5.1
DECON ALTERNATIVE
DECOMMISSIONING WASTE SUMMARY

Waste	Cost Basis	Class [1]	Waste Volume (cubic feet)	Mass (pounds)
Low-Level Radioactive Waste (near-surface disposal)	Energy*Solutions*	A	187,840	11,878,919
	WCS	B	1,750	191,469
	WCS	C	393	47,411
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,217	433,180
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	254,732	9,940,690
Totals [2]			446,931	22,491,670

[1] Waste is classified according to the requirements as delineated in Title 10 CFR, Part 61.55
[2] Columns may not add due to rounding

TABLE 5.2
SAFSTOR ALTERNATIVE
DECOMMISSIONING WASTE SUMMARY

Waste	Cost Basis	Class [1]	Waste Volume (cubic feet)	Mass (pounds)
Low-Level Radioactive Waste (near-surface disposal)	Energy*Solutions*	A	153,674	9,409,645
	WCS	B	501	50,254
	WCS	C	393	47,411
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,217	433,180
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	282,530	11,104,170
Totals [2]			439,314	21,044,660

[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 Wolf Creek relied upon the site-specific, technical information developed for a previous analysis prepared in 2014. While not an engineering study, the estimates provide the operator and the plant owners with sufficient information to assess their financial obligations, as they pertain to the eventual decommissioning of the nuclear station.

The estimates are based on numerous fundamental assumptions that consider current regulations, low-level radioactive waste disposal options, spent fuel management requirements, site restoration practices, and project contingencies. The estimates incorporate a minimum cooling period of approximately five and one-half years for the spent fuel that resides in the plant's wet storage pool when operations cease. During this period, it is assumed that the DOE will complete the transfer of the spent fuel from the site to a federal facility.

The cost projected to promptly decommission (DECON) Wolf Creek is estimated to be $813.7 million. The majority of this cost (approximately 87.4%) is associated with the physical decontamination and dismantling of the nuclear station so that the operating license can be terminated. Another 5.9% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 6.7% 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 $1,093.1 million. The majority of this cost (approximately 89.7%) is associated with placing the station in storage, ongoing caretaking of the station during dormancy, and the eventual physical decontamination and dismantling of the nuclear station so that the operating license can be terminated. Another 5.3% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 5.0% 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 WCNOC will oversee the decommissioning program, using a DOC to manage the decommissioning labor force and the associated subcontractors. The size and composition of the management organization varies with the decommissioning phase and associated site activities.

However, once the operating license is terminated, the staff is substantially reduced for the conventional demolition and restoration of the site (for the DECON alternative).

As described in this report, the spent fuel pool will remain operational for a minimum of five and one-half years following the cessation of operations. The pool will be isolated and an independent spent fuel island created. This will allow decommissioning operations to proceed in and around the pool area. Over the five and one-half year period, the spent fuel will be packaged into 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 requiring controlled disposal is at licensed facility (e.g., Energy*Solutions*' or equivalent). 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 station.

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 2017 dollars)

Cost Element	Total	Percentage
Decontamination	16,486	2.0
Removal	120,128	14.8
Packaging	24,544	3.0
Transportation	12,533	1.5
Waste Disposal	84,171	10.3
Off-site Waste Processing	24,134	3.0
Program Management [1]	273,568	33.6
Security	115,889	14.2
Corporate Allocations	2,002	0.2
Spent Fuel Pool Isolation	13,445	1.7
Spent Fuel Management - Direct Costs [2]	46,385	5.7
Insurance and Regulatory Fees	19,065	2.3
Energy	14,431	1.8
Characterization and Licensing Surveys	24,313	3.0
Property Taxes	15,363	1.9
Miscellaneous Equipment	7,279	0.9
Total [3]	813,733	100.0

Cost Element	Total	Percentage
License Termination	711,273	87.4
Spent Fuel Management	48,251	5.9
Site Restoration	54,208	6.7
Total [3]	813,733	100.0

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

TABLE 6.2
SAFSTOR ALTERNATIVE
DECOMMISSIONING COST ELEMENTS
(thousands of 2017 dollars)

Cost Element	Total	Percentage
Decontamination	14,346	1.3
Removal	123,154	11.3
Packaging	19,286	1.8
Transportation	9,751	0.9
Waste Disposal	62,163	5.7
Off-site Waste Processing	26,984	2.5
Program Management [1]	366,223	33.5
Security	224,686	20.6
Corporate Allocations	3,292	0.3
Spent Fuel Pool Isolation	13,445	1.2
Spent Fuel Management - Direct Costs [2]	46,385	4.2
Insurance and Regulatory Fees	71,272	6.5
Energy	29,815	2.7
Characterization and Licensing Surveys	24,929	2.3
Property Taxes	33,724	3.1
Miscellaneous Equipment	23,661	2.2
Total [3]	1,093,117	100.0

Cost Element	Total	Percentage
License Termination	980,846	89.7
Spent Fuel Management	58,028	5.3
Site Restoration	54,243	5.0
Total [3]	1,093,117	100.0

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

7. REFERENCES

1. "Decommissioning Cost Analysis for the Wolf Creek Generating Station," Document No. W11-1697-001, Rev. 0, TLG Services, Inc., August 2014

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

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

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

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

6. U.S. Code of Federal Regulations, Title 10, Parts 2, 50 and 51, "Decommissioning of Nuclear Power Reactors," Nuclear Regulatory Commission, 61 Fed. Reg. 39278, July 29, 1996 [Open]

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

8. "Nuclear Waste Policy Act of 1982," 42 U.S. Code 10101, et seq. [Open]

9. Charter of the Blue Ribbon Commission on America's Nuclear Future, "Objectives and Scope of Activities" [Open]

10. "Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy," p. 27, 32, January 2012 [Open]

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

12. United States Court of Appeals for the District of Columbia Circuit, In Re: Aiken County, Et Al., August 2013 [Open]

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13. "Acceptance Priority Ranking & Annual Capacity Report," DOE/RW-0567, July 2004

14. "Report to Congress on the Demonstration of the Interim Storage of Spent Nuclear Fuel from Decommissioned Nuclear Power Reactor Sites" DOE/RW-0596, December 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" [Open]

16. "Low-Level Radioactive Waste Policy Act," Public Law 96-573, 1980 [Open]

17. "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, January 15, 1986 [Open]

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

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

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

21. U.S. Code of Federal Regulations, Title 40, Part 141.66, "Maximum contaminant levels for radionuclides" [Open]

22. "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 [Open]

23. "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," NUREG-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, August 2000 [Open]

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26. "Building Construction Cost Data 2017," RSMeans (From the Gordian Group), Rockland, Massachusetts

27. "Decommissioning of Nuclear Power Reactors," Regulatory Guide 1.184, Nuclear Regulatory Commission, October 2013 [Open]

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

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

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34. 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 [Open Main Report] [Open Appendices]

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APPENDIX A

UNIT COST FACTOR DEVELOPMENT

APPENDIX A
UNIT COST FACTOR DEVELOPMENT

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

1. SCOPE

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

2. CALCULATIONS

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

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

***** Total duration = 11.217 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	$20.56	$691.86
Craftsmen	2.00	11.217	$37.39	$838.81
Foreman	1.00	11.217	$41.07	$460.68
General Foreman	0.25	11.217	$44.42	$124.56
Fire Watch	0.05	11.217	$20.56	$11.53
Health Physics Technician	1.00	11.217	$48.84	$547.84
Total Labor Cost				$2,675.28

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
• Universal Polypropylene Sorbent 50 @ $0.64/sq ft [1]	$32.00
• Tarpaulin, oil resistant, fire retardant 50 @ $0.47/sq ft [2]	$23.50
• Gas torch consumables 1 @ $21.17 x 1 /hr [3]	$21.17
Subtotal cost of equipment and materials	$76.67
Overhead & profit on equipment and materials @ 18.50 %	$14.18
Total costs, equipment & material	$90.85

TOTAL COST:

Removal of contaminated heat exchanger <3000 pounds:	**$2,766.13**
Total labor cost:	$2,675.28
Total equipment/material costs:	$90.85
Total craft labor man-hours required per unit:	81.88

5. NOTES AND REFERENCES

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

- References for equipment & consumables costs:

    1. www.mcmaster.com online catalog, McMaster Carr Spill Control (7193T88)
    2. RSMeans (2017) Division 01 56, Section 13.60-0600, page 23
    3. RSMeans (2017) Division 01 54 33, Section 40-6360, page 718

- Material and consumable costs were adjusted using the regional indices for Emporia, Kansas.

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	0.26
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	2.66
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	3.99
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	8.27
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	15.35
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	20.19
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	29.64
Removal of clean pipe >36 inches diameter, $/linear foot	35.12
Removal of clean valve >2 to 4 inches	54.75
Removal of clean valve >4 to 8 inches	82.70
Removal of clean valve >8 to 14 inches	153.51
Removal of clean valve >14 to 20 inches	201.85
Removal of clean valve >20 to 36 inches	296.44
Removal of clean valve >36 inches	351.19
Removal of clean pipe hanger for small bore piping	21.27
Removal of clean pipe hanger for large bore piping	66.80
Removal of clean pump, <300 pound	144.29
Removal of clean pump, 300-1000 pound	405.30
Removal of clean pump, 1000-10,000 pound	1,556.09
Removal of clean pump, >10,000 pound	3,026.06
Removal of clean pump motor, 300-1000 pound	165.70
Removal of clean pump motor, 1000-10,000 pound	641.11
Removal of clean pump motor, >10,000 pound	1,442.51
Removal of clean heat exchanger <3000 pound	846.90
Removal of clean heat exchanger >3000 pound	2,154.97
Removal of clean feedwater heater/deaerator	5,994.85
Removal of clean moisture separator/reheater	12,217.99
Removal of clean tank, <300 gallons	185.04
Removal of clean tank, 300-3000 gallon	574.34
Removal of clean tank, >3000 gallons, $/square foot surface area	5.04

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean electrical equipment, <300 pound	74.99
Removal of clean electrical equipment, 300-1000 pound	269.78
Removal of clean electrical equipment, 1000-10,000 pound	539.55
Removal of clean electrical equipment, >10,000 pound	1,310.99
Removal of clean electrical transformer < 30 tons	910.47
Removal of clean electrical transformer > 30 tons	2,621.97
Removal of clean standby diesel generator, <100 kW	929.96
Removal of clean standby diesel generator, 100 kW to 1 MW	2,075.72
Removal of clean standby diesel generator, >1 MW	4,297.17
Removal of clean electrical cable tray, $/linear foot	7.28
Removal of clean electrical conduit, $/linear foot	3.20
Removal of clean mechanical equipment, <300 pound	74.99
Removal of clean mechanical equipment, 300-1000 pound	269.78
Removal of clean mechanical equipment, 1000-10,000 pound	539.55
Removal of clean mechanical equipment, >10,000 pound	1,310.99
Removal of clean HVAC equipment, <300 pound	90.68
Removal of clean HVAC equipment, 300-1000 pound	324.16
Removal of clean HVAC equipment, 1000-10,000 pound	646.04
Removal of clean HVAC equipment, >10,000 pound	1,310.99
Removal of clean HVAC ductwork, $/pound	0.27
Removal of contaminated instrument and sampling tubing, $/linear foot	1.00
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	16.21
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	25.54
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	41.86
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	77.54
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	91.96
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	124.55
Removal of contaminated pipe >36 inches diameter, $/linear foot	145.84
Removal of contaminated valve >2 to 4 inches	306.15
Removal of contaminated valve >4 to 8 inches	361.56

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated valve >8 to 14 inches	709.67
Removal of contaminated valve >14 to 20 inches	894.66
Removal of contaminated valve >20 to 36 inches	1,179.75
Removal of contaminated valve >36 inches	1,392.59
Removal of contaminated pipe hanger for small bore piping	101.80
Removal of contaminated pipe hanger for large bore piping	319.02
Removal of contaminated pump, <300 pound	652.86
Removal of contaminated pump, 300-1000 pound	1,494.51
Removal of contaminated pump, 1000-10,000 pound	4,475.05
Removal of contaminated pump, >10,000 pound	10,895.28
Removal of contaminated pump motor, 300-1000 pound	672.15
Removal of contaminated pump motor, 1000-10,000 pound	1,859.76
Removal of contaminated pump motor, >10,000 pound	4,175.77
Removal of contaminated heat exchanger <3000 pound	2,766.13
Removal of contaminated heat exchanger >3000 pound	8,143.01
Removal of contaminated tank, <300 gallons	1,094.05
Removal of contaminated tank, >300 gallons, $/square foot	20.31
Removal of contaminated electrical equipment, <300 pound	484.52
Removal of contaminated electrical equipment, 300-1000 pound	1,187.87
Removal of contaminated electrical equipment, 1000-10,000 pound	2,290.07
Removal of contaminated electrical equipment, >10,000 pound	4,544.55
Removal of contaminated electrical cable tray, $/linear foot	23.53
Removal of contaminated electrical conduit, $/linear foot	12.77
Removal of contaminated mechanical equipment, <300 pound	538.22
Removal of contaminated mechanical equipment, 300-1000 pound	1,308.86
Removal of contaminated mechanical equipment, 1000-10,000 pound	2,519.06
Removal of contaminated mechanical equipment, >10,000 pound	4,544.55
Removal of contaminated HVAC equipment, <300 pound	538.22
Removal of contaminated HVAC equipment, 300-1000 pound	1,308.86
Removal of contaminated HVAC equipment, 1000-10,000 pound	2,519.06

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated HVAC equipment, >10,000 pound	4,544.55
Removal of contaminated HVAC ductwork, $/pound	1.60
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	2.51
Additional decontamination of surface by washing, $/square foot	5.25
Additional decontamination of surfaces by hydrolasing, $/square foot	24.42
Decontamination rig hook up and flush, $/ 250 foot length	4,477.76
Chemical flush of components/systems, $/gallon	21.64
Removal of clean standard reinforced concrete, $/cubic yard	66.27
Removal of grade slab concrete, $/cubic yard	75.32
Removal of clean concrete floors, $/cubic yard	307.36
Removal of sections of clean concrete floors, $/cubic yard	873.10
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	95.43
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	1,621.76
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	129.29
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	2,141.37
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cubic yard	355.85
Removal of below-grade suspended floors, $/cubic yard	181.13
Removal of clean monolithic concrete structures, $/cubic yard	680.04
Removal of contaminated monolithic concrete structures, $/cubic yard	1,603.30
Removal of clean foundation concrete, $/cubic yard	539.47
Removal of contaminated foundation concrete, $/cubic yard	1,494.90
Explosive demolition of bulk concrete, $/cubic yard	39.35
Removal of clean hollow masonry block wall, $/cubic yard	23.17
Removal of contaminated hollow masonry block wall, $/cubic yard	60.60
Removal of clean solid masonry block wall, $/cubic yard	23.17
Removal of contaminated solid masonry block wall, $/cubic yard	60.60
Backfill of below-grade voids, $/cubic yard	31.73
Removal of subterranean tunnels/voids, $/linear foot	82.06
Placement of concrete for below-grade voids, $/cubic yard	146.85
Excavation of clean material, $/cubic yard	2.81

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Excavation of contaminated material, $/cubic yard	35.81
Removal of clean concrete rubble (tipping fee included), $/cubic yard	24.27
Removal of contaminated concrete rubble, $/cubic yard	22.94
Removal of building by volume, $/cubic foot	0.26
Removal of clean building metal siding, $/square foot	0.93
Removal of contaminated building metal siding, $/square foot	3.46
Removal of standard asphalt roofing, $/square foot	1.21
Removal of transite panels, $/square foot	1.49
Scarifying contaminated concrete surfaces (drill & spall), $/square foot	10.15
Scabbling contaminated concrete floors, $/square foot	5.60
Scabbling contaminated concrete walls, $/square foot	14.25
Scabbling contaminated ceilings, $/square foot	48.40
Scabbling structural steel, $/square foot	4.67
Removal of clean overhead crane/monorail < 10 ton capacity	394.64
Removal of contaminated overhead crane/monorail < 10 ton capacity	1,242.95
Removal of clean overhead crane/monorail >10-50 ton capacity	947.13
Removal of contaminated overhead crane/monorail >10-50 ton capacity	2,982.57
Removal of polar crane > 50 ton capacity	4,027.16
Removal of gantry crane > 50 ton capacity	16,387.31
Removal of structural steel, $/pound	0.14
Removal of clean steel floor grating, $/square foot	3.29
Removal of contaminated steel floor grating, $/square foot	10.07
Removal of clean free standing steel liner, $/square foot	7.56
Removal of contaminated free standing steel liner, $/square foot	23.55
Removal of clean concrete-anchored steel liner, $/square foot	3.78
Removal of contaminated concrete-anchored steel liner, $/square foot	27.49
Placement of scaffolding in clean areas, $/square foot	14.44
Placement of scaffolding in contaminated areas, $/square foot	21.21
Landscaping with topsoil, $/acre	24,013.40
Cost of CPC B-88 LSA box & preparation for use	2,083.45

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	1,958.03
Cost of CPC B-12V 12 gauge LSA box & preparation for use	1,540.78
Cost of CPC B-144 LSA box & preparation for use	10,871.54
Cost of LSA drum & preparation for use	194.02
Cost of cask liner for CNSI 8 120A cask (resins)	12,196.03
Cost of cask liner for CNSI 8 120A cask (filters)	8,614.99
Decontamination of surfaces with vacuuming, $/square foot	0.59

APPENDIX C

DETAILED COST ANALYSIS

DECON

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2017 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	-	-	-	-	-	-	152	23	175	175	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	234	35	269	269	-	-	-	-	-	-	-	-	-	2,000
1a.1.7	Review plant dwgs & specs.	-	-	-	-	-	-	538	81	618	618	-	-	-	-	-	-	-	-	-	4,600
1a.1.8	Perform detailed rad survey									a											
1a.1.9	Estimate by-product inventory	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
1a.1.10	End product description	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	Detailed by-product inventory	-	-	-	-	-	-	152	23	175	175	-	-	-	-	-	-	-	-	-	1,300
1a.1.12	Define major work sequence	-	-	-	-	-	-	877	131	1,008	1,008	-	-	-	-	-	-	-	-	-	7,500
1a.1.13	Perform SER and EA	-	-	-	-	-	-	362	54	417	417	-	-	-	-	-	-	-	-	-	3,100
1a.1.14	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	877	131	1,008	1,008	-	-	-	-	-	-	-	-	-	7,500
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	584	88	672	672	-	-	-	-	-	-	-	-	-	5,000
1a.1.16	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
1a.1.17.1	Plant & temporary facilities	-	-	-	-	-	-	575	86	661	595	-	66	-	-	-	-	-	-	-	4,920
1a.1.17.2	Plant systems	-	-	-	-	-	-	487	73	560	504	-	56	-	-	-	-	-	-	-	4,167
1a.1.17.3	NSSS Decontamination Flush	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	500
1a.1.17.4	Reactor internals	-	-	-	-	-	-	830	124	954	954	-	-	-	-	-	-	-	-	-	7,100
1a.1.17.5	Reactor vessel	-	-	-	-	-	-	760	114	874	874	-	-	-	-	-	-	-	-	-	6,500
1a.1.17.6	Biological shield	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	500
1a.1.17.7	Steam generators	-	-	-	-	-	-	365	55	419	419	-	-	-	-	-	-	-	-	-	3,120
1a.1.17.8	Reinforced concrete	-	-	-	-	-	-	187	28	215	108	-	108	-	-	-	-	-	-	-	1,600
1a.1.17.9	Main Turbine	-	-	-	-	-	-	47	7	54	-	-	54	-	-	-	-	-	-	-	400
1a.1.17.10	Main Condensers	-	-	-	-	-	-	47	7	54	-	-	54	-	-	-	-	-	-	-	400
1a.1.17.11	Plant structures & buildings	-	-	-	-	-	-	365	55	419	210	-	210	-	-	-	-	-	-	-	3,120
1a.1.17.12	Waste management	-	-	-	-	-	-	538	81	618	618	-	-	-	-	-	-	-	-	-	4,600
1a.1.17.13	Facility & site closeout	-	-	-	-	-	-	105	16	121	60	-	60	-	-	-	-	-	-	-	900
1a.1.17	Total	-	-	-	-	-	-	4,421	663	5,084	4,477	-	607	-	-	-	-	-	-	-	37,827
Planning & Site Preparations																					
1a.1.18	Prepare dismantling sequence	-	-	-	-	-	-	281	42	323	323	-	-	-	-	-	-	-	-	-	2,400
1a.1.19	Plant prep. & temp. svces	-	-	-	-	-	-	3,300	495	3,795	3,795	-	-	-	-	-	-	-	-	-	-
1a.1.20	Design water clean-up system	-	-	-	-	-	-	164	25	188	188	-	-	-	-	-	-	-	-	-	1,400
1a.1.21	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,300	345	2,645	2,645	-	-	-	-	-	-	-	-	-	-
1a.1.22	Procure casks/liners & containers	-	-	-	-	-	-	144	22	165	165	-	-	-	-	-	-	-	-	-	1,230
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	14,735	2,210	16,945	16,338	-	607	-	-	-	-	-	-	-	78,157
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	1,134	170	1,304	-	1,304	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	1,134	170	1,304	-	1,304	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	3,754	375	4,130	4,130	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	2,274	227	2,502	2,502	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	515	-	-	-	-	-	129	644	644	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	567	-	-	-	-	-	85	652	652	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	13	3	-	33	-	10	59	59	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	2,111	317	2,428	2,428	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	1,110	111	1,221	1,221	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,225	122	1,347	-	1,347	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	333	50	383	383	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	803	120	923	-	923	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	103	15	119	-	119	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate Allocations	-	-	-	-	-	-	357	54	411	411	-	-	-	-	-	-	-	-	-	-
1a.4.13	NEI Annual Fees	-	-	-	-	-	-	530	79	609	609	-	-	-	-	-	-	-	-	-	-
1a.4.14	Security Staff Cost	-	-	-	-	-	-	19,401	2,910	22,311	22,311	-	-	-	-	-	-	-	-	-	316,295
1a.4.15	Utility Staff Cost	-	-	-	-	-	-	28,719	4,308	33,027	33,027	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,083	13	3	-	33	60,721	8,914	70,766	68,377	2,389	-	-	610	-	-	-	12,190	20	738,535
1a.0	TOTAL PERIOD 1a COST	-	1,083	13	3	-	33	76,590	11,294	89,016	84,715	3,694	607	-	610	-	-	-	12,190	20	816,691

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2017 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 1b - Decommissioning Preparations																					
Period 1b Direct Decommissioning Activities																					
Detailed Work Procedures																					
1b.1.1.1	Plant systems	-	-	-	-	-	-	553	83	636	573	-	64	-	-	-	-	-	-	-	4,733
1b.1.1.2	NSSS Decontamination Flush	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.3	Reactor internals	-	-	-	-	-	-	292	44	336	336	-	-	-	-	-	-	-	-	-	2,500
1b.1.1.4	Remaining buildings	-	-	-	-	-	-	158	24	181	45	-	136	-	-	-	-	-	-	-	1,350
1b.1.1.5	CRD cooling assembly	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.6	CRD housings & ICI tubes	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.7	Incore instrumentation	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.8	Reactor vessel	-	-	-	-	-	-	424	64	488	488	-	-	-	-	-	-	-	-	-	3,630
1b.1.1.9	Facility closeout	-	-	-	-	-	-	140	21	161	81	-	81	-	-	-	-	-	-	-	1,200
1b.1.1.10	Missile shields	-	-	-	-	-	-	53	8	60	60	-	-	-	-	-	-	-	-	-	450
1b.1.1.11	Biological shield	-	-	-	-	-	-	140	21	161	161	-	-	-	-	-	-	-	-	-	1,200
1b.1.1.12	Steam generators	-	-	-	-	-	-	538	81	618	618	-	-	-	-	-	-	-	-	-	4,600
1b.1.1.13	Reinforced concrete	-	-	-	-	-	-	117	18	134	67	-	67	-	-	-	-	-	-	-	1,000
1b.1.1.14	Main Turbine	-	-	-	-	-	-	182	27	210	-	-	210	-	-	-	-	-	-	-	1,560
1b.1.1.15	Main Condensers	-	-	-	-	-	-	182	27	210	-	-	210	-	-	-	-	-	-	-	1,560
1b.1.1.16	Auxiliary building	-	-	-	-	-	-	319	48	367	330	-	37	-	-	-	-	-	-	-	2,730
1b.1.1.17	Reactor building	-	-	-	-	-	-	319	48	367	330	-	37	-	-	-	-	-	-	-	2,730
1b.1.1	Total	-	-	-	-	-	-	3,885	583	4,468	3,628	-	840	-	-	-	-	-	-	-	33,243
1b.1.2	Decon primary loop	721	-	-	-	-	-	-	361	1,082	1,082	-	-	-	-	-	-	-	-	1,067	-
1b.1	Subtotal Period 1b Activity Costs	721	-	-	-	-	-	3,885	943	5,550	4,710	-	840	-	-	-	-	-	-	1,067	33,243
Period 1b Additional Costs																					
1b.2.1	Spent fuel pool isolation	-	-	-	-	-	-	11,691	1,754	13,445	13,445	-	-	-	-	-	-	-	-	-	-
1b.2.2	Site Characterization	-	-	-	-	-	-	2,984	895	3,880	3,880	-	-	-	-	-	-	-	-	19,100	7,852
1b.2.3	Misc/Hazardous Waste	-	-	76	20	16	-	-	13	125	125	-	-	2,151	-	-	-	-	137,800	740	-
1b.2	Subtotal Period 1b Additional Costs	-	-	76	20	16	-	14,676	2,662	17,449	17,449	-	-	2,151	-	-	-	-	137,800	19,840	7,852
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	973	-	-	-	-	-	-	146	1,119	1,119	-	-	-	-	-	-	-	-	-	-
1b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,323	198	1,521	1,521	-	-	-	-	-	-	-	-	-	-
1b.3.3	Process decommissioning water waste	45	-	29	70	-	129	-	68	341	341	-	-	-	283	-	-	-	16,989	55	-
1b.3.4	Process decommissioning chemical flush waste	2	-	77	278	-	3,307	-	877	4,542	4,542	-	-	-	-	788	-	-	83,917	147	-
1b.3.5	Small tool allowance	-	2	-	-	-	-	-	0	2	2	-	-	-	-	-	-	-	-	-	-
1b.3.6	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-
1b.3.7	Decon rig	2,015	-	-	-	-	-	-	302	2,317	2,317	-	-	-	-	-	-	-	-	-	-
1b.3.8	Spent Fuel Capital and Transfer	-	-	-	-	-	-	3,025	454	3,478	-	3,478	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	3,034	1,202	106	348	-	3,437	4,347	2,226	14,700	11,222	3,478	-	-	283	788	-	-	100,906	203	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	36	-	-	-	-	-	-	9	44	44	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	1,893	189	2,082	2,082	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	1,147	115	1,261	1,261	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	295	-	-	-	-	-	74	369	369	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	286	-	-	-	-	-	43	329	329	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	8	2	-	19	-	6	35	35	-	-	-	360	-	-	-	7,197	12	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	2,129	319	2,448	2,448	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	323	32	355	355	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	618	62	679	-	679	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	405	61	465	-	465	-	-	-	-	-	-	-	-	-
1b.4.11	ISFSI Operating Costs	-	-	-	-	-	-	52	8	60	-	60	-	-	-	-	-	-	-	-	-
1b.4.12	Corporate Allocations	-	-	-	-	-	-	181	27	208	208	-	-	-	-	-	-	-	-	-	-
1b.4.13	NEI Annual Fees	-	-	-	-	-	-	267	40	307	307	-	-	-	-	-	-	-	-	-	-
1b.4.14	Security Staff Cost	-	-	-	-	-	-	9,577	1,437	11,014	11,014	-	-	-	-	-	-	-	-	-	156,018
1b.4.15	DOC Staff Cost	-	-	-	-	-	-	5,350	803	6,153	6,153	-	-	-	-	-	-	-	-	-	63,961
1b.4.16	Utility Staff Cost	-	-	-	-	-	-	14,551	2,183	16,733	16,733	-	-	-	-	-	-	-	-	-	213,904
1b.4	Subtotal Period 1b Period-Dependent Costs	36	581	8	2	-	19	36,491	5,406	42,543	41,339	1,204	-	-	360	-	-	-	7,197	12	433,883
1b.0	TOTAL PERIOD 1b COST	3,791	1,783	189	370	16	3,456	59,399	11,238	80,243	74,719	4,683	840	2,151	643	788	-	-	245,903	21,120	474,978
PERIOD 1 TOTALS		3,791	2,865	202	373	16	3,489	135,989	22,532	169,259	159,435	8,376	1,448	2,151	1,253	788	-	-	258,093	21,140	1,291,669

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2017 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 2a - Large Component Removal																					
Period 2a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
2a.1.1.1	Reactor Coolant Piping	129	140	42	49	-	542	-	247	1,149	1,149	-	-	-	2,046	-	-	-	142,726	6,863	-
2a.1.1.2	Pressurizer Relief Tank	22	18	12	14	-	153	-	57	276	276	-	-	-	578	-	-	-	40,338	1,077	-
2a.1.1.3	Reactor Coolant Pumps & Motors	72	74	123	213	-	1,061	-	364	1,906	1,906	-	-	-	3,386	-	-	-	816,140	4,188	100
2a.1.1.4	Pressurizer	35	37	602	159	-	1,171	-	404	2,407	2,407	-	-	-	3,739	-	-	-	293,734	2,534	1,875
2a.1.1.5	Steam Generators	274	5,183	3,875	3,165	2,688	7,273	-	4,516	26,974	26,974	-	-	40,845	23,217	-	-	-	3,577,181	30,060	5,750
2a.1.1.6	CRDMs/ICIs/Service Structure Removal	109	202	256	53	-	639	-	298	1,557	1,557	-	-	-	4,534	-	-	-	168,041	8,136	-
2a.1.1.7	Reactor Vessel Internals	98	6,706	9,397	1,492	-	14,843	396	15,282	48,214	48,214	-	-	-	1,878	963	393	-	329,968	34,307	1,531
2a.1.1.8	Vessel & Internals GTCC Disposal	-	-	-	-	-	11,615	-	1,742	13,357	13,357	-	-	-	-	-	-	2,217	433,180	-	-
2a.1.1.9	Reactor Vessel	78	8,230	2,820	1,180	-	4,491	396	9,516	26,711	26,711	-	-	-	13,554	-	-	-	972,836	34,307	1,531
2a.1.1	Totals	817	20,590	17,125	6,325	2,688	41,788	793	32,426	122,551	122,551	-	-	40,845	52,932	963	393	2,217	6,774,144	121,472	10,786
Removal of Major Equipment																					
2a.1.2	Main Turbine/Generator	-	336	419	75	619	615	-	384	2,449	2,449	-	-	4,844	2,698	-	-	-	462,027	9,734	-
2a.1.3	Main Condensers	-	936	241	85	738	776	-	576	3,353	3,353	-	-	7,701	3,216	-	-	-	550,847	27,762	-
Cascading Costs from Clean Building Demolition																					
2a.1.4.1	Reactor	-	443	-	-	-	-	-	66	510	510	-	-	-	-	-	-	-	-	4,871	-
2a.1.4.2	Auxiliary	-	229	-	-	-	-	-	34	264	264	-	-	-	-	-	-	-	-	2,194	-
2a.1.4.3	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	7	-
2a.1.4.4	Radwaste	-	44	-	-	-	-	-	7	51	51	-	-	-	-	-	-	-	-	387	-
2a.1.4.5	Fuel Building	-	97	-	-	-	-	-	15	112	112	-	-	-	-	-	-	-	-	773	-
2a.1.4	Totals	-	815	-	-	-	-	-	122	937	937	-	-	-	-	-	-	-	-	8,233	-
Disposal of Plant Systems																					
2a.1.5.1	AB - Main Steam	-	163	-	-	-	-	-	24	187	-	-	187	-	-	-	-	-	-	5,833	-
2a.1.5.2	AB - Main Steam RCA	-	60	4	11	186	-	-	45	305	305	-	-	2,156	-	-	-	-	87,550	1,515	-
2a.1.5.3	AC - Main Turbine	-	163	-	-	-	-	-	24	187	-	-	187	-	-	-	-	-	-	5,641	-
2a.1.5.4	AD - Condensate	-	181	-	-	-	-	-	27	208	-	-	208	-	-	-	-	-	-	6,144	-
2a.1.5.5	AE - Feedwater	-	123	-	-	-	-	-	19	142	-	-	142	-	-	-	-	-	-	4,271	-
2a.1.5.6	AF - Feedwater Hter Extrction, Drn & Vnt	-	152	-	-	-	-	-	23	175	-	-	175	-	-	-	-	-	-	5,352	-
2a.1.5.7	AK - Condensate Demineralizer	-	56	-	-	-	-	-	8	65	-	-	65	-	-	-	-	-	-	1,944	-
2a.1.5.8	AL - Auxiliary Feedwater	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	1,174	-
2a.1.5.9	AL-Auxiliary Feedwater Surge Tanks	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	72	-
2a.1.5.10	AQ - Condensate & Feedwater Chem Additn	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	468	-
2a.1.5.11	AX - Acid Feed	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	754	-
2a.1.5.12	Auxiliary Bldg Non-System Specific	-	85	7	6	41	68	-	46	253	253	-	-	474	282	-	-	-	37,164	2,282	-
2a.1.5.13	Auxiliary Bldg Non-System Specific RCA	-	537	13	38	660	-	-	240	1,487	1,487	-	-	7,629	-	-	-	-	309,812	13,471	-
2a.1.5.14	BL - Reactor Makeup Water	-	223	23	21	167	207	-	138	779	779	-	-	1,928	850	-	-	-	132,796	5,872	-
2a.1.5.15	BM - Steam Generator Blowdown	-	452	8	26	446	-	-	185	1,118	1,118	-	-	5,160	-	-	-	-	209,560	11,982	-
2a.1.5.16	CA - Steam Seal	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	455	-
2a.1.5.17	CB - Main Turbine Lube Oil	-	38	-	-	-	-	-	6	43	-	-	43	-	-	-	-	-	-	1,207	-
2a.1.5.18	CC - Generator Hydrogen & CO2	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	198	-
2a.1.5.19	CD - Generator Seal Oil	-	8	-	-	-	-	-	1	10	-	-	10	-	-	-	-	-	-	287	-
2a.1.5.20	CE - Stator Cooling Water	-	7	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	241	-
2a.1.5.21	CF - Lube Oil Strg, Xfer & Purification	-	24	-	-	-	-	-	4	28	-	-	28	-	-	-	-	-	-	812	-
2a.1.5.22	CG - Condenser Air Removal	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	657	-
2a.1.5.23	CH - Main Turbine Control Oil	-	39	-	-	-	-	-	6	45	-	-	45	-	-	-	-	-	-	1,219	-
2a.1.5.24	CL - Chlorination	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	569	-
2a.1.5.25	CO - Carbon Dioxide	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	121	-
2a.1.5.26	CW - Circulating Water	-	219	-	-	-	-	-	33	252	-	-	252	-	-	-	-	-	-	7,858	-
2a.1.5.27	CZ - Caustic Acid	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	111	-
2a.1.5.28	DA - Circulating Water System	-	223	-	-	-	-	-	33	256	-	-	256	-	-	-	-	-	-	7,953	-
2a.1.5.29	DM - Equipment Drains	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,223	-
2a.1.5.30	DM - Equipment Drains RCA	-	111	26	77	1,336	-	-	242	1,793	1,793	-	-	15,445	-	-	-	-	627,223	2,840	-
2a.1.5.31	EG - Component Cooling Water RCA	-	557	24	70	1,225	-	-	336	2,213	2,213	-	-	14,161	-	-	-	-	575,071	13,646	-
2a.1.5.32	EJ - Residual Heat Removal	-	287	58	46	236	585	-	266	1,477	1,477	-	-	2,727	2,411	-	-	-	264,564	7,897	-
2a.1.5.33	EM - High Pressure Coolant Injection	-	240	18	15	109	158	-	120	660	660	-	-	1,260	648	-	-	-	92,828	6,201	-
2a.1.5.34	EN - Containment Spray	-	170	5	15	262	-	-	84	536	536	-	-	3,026	-	-	-	-	122,874	4,134	-
2a.1.5.35	FB - Auxiliary Steam	-	60	-	-	-	-	-	9	69	-	-	69	-	-	-	-	-	-	2,106	-
2a.1.5.36	FB - Auxiliary Steam RCA	-	66	1	4	71	-	-	28	169	169	-	-	816	-	-	-	-	33,148	1,537	-
2a.1.5.37	FC - Auxiliary Turbines	-	39	-	-	-	-	-	6	45	-	-	45	-	-	-	-	-	-	1,301	-
2a.1.5.38	FE - Auxiliary Steam Chemical Addition	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	105	-
2a.1.5.39	GE - Turbine Bldg HVAC	-	86	-	-	-	-	-	13	99	-	-	99	-	-	-	-	-	-	3,189	-
2a.1.5.40	GF - Miscellaneous Building HVAC	-	26	-	-	-	-	-	4	30	-	-	30	-	-	-	-	-	-	987	-

Table C
Wolf Creek Generating Station
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(thousands of 2017 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)																					
2a.1.5.41	GS - Containment Hydrogen Control	-	58	4	5	57	26	-	31	180	180	-	-	658	104	-	-	-	33,502	1,559	-
2a.1.5.42	HF - Secondary Liquid Waste	547	741	85	73	535	780	-	754	3,515	3,515	-	-	6,186	3,203	-	-	-	456,359	31,896	-
2a.1.5.43	HY - Hydrogen	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	223	-
2a.1.5.44	KH - Service Gas	-	20	-	-	-	-	-	3	23	-	-	23	-	-	-	-	-	-	644	-
2a.1.5.45	LE - Oily Waste	-	74	-	-	-	-	-	11	85	-	-	85	-	-	-	-	-	-	2,575	-
2a.1.5.46	LE - Oily Waste RCA	-	153	3	9	149	-	-	62	376	376	-	-	1,718	-	-	-	-	69,785	3,518	-
2a.1.5.47	NT - Nitrogen	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	149	-
2a.1.5.48	OX - Oxygen	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	171	-
2a.1.5.49	SW - Screen Wash	-	20	-	-	-	-	-	3	23	-	-	23	-	-	-	-	-	-	635	-
2a.1.5.50	Turbine Bldg Non-System Specific	-	471	-	-	-	-	-	71	542	-	-	542	-	-	-	-	-	-	15,405	-
2a.1.5.51	VH - Circ Water & Makeup Water Scrnhs	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	272	-
2a.1.5.52	VV - Misc Bldg HVAC	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	148	-
2a.1.5.53	WG - Gland Water & Motor Cooling Water	-	16	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	593	-
2a.1.5.54	WL - Cooling Lake Makeup & Blowdown	-	22	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	745	-
2a.1.5	Totals	547	6,171	279	414	5,479	1,823	-	2,941	17,656	14,861	-	2,794	63,344	7,498	-	-	-	3,052,234	192,162	-
2a.1.6	Scaffolding in support of decommissioning	-	1,035	29	8	116	26	-	287	1,500	1,500	-	-	1,206	106	-	-	-	61,032	36,964	-
2a.1	Subtotal Period 2a Activity Costs	1,364	29,884	18,094	6,907	9,640	45,029	793	36,736	148,446	145,651	-	2,794	117,940	66,450	963	393	2,217	10,900,280	396,325	10,786
Period 2a Additional Costs																					
2a.2.1	Remedial Action Surveys	-	-	-	-	-	-	1,827	548	2,376	2,376	-	-	-	-	-	-	-	-	37,415	-
2a.2	Subtotal Period 2a Additional Costs	-	-	-	-	-	-	1,827	548	2,376	2,376	-	-	-	-	-	-	-	-	37,415	-
Period 2a Collateral Costs																					
2a.3.1	Process decommissioning water waste	161	-	105	257	-	474	-	248	1,246	1,246	-	-	-	1,037	-	-	-	62,244	202	-
2a.3.2	Process decommissioning chemical flush waste	1	-	26	94	-	216	-	71	408	408	-	-	-	266	-	-	-	28,388	50	-
2a.3.3	Small tool allowance	-	278	-	-	-	-	-	42	319	287	-	32	-	-	-	-	-	-	-	-
2a.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	10,792	1,619	12,411	-	12,411	-	-	-	-	-	-	-	-	-
2a.3.5	On-site survey and release of 115.8 tons clean metallic waste	-	-	-	-	-	-	165	16	181	181	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	162	278	131	351	-	691	10,956	1,996	14,565	2,122	12,411	32	-	1,304	-	-	-	90,632	252	-
Period 2a Period-Dependent Costs																					
2a.4.1	Decon supplies	127	-	-	-	-	-	-	32	159	159	-	-	-	-	-	-	-	-	-	-
2a.4.2	Insurance	-	-	-	-	-	-	1,248	125	1,373	1,373	-	-	-	-	-	-	-	-	-	-
2a.4.3	Property taxes	-	-	-	-	-	-	4,094	409	4,503	4,503	-	-	-	-	-	-	-	-	-	-
2a.4.4	Health physics supplies	-	3,021	-	-	-	-	-	755	3,777	3,777	-	-	-	-	-	-	-	-	-	-
2a.4.5	Heavy equipment rental	-	3,952	-	-	-	-	-	593	4,545	4,545	-	-	-	-	-	-	-	-	-	-
2a.4.6	Disposal of DAW generated	-	-	140	35	-	347	-	106	629	629	-	-	-	6,453	-	-	-	129,051	210	-
2a.4.7	Plant energy budget	-	-	-	-	-	-	3,610	542	4,152	4,152	-	-	-	-	-	-	-	-	-	-
2a.4.8	NRC Fees	-	-	-	-	-	-	1,042	104	1,146	1,146	-	-	-	-	-	-	-	-	-	-
2a.4.9	Emergency Planning Fees	-	-	-	-	-	-	1,262	126	1,388	-	1,388	-	-	-	-	-	-	-	-	-
2a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,445	217	1,661	-	1,661	-	-	-	-	-	-	-	-	-
2a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	186	28	214	-	214	-	-	-	-	-	-	-	-	-
2a.4.12	Corporate Allocations	-	-	-	-	-	-	448	67	516	516	-	-	-	-	-	-	-	-	-	-
2a.4.13	NEI Annual Fees	-	-	-	-	-	-	953	143	1,096	1,096	-	-	-	-	-	-	-	-	-	-
2a.4.14	Security Staff Cost	-	-	-	-	-	-	30,401	4,560	34,961	34,961	-	-	-	-	-	-	-	-	-	493,870
2a.4.15	DOC Staff Cost	-	-	-	-	-	-	23,034	3,455	26,490	26,490	-	-	-	-	-	-	-	-	-	284,544
2a.4.16	Utility Staff Cost	-	-	-	-	-	-	37,595	5,639	43,234	43,234	-	-	-	-	-	-	-	-	-	529,776
2a.4	Subtotal Period 2a Period-Dependent Costs	127	6,974	140	35	-	347	105,318	16,901	129,842	126,579	3,263	-	-	6,453	-	-	-	129,051	210	1,308,190
2a.0	TOTAL PERIOD 2a COST	1,652	37,135	18,365	7,293	9,640	46,067	118,894	56,182	295,229	276,729	15,674	2,826	117,940	74,207	963	393	2,217	11,119,970	434,203	1,318,976
PERIOD 2b - Site Decontamination																					
Period 2b Direct Decommissioning Activities																					
Disposal of Plant Systems																					
2b.1.1.1	AN - Demineralized Wtr Storage & xfer	-	45	-	-	-	-	-	7	51	-	-	51	-	-	-	-	-	-	1,548	-
2b.1.1.2	AN - Demineralized Wtr Strg & xfer RCA	-	15	0	1	10	-	-	5	32	32	-	-	120	-	-	-	-	4,855	334	-
2b.1.1.3	AP - Condensate Storage & Transfer	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	1,660	-
2b.1.1.4	BB - Reactor Coolant	-	226	38	31	151	404	-	189	1,038	1,038	-	-	1,746	1,669	-	-	-	177,118	6,412	-
2b.1.1.5	BG - Chemical & Volume Control	726	721	121	90	424	1,197	-	932	4,210	4,210	-	-	4,899	4,925	-	-	-	513,906	27,846	-
2b.1.1.6	BN - Borated Refueling Water Storage	-	247	20	34	477	129	-	173	1,080	1,080	-	-	5,512	533	-	-	-	257,802	6,939	-
2b.1.1.7	Control Bldg Non-System Specific	-	139	4	11	185	-	-	64	402	402	-	-	2,139	-	-	-	-	86,849	3,413	-
2b.1.1.8	Control Bldg Non-System Specific Cln	-	988	-	-	-	-	-	148	1,137	-	-	1,137	-	-	-	-	-	-	29,076	-
2b.1.1.9	DO - Diesel Oil	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	48	-
2b.1.1.10	EA - Service Water	-	74	-	-	-	-	-	11	85	-	-	85	-	-	-	-	-	-	2,592	-

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DECON Decommissioning Cost Estimate
(thousands of 2017 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)																					
2b.1.1.11	EB - Closed Cooling Water	-	36	-	-	-	-	-	5	42	-	-	42	-	-	-	-	-	-	1,267	-
2b.1.1.12	EF - Essential Service Water	-	108	-	-	-	-	-	16	124	-	-	124	-	-	-	-	-	-	3,800	-
2b.1.1.13	EF - Essential Service Water RCA	-	70	2	7	123	-	-	37	240	240	-	-	1,427	-	-	-	-	57,959	1,734	-
2b.1.1.14	EP - Accumulator Safety Injection	-	124	10	12	136	69	-	71	422	422	-	-	1,568	283	-	-	-	81,940	3,246	-
2b.1.1.15	FA - Auxiliary Steam Generator	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	521	-
2b.1.1.16	FO - Fuel Oil	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	486	-
2b.1.1.17	FP - Fire Protection	-	107	-	-	-	-	-	16	123	-	-	123	-	-	-	-	-	-	3,826	-
2b.1.1.18	FP - Fire Protection RCA	-	150	8	22	389	-	-	100	669	669	-	-	4,492	-	-	-	-	182,411	3,541	-
2b.1.1.19	GA - Plant Heating	-	55	-	-	-	-	-	8	63	-	-	63	-	-	-	-	-	-	1,912	-
2b.1.1.20	GA - Plant Heating RCA	-	92	1	4	64	-	-	33	194	194	-	-	746	-	-	-	-	30,275	2,072	-
2b.1.1.21	GB - Central Chilled Water	-	52	-	-	-	-	-	8	59	-	-	59	-	-	-	-	-	-	1,803	-
2b.1.1.22	GB - Central Chilled Water RCA	-	21	0	1	16	-	-	8	47	47	-	-	187	-	-	-	-	7,591	482	-
2b.1.1.23	GD - Esstl Srvc Wtr Pumphs Bldg HVAC	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	284	-
2b.1.1.24	GH - Radwaste Building HVAC	-	145	6	13	210	24	-	76	474	474	-	-	2,425	98	-	-	-	104,702	3,455	-
2b.1.1.25	GK - Control Building HVAC	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	3,959	-
2b.1.1.26	GL - Auxiliary Building HVAC	-	363	13	28	438	55	-	176	1,073	1,073	-	-	5,064	228	-	-	-	220,197	8,491	-
2b.1.1.27	GM - Diesel Generator Building HVAC	-	17	-	-	-	-	-	3	20	-	-	20	-	-	-	-	-	-	695	-
2b.1.1.28	GN - Containment Cooling	-	392	26	45	636	156	-	242	1,495	1,495	-	-	7,354	643	-	-	-	339,572	9,502	-
2b.1.1.29	GP - Containmnt Integratd Leak Rate Test	-	30	1	3	50	-	-	16	100	100	-	-	580	-	-	-	-	23,570	750	-
2b.1.1.30	GR - Containment Atmospheric Control	-	14	3	6	94	10	-	21	148	148	-	-	1,086	41	-	-	-	46,686	392	-
2b.1.1.31	GT - Contaiment Purge HVAC	-	92	7	12	168	41	-	61	382	382	-	-	1,948	170	-	-	-	89,946	2,259	-
2b.1.1.32	HA - Gaseous Radwaste	-	278	23	23	241	164	-	152	882	882	-	-	2,782	666	-	-	-	156,216	7,037	-
2b.1.1.33	HB - Liquid Radwaste	584	657	77	64	480	670	-	713	3,244	3,244	-	-	5,544	2,742	-	-	-	401,460	30,762	-
2b.1.1.34	HC - Solid Radwaste	-	369	52	41	241	505	-	266	1,474	1,474	-	-	2,781	2,076	-	-	-	245,800	9,589	-
2b.1.1.35	HD - Decontamination	-	78	6	7	85	42	-	44	262	262	-	-	983	171	-	-	-	50,973	2,051	-
2b.1.1.36	HE - Boron Recycle	297	383	38	32	225	344	-	373	1,691	1,691	-	-	2,600	1,411	-	-	-	196,130	16,660	-
2b.1.1.37	JE - Emergency Fuel Oil	-	40	-	-	-	-	-	6	46	-	-	46	-	-	-	-	-	-	1,260	-
2b.1.1.38	KA - Compressed Air and Instrument	-	178	-	-	-	-	-	27	205	-	-	205	-	-	-	-	-	-	6,089	-
2b.1.1.39	KB - Breathing Air	-	31	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	1,075	-
2b.1.1.40	KC - Fire Protection	-	262	-	-	-	-	-	39	301	-	-	301	-	-	-	-	-	-	9,256	-
2b.1.1.41	KC - Fire Protection RCA	-	271	10	30	514	-	-	150	975	975	-	-	5,944	-	-	-	-	241,384	6,383	-
2b.1.1.42	KD - Domestic Water	-	50	-	-	-	-	-	7	57	-	-	57	-	-	-	-	-	-	1,708	-
2b.1.1.43	KE - Fuel Hndlg & Strg Reactor Vssl Serv	-	14	4	5	57	38	-	23	141	141	-	-	661	158	-	-	-	36,889	375	-
2b.1.1.44	KJ - Standby Diesel Engine	-	208	-	-	-	-	-	31	239	-	-	239	-	-	-	-	-	-	6,749	-
2b.1.1.45	LA - Sanitary Drains	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	290	-
2b.1.1.46	LA - Sanitary Drains RCA	-	21	0	1	24	-	-	9	55	55	-	-	272	-	-	-	-	11,053	422	-
2b.1.1.47	LB - Roof Drains	-	37	-	-	-	-	-	5	42	-	-	42	-	-	-	-	-	-	1,276	-
2b.1.1.48	LB - Roof Drains RCA	-	113	4	11	185	-	-	58	371	371	-	-	2,139	-	-	-	-	86,858	2,694	-
2b.1.1.49	LC - Yard Drains	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	96	-
2b.1.1.50	LD - Chemical & Detergent Waste	54	91	6	5	44	51	-	70	321	321	-	-	504	211	-	-	-	33,951	3,490	-
2b.1.1.51	LF - Floor & Equipment Drains	-	1,129	129	94	323	1,386	-	704	3,766	3,766	-	-	3,739	5,724	-	-	-	516,484	29,320	-
2b.1.1.52	RM - Process Sampling & Analysis	-	100	8	7	57	60	-	50	283	283	-	-	661	240	-	-	-	42,525	2,774	-
2b.1.1.53	Radwaste Bldg Non-System Specific	-	139	11	10	61	120	-	77	418	418	-	-	705	497	-	-	-	60,190	3,653	-
2b.1.1.54	Radwaste Bldg Non-System Specific RCA	-	893	22	63	1,097	-	-	400	2,475	2,475	-	-	12,684	-	-	-	-	515,103	21,919	-
2b.1.1.55	Reactor Bldg Non-System Specific	-	71	4	4	23	45	-	33	180	180	-	-	269	186	-	-	-	22,727	1,760	-
2b.1.1.56	Reactor Bldg Non-System Specific RCA	-	460	8	24	412	-	-	181	1,086	1,086	-	-	4,768	-	-	-	-	193,612	10,425	-
2b.1.1.57	SBO Diesel Generator	-	113	-	-	-	-	-	17	130	-	-	130	-	-	-	-	-	-	3,610	-
2b.1.1.58	SJ - Nuclear Sampling	-	57	6	5	37	46	-	32	182	182	-	-	423	184	-	-	-	29,191	1,620	-
2b.1.1.59	ST - Sewage Treatment	-	67	-	-	-	-	-	10	77	-	-	77	-	-	-	-	-	-	2,316	-
2b.1.1.60	SZ - Service Air	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	1,892	-
2b.1.1.61	VA - I&C Shop HVAC	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	155	-
2b.1.1.62	VB - I&C Shop Computer Room HVAC	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	106	-
2b.1.1.63	VC - Health Physics Computer Room HVAC	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	208	-
2b.1.1.64	VJ - Shop Bldg Machine Shop Area Vent	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	57	-
2b.1.1.65	VL - Shop Building HVAC	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	101	-
2b.1.1.66	VS - Admin Bldg HVAC	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	262	-
2b.1.1.67	VT - Tech Support Building HVAC	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	87	-
2b.1.1.68	VW - Waste Water Treatment Ventilation	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	52	-
2b.1.1.69	WD - Domestic Water	-	24	-	-	-	-	-	4	28	-	-	28	-	-	-	-	-	-	870	-
2b.1.1.70	WM - Makeup Demineralizer	-	113	-	-	-	-	-	17	130	-	-	130	-	-	-	-	-	-	3,929	-
2b.1.1.71	WS - Plant Services Water	-	93	-	-	-	-	-	14	107	-	-	107	-	-	-	-	-	-	3,297	-
2b.1.1.72	WS - Plant Services Water RCA	-	29	3	9	159	-	-	33	233	233	-	-	1,838	-	-	-	-	74,625	782	-
2b.1.1.73	WT - Waste Water Treatment	-	22	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	769	-
2b.1.1.74	WZ - Radioactive Liquid Waste	-	36	6	4	10	62	-	27	145	145	-	-	120	258	-	-	-	21,303	879	-
2b.1.1.75	Yard Non-System Specific	-	18	-	-	-	-	-	3	21	-	-	21	-	-	-	-	-	-	603	-
2b.1.1	Totals	1,661	11,052	679	758	7,846	5,617	-	6,054	33,668	30,191	-	3,477	90,709	23,114	-	-	-	5,161,856	333,052	-
2b.1.2	Scaffolding in support of decommissioning	-	1,294	36	10	145	32	-	358	1,875	1,875	-	-	1,508	133	-	-	-	76,290	46,205	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2017 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			
Decontamination of Site Buildings																					
2b.1.3.1	Reactor	885	837	54	202	515	1,640	-	1,175	5,308	5,308	-	-	5,955	17,517	-	-	-	997,209	44,353	-
2b.1.3.2	Auxiliary	463	302	24	93	189	250	-	414	1,735	1,735	-	-	2,185	6,943	-	-	-	417,552	19,560	-
2b.1.3.3	Communication Corridor - Contaminated	10	5	0	2	1	5	-	8	33	33	-	-	17	152	-	-	-	7,854	395	-
2b.1.3.4	Hot Machine Shop	13	10	1	2	-	6	-	11	43	43	-	-	-	188	-	-	-	8,892	597	-
2b.1.3.5	RWST Foundation Decon	-	7	1	4	-	11	-	5	28	28	-	-	-	335	-	-	-	15,840	108	-
2b.1.3.6	Radwaste	246	144	12	48	73	130	-	211	865	865	-	-	844	3,681	-	-	-	208,617	10,005	-
2b.1.3.7	Radwaste Drum Storage	28	15	1	5	6	14	-	23	92	92	-	-	66	413	-	-	-	22,243	1,093	-
2b.1.3.8	Radwaste Storage Building	71	32	3	13	-	37	-	55	210	210	-	-	-	1,090	-	-	-	51,480	2,634	-
2b.1.3	Totals	1,715	1,353	96	369	784	2,094	-	1,902	8,314	8,314	-	-	9,068	30,319	-	-	-	1,729,687	78,745	-
2b.1.4	Prepare/submit License Termination Plan	-	-	-	-	-	-	479	72	551	551	-	-	-	-	-	-	-	-	-	4,096
2b.1.5	Receive NRC approval of termination plan									a											
2b.1	Subtotal Period 2b Activity Costs	3,377	13,699	811	1,137	8,775	7,743	479	8,386	44,407	40,930	-	3,477	101,284	53,566	-	-	-	6,967,833	458,002	4,096
Period 2b Additional Costs																					
2b.2.1	Remedial Action Surveys	-	-	-	-	-	-	2,236	671	2,907	2,907	-	-	-	-	-	-	-	-	45,787	-
2b.2.2	Operational Equipment	-	-	19	49	624	-	-	103	794	794	-	-	11,710	-	-	-	-	292,750	32	-
2b.2	Subtotal Period 2b Additional Costs	-	-	19	49	624	-	2,236	774	3,701	3,701	-	-	11,710	-	-	-	-	292,750	45,819	-
Period 2b Collateral Costs																					
2b.3.1	Process decommissioning water waste	190	-	128	311	-	575	-	299	1,504	1,504	-	-	-	1,258	-	-	-	75,490	245	-
2b.3.2	Process decommissioning chemical flush waste	4	-	145	524	-	1,203	-	396	2,271	2,271	-	-	-	1,481	-	-	-	157,863	277	-
2b.3.3	Small tool allowance	-	251	-	-	-	-	-	38	289	289	-	-	-	-	-	-	-	-	-	-
2b.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	15,949	2,392	18,342	-	18,342	-	-	-	-	-	-	-	-	-
2b.3.5	On-site survey and release of 44.30 tons clean metallic waste	-	-	-	-	-	-	63	6	69	69	-	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	195	251	272	835	-	1,778	16,012	3,131	22,474	4,133	18,342	-	-	2,740	-	-	-	233,353	523	-
Period 2b Period-Dependent Costs																					
2b.4.1	Decon supplies	1,600	-	-	-	-	-	-	400	2,000	2,000	-	-	-	-	-	-	-	-	-	-
2b.4.2	Insurance	-	-	-	-	-	-	1,527	153	1,680	1,680	-	-	-	-	-	-	-	-	-	-
2b.4.3	Property taxes	-	-	-	-	-	-	5,010	501	5,511	5,511	-	-	-	-	-	-	-	-	-	-
2b.4.4	Health physics supplies	-	3,553	-	-	-	-	-	888	4,442	4,442	-	-	-	-	-	-	-	-	-	-
2b.4.5	Heavy equipment rental	-	4,973	-	-	-	-	-	746	5,719	5,719	-	-	-	-	-	-	-	-	-	-
2b.4.6	Disposal of DAW generated	-	-	139	35	-	344	-	105	622	622	-	-	-	6,385	-	-	-	127,708	208	-
2b.4.7	Plant energy budget	-	-	-	-	-	-	3,488	523	4,011	4,011	-	-	-	-	-	-	-	-	-	-
2b.4.8	NRC Fees	-	-	-	-	-	-	1,275	128	1,403	1,403	-	-	-	-	-	-	-	-	-	-
2b.4.9	Emergency Planning Fees	-	-	-	-	-	-	1,544	154	1,698	-	1,698	-	-	-	-	-	-	-	-	-
2b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,768	265	2,033	-	2,033	-	-	-	-	-	-	-	-	-
2b.4.11	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	446	67	513	513	-	-	-	-	-	-	-	-	-	-
2b.4.12	ISFSI Operating Costs	-	-	-	-	-	-	227	34	262	-	262	-	-	-	-	-	-	-	-	-
2b.4.13	Corporate Allocations	-	-	-	-	-	-	526	79	604	604	-	-	-	-	-	-	-	-	-	-
2b.4.14	NEI Annual Fees	-	-	-	-	-	-	1,166	175	1,341	1,341	-	-	-	-	-	-	-	-	-	-
2b.4.15	Security Staff Cost	-	-	-	-	-	-	37,203	5,580	42,783	42,783	-	-	-	-	-	-	-	-	-	604,370
2b.4.16	DOC Staff Cost	-	-	-	-	-	-	27,105	4,066	31,171	31,171	-	-	-	-	-	-	-	-	-	334,464
2b.4.17	Utility Staff Cost	-	-	-	-	-	-	44,158	6,624	50,782	50,782	-	-	-	-	-	-	-	-	-	620,820
2b.4	Subtotal Period 2b Period-Dependent Costs	1,600	8,527	139	35	-	344	125,443	20,488	156,575	152,582	3,993	-	-	6,385	-	-	-	127,708	208	1,559,655
2b.0	TOTAL PERIOD 2b COST	5,171	22,477	1,241	2,056	9,399	9,865	144,171	32,779	227,158	201,346	22,335	3,477	112,994	62,691	-	-	-	7,621,644	504,552	1,563,751
PERIOD 2d - Decontamination Following Wet Fuel Storage																					
Period 2d Direct Decommissioning Activities																					
2d.1.1	Remove spent fuel racks	521	50	281	83	-	1,509	-	691	3,134	3,134	-	-	-	6,250	-	-	-	397,077	1,722	-
Disposal of Plant Systems																					
2d.1.2.1	EC - Fuel Pool Cooling & Cleanup	-	305	28	27	225	264	-	183	1,033	1,033	-	-	2,600	1,088	-	-	-	175,058	8,041	-
2d.1.2.2	Fuel Bldg Non-System Specific	-	37	3	2	15	29	-	19	106	106	-	-	170	120	-	-	-	14,568	954	-
2d.1.2.3	Fuel Bldg Non-System Specific RCA	-	245	5	16	277	-	-	106	649	649	-	-	3,200	-	-	-	-	129,974	5,859	-
2d.1.2.4	Fuel Building Fire Protection	-	119	5	15	254	-	-	71	463	463	-	-	2,941	-	-	-	-	119,444	2,802	-
2d.1.2.5	GG - Fuel Building HVAC	-	199	9	21	323	38	-	112	701	701	-	-	3,729	155	-	-	-	161,297	4,673	-
2d.1.2	Totals	-	906	51	81	1,093	331	-	490	2,953	2,953	-	-	12,641	1,364	-	-	-	600,340	22,329	-
Decontamination of Site Buildings																					
2d.1.3.1	Fuel Building	569	611	12	34	234	85	-	500	2,046	2,046	-	-	2,705	1,864	-	-	-	199,762	31,564	-
2d.1.3	Totals	569	611	12	34	234	85	-	500	2,046	2,046	-	-	2,705	1,864	-	-	-	199,762	31,564	-
2d.1.4	Scaffolding in support of decommissioning	-	259	7	2	29	6	-	72	375	375	-	-	302	27	-	-	-	15,258	9,241	-

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															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
2d.1	Subtotal Period 2d Activity Costs	1,090	1,826	351	200	1,356	1,931	-	1,753	8,507	8,507	-	-	15,647	9,505	-	-	-	1,212,437	64,856	-
Period 2d Additional Costs																					
2d.2.1	License Termination Survey Planning	-	-	-	-	-	-	1,340	402	1,742	1,742	-	-	-	-	-	-	-	-	-	12,480
2d.2.2	Remedial Action Surveys	-	-	-	-	-	-	684	205	890	890	-	-	-	-	-	-	-	-	14,009	-
2d.2.3	Excavation of Underground Services	-	2,001	-	-	-	-	907	636	3,545	3,545	-	-	-	-	-	-	-	-	15,949	-
2d.2.4	License Termination ISFSI	-	155	205	500	-	2,529	1,964	1,338	6,691	6,691	-	-	-	36,660	-	-	-	1,893,161	5,152	10,496
2d.2	Subtotal Period 2d Additional Costs	-	2,156	205	500	-	2,529	4,895	2,582	12,867	12,867	-	-	-	36,660	-	-	-	1,893,161	35,110	22,976
Period 2d Collateral Costs																					
2d.3.1	Process decommissioning water waste	86	-	58	141	-	261	-	135	681	681	-	-	-	571	-	-	-	34,248	111	-
2d.3.3	Small tool allowance	-	54	-	-	-	-	-	8	62	62	-	-	-	-	-	-	-	-	-	-
2d.3.4	Decommissioning Equipment Disposition	-	-	143	45	575	128	-	139	1,030	1,030	-	-	6,000	529	-	-	-	303,608	147	-
2d.3	Subtotal Period 2d Collateral Costs	86	54	201	187	575	389	-	282	1,773	1,773	-	-	6,000	1,100	-	-	-	337,856	258	-
Period 2d Period-Dependent Costs																					
2d.4.1	Decon supplies	229	-	-	-	-	-	-	57	286	286	-	-	-	-	-	-	-	-	-	-
2d.4.2	Insurance	-	-	-	-	-	-	467	47	514	514	-	-	-	-	-	-	-	-	-	-
2d.4.3	Property taxes	-	-	-	-	-	-	447	45	492	492	-	-	-	-	-	-	-	-	-	-
2d.4.4	Health physics supplies	-	760	-	-	-	-	-	190	950	950	-	-	-	-	-	-	-	-	-	-
2d.4.5	Heavy equipment rental	-	1,522	-	-	-	-	-	228	1,750	1,750	-	-	-	-	-	-	-	-	-	-
2d.4.6	Disposal of DAW generated	-	-	45	11	-	111	-	34	201	201	-	-	-	2,065	-	-	-	41,306	67	-
2d.4.7	Plant energy budget	-	-	-	-	-	-	569	85	655	655	-	-	-	-	-	-	-	-	-	-
2d.4.8	NRC Fees	-	-	-	-	-	-	330	33	363	363	-	-	-	-	-	-	-	-	-	-
2d.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	273	41	314	314	-	-	-	-	-	-	-	-	-	-
2d.4.10	Corporate Allocations	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	-
2d.4.11	Security Staff Cost	-	-	-	-	-	-	1,558	234	1,791	1,791	-	-	-	-	-	-	-	-	-	43,808
2d.4.12	DOC Staff Cost	-	-	-	-	-	-	5,766	865	6,631	6,631	-	-	-	-	-	-	-	-	-	70,093
2d.4.13	Utility Staff Cost	-	-	-	-	-	-	9,719	1,458	11,177	10,305	872	-	-	-	-	-	-	-	-	132,476
2d.4	Subtotal Period 2d Period-Dependent Costs	229	2,282	45	11	-	111	19,241	3,333	25,252	24,380	872	-	-	2,065	-	-	-	41,306	67	246,377
2d.0	TOTAL PERIOD 2d COST	1,405	6,317	802	897	1,931	4,960	24,136	7,950	48,399	47,527	872	-	21,647	49,330	-	-	-	3,484,760	100,291	269,353
PERIOD 2f - License Termination																					
Period 2f Direct Decommissioning Activities																					
2f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	159	48	207	207	-	-	-	-	-	-	-	-	-	-
2f.1.2	Terminate license									a											
2f.1	Subtotal Period 2f Activity Costs	-	-	-	-	-	-	159	48	207	207	-	-	-	-	-	-	-	-	-	-
Period 2f Additional Costs																					
2f.2.1	License Termination Survey	-	-	-	-	-	-	6,489	1,947	8,436	8,436	-	-	-	-	-	-	-	-	152,819	6,240
2f.2	Subtotal Period 2f Additional Costs	-	-	-	-	-	-	6,489	1,947	8,436	8,436	-	-	-	-	-	-	-	-	152,819	6,240
Period 2f Collateral Costs																					
2f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,323	198	1,521	1,521	-	-	-	-	-	-	-	-	-	-
2f.3	Subtotal Period 2f Collateral Costs	-	-	-	-	-	-	1,323	198	1,521	1,521	-	-	-	-	-	-	-	-	-	-
Period 2f Period-Dependent Costs																					
2f.4.1	Insurance	-	-	-	-	-	-	536	54	589	589	-	-	-	-	-	-	-	-	-	-
2f.4.2	Property taxes	-	-	-	-	-	-	513	51	564	564	-	-	-	-	-	-	-	-	-	-
2f.4.3	Health physics supplies	-	768	-	-	-	-	-	192	960	960	-	-	-	-	-	-	-	-	-	-
2f.4.4	Disposal of DAW generated	-	-	8	2	-	19	-	6	35	35	-	-	-	360	-	-	-	7,203	12	-
2f.4.5	Plant energy budget	-	-	-	-	-	-	326	49	375	375	-	-	-	-	-	-	-	-	-	-
2f.4.6	NRC Fees	-	-	-	-	-	-	431	43	474	474	-	-	-	-	-	-	-	-	-	-
2f.4.7	Corporate Allocations	-	-	-	-	-	-	65	10	74	74	-	-	-	-	-	-	-	-	-	-
2f.4.8	Security Staff Cost	-	-	-	-	-	-	900	135	1,036	1,036	-	-	-	-	-	-	-	-	-	19,284
2f.4.9	DOC Staff Cost	-	-	-	-	-	-	5,038	756	5,794	5,794	-	-	-	-	-	-	-	-	-	58,656
2f.4.10	Utility Staff Cost	-	-	-	-	-	-	6,051	908	6,959	5,963	995	-	-	-	-	-	-	-	-	76,333
2f.4	Subtotal Period 2f Period-Dependent Costs	-	768	8	2	-	19	13,859	2,203	16,859	15,864	995	-	-	360	-	-	-	7,203	12	154,273
2f.0	TOTAL PERIOD 2f COST	-	768	8	2	-	19	21,830	4,396	27,023	26,028	995	-	-	360	-	-	-	7,203	152,831	160,513
PERIOD 2 TOTALS		8,228	66,697	20,416	10,249	20,970	60,910	309,031	101,306	597,808	551,629	39,875	6,303	252,581	186,588	963	393	2,217	22,233,570	1,191,877	3,312,593

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2017 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 - Site Restoration																					
Period 3b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
3b.1.1.1	Reactor	-	2,518	-	-	-	-	-	378	2,896	-	-	2,896	-	-	-	-	-	-	27,724	-
3b.1.1.2	Access Vaults	-	10	-	-	-	-	-	1	11	-	-	11	-	-	-	-	-	-	59	-
3b.1.1.3	Administration	-	118	-	-	-	-	-	18	135	-	-	135	-	-	-	-	-	-	1,724	-
3b.1.1.4	Auxiliary	-	2,063	-	-	-	-	-	309	2,373	-	-	2,373	-	-	-	-	-	-	19,753	-
3b.1.1.5	Auxiliary Boiler	-	16	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	248	-
3b.1.1.6	Chemical Addition Structure	-	33	-	-	-	-	-	5	37	-	-	37	-	-	-	-	-	-	469	-
3b.1.1.7	Circ Water Pump Enclosure	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	164	-
3b.1.1.8	Circ Water Travel Screen Enclosure	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	160	-
3b.1.1.9	Circulating Water Discharge Structure	-	90	-	-	-	-	-	13	103	-	-	103	-	-	-	-	-	-	542	-
3b.1.1.10	Circulating Water Intake & Screenhouse	-	83	-	-	-	-	-	12	95	-	-	95	-	-	-	-	-	-	683	-
3b.1.1.11	Communication Corridor - Clean	-	683	-	-	-	-	-	102	785	-	-	785	-	-	-	-	-	-	8,280	-
3b.1.1.12	Communication Corridor - Contaminated	-	30	-	-	-	-	-	4	34	-	-	34	-	-	-	-	-	-	184	-
3b.1.1.13	Covered Walkways	-	11	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	242	-
3b.1.1.14	Diesel Generator	-	239	-	-	-	-	-	36	274	-	-	274	-	-	-	-	-	-	2,185	-
3b.1.1.15	E.S.W.S. Pumphouse	-	124	-	-	-	-	-	19	143	-	-	143	-	-	-	-	-	-	801	-
3b.1.1.16	ESWS Valve House	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	42	-
3b.1.1.17	FLEX Building No. 1 & 2	-	347	-	-	-	-	-	52	399	-	-	399	-	-	-	-	-	-	2,880	-
3b.1.1.18	GOB - Administration Building	-	193	-	-	-	-	-	29	222	-	-	222	-	-	-	-	-	-	2,962	-
3b.1.1.19	Hot Machine Shop	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	243	-
3b.1.1.20	M.M.O. Building	-	225	-	-	-	-	-	34	259	-	-	259	-	-	-	-	-	-	2,389	-
3b.1.1.21	Material Center West	-	72	-	-	-	-	-	11	83	-	-	83	-	-	-	-	-	-	1,379	-
3b.1.1.22	Misc Structures and Additions	-	57	-	-	-	-	-	9	66	-	-	66	-	-	-	-	-	-	910	-
3b.1.1.23	Miscellaneous Site Foundations	-	204	-	-	-	-	-	31	234	-	-	234	-	-	-	-	-	-	1,242	-
3b.1.1.24	Miscellaneous Site Structures	-	1,284	-	-	-	-	-	193	1,477	-	-	1,477	-	-	-	-	-	-	13,693	-
3b.1.1.25	New Covered Walkway	-	6	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	79	-
3b.1.1.26	Oil Separator and Waste Tank	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	8	-
3b.1.1.27	Radwaste	-	864	-	-	-	-	-	130	993	-	-	993	-	-	-	-	-	-	8,111	-
3b.1.1.28	Radwaste Drum Storage	-	126	-	-	-	-	-	19	144	-	-	144	-	-	-	-	-	-	1,504	-
3b.1.1.29	Radwaste Storage Building	-	67	-	-	-	-	-	10	77	-	-	77	-	-	-	-	-	-	1,028	-
3b.1.1.30	SBO Diesel Generator	-	240	-	-	-	-	-	36	276	-	-	276	-	-	-	-	-	-	3,079	-
3b.1.1.31	Security Main Gate North	-	70	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,123	-
3b.1.1.32	Security Additions	-	30	-	-	-	-	-	4	34	-	-	34	-	-	-	-	-	-	405	-
3b.1.1.33	Security/Guardhouse	-	30	-	-	-	-	-	5	35	-	-	35	-	-	-	-	-	-	342	-
3b.1.1.34	Site Diesel Generator	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	18	-
3b.1.1.35	Support Complex	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	389	-
3b.1.1.36	Turbine Building	-	2,393	-	-	-	-	-	359	2,752	-	-	2,752	-	-	-	-	-	-	47,184	-
3b.1.1.37	Turbine Pedestal	-	478	-	-	-	-	-	72	549	-	-	549	-	-	-	-	-	-	2,934	-
3b.1.1.38	Waste Water Treatment	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	172	-
3b.1.1.39	Water Treatment Building North (Z110)	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	608	-
3b.1.1.40	Fuel Building	-	909	-	-	-	-	-	136	1,045	-	-	1,045	-	-	-	-	-	-	7,983	-
3b.1.1	Totals	-	13,727	-	-	-	-	-	2,059	15,787	-	-	15,787	-	-	-	-	-	-	163,924	-
Site Closeout Activities																					
3b.1.2	Remove Rubble	-	948	-	-	-	-	-	142	1,090	-	-	1,090	-	-	-	-	-	-	5,352	-
3b.1.3	Grade & landscape site	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	512	-
3b.1.4	Final report to NRC	-	-	-	-	-	-	182	27	210	210	-	-	-	-	-	-	-	-	-	1,560
3b.1	Subtotal Period 3b Activity Costs	-	14,776	-	-	-	-	182	2,244	17,202	210	-	16,992	-	-	-	-	-	-	169,788	1,560
Period 3b Additional Costs																					
3b.2.1	Concrete Crushing	-	880	-	-	-	-	11	134	1,025	-	-	1,025	-	-	-	-	-	-	4,585	-
3b.2.2	Circulating Water Intake Cofferdam	-	308	-	-	-	-	-	46	354	-	-	354	-	-	-	-	-	-	2,584	-
3b.2.3	E.S.W.S. Pumphouse Cofferdam	-	404	-	-	-	-	-	61	465	-	-	465	-	-	-	-	-	-	3,552	-
3b.2.4	Construction Debris	-	-	-	-	-	-	1,730	260	1,990	-	-	1,990	-	-	-	-	-	-	-	-
3b.2.5	Site Restoration ISFSI	-	462	-	-	-	-	111	86	659	-	-	659	-	-	-	-	-	-	4,099	160
3b.2.6	Firing Range Closure	-	-	-	-	-	-	692	104	796	-	-	796	-	-	-	-	-	-	-	-
3b.2	Subtotal Period 3b Additional Costs	-	2,055	-	-	-	-	2,544	690	5,289	-	-	5,289	-	-	-	-	-	-	14,821	160
Period 3b Collateral Costs																					
3b.3.1	Small tool allowance	-	105	-	-	-	-	-	16	120	-	-	120	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	-	105	-	-	-	-	-	16	120	-	-	120	-	-	-	-	-	-	-	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2017 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																					
3b.4.2	Property taxes	-	-	-	-	-	-	482	48	530	-	-	530	-	-	-	-	-	-	-	-
3b.4.3	Heavy equipment rental	-	4,679	-	-	-	-	-	702	5,381	-	-	5,381	-	-	-	-	-	-	-	-
3b.4.4	Plant energy budget	-	-	-	-	-	-	314	47	361	-	-	361	-	-	-	-	-	-	-	-
3b.4.5	Corporate Allocations	-	-	-	-	-	-	51	8	59	-	-	59	-	-	-	-	-	-	-	-
3b.4.6	Security Staff Cost	-	-	-	-	-	-	1,734	260	1,994	-	-	1,994	-	-	-	-	-	-	-	37,132
3b.4.7	DOC Staff Cost	-	-	-	-	-	-	9,107	1,366	10,473	-	-	10,473	-	-	-	-	-	-	-	105,208
3b.4.8	Utility Staff Cost	-	-	-	-	-	-	4,573	686	5,259	-	-	5,259	-	-	-	-	-	-	-	60,340
3b.4	Subtotal Period 3b Period-Dependent Costs	-	4,679	-	-	-	-	16,260	3,117	24,056	-	-	24,056	-	-	-	-	-	-	-	202,680
3b.0	TOTAL PERIOD 3b COST	-	21,614	-	-	-	-	18,987	6,066	46,667	210	-	46,457	-	-	-	-	-	-	184,609	204,400
PERIOD 3 TOTALS		-	21,614	-	-	-	-	18,987	6,066	46,667	210	-	46,457	-	-	-	-	-	-	184,609	204,400
TOTAL COST TO DECOMMISSION		**12,020**	**91,177**	**20,618**	**10,622**	**20,986**	**64,399**	**464,007**	**129,904**	**813,733**	**711,273**	**48,251**	**54,208**	**254,732**	**187,840**	**1,750**	**393**	**2,217**	**22,491,670**	**1,397,626**	**4,808,663**

TOTAL COST TO DECOMMISSION WITH 19% CONTINGENCY:	**$813,733**	**thousands of 2017 dollars**
TOTAL NRC LICENSE TERMINATION COST IS 87.41% OR:	**$711,273**	**thousands of 2017 dollars**
SPENT FUEL MANAGEMENT COST IS 5.93% OR:	**$48,251**	**thousands of 2017 dollars**
NON-NUCLEAR DEMOLITION COST IS 6.66% OR:	**$54,208**	**thousands of 2017 dollars**
TOTAL LOW-LEVEL RADIOACTIVE RADWASTE VOLUME BURIED (EXCLUDING GTCC):	**189,983**	**cubic feet**
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	**2,217**	**cubic feet**
TOTAL SCRAP METAL REMOVED:	**69,384**	**tons**
TOTAL CRAFT LABOR REQUIREMENTS:	**1,397,626**	**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
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2017 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	-	-	-	-	-	-	380	114	494	494	-	-	-	-	-	-	-	-	-	-
1a.1.2	Prepare preliminary decommissioning cost	-	-	-	-	-	-	152	23	175	175	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	234	35	269	269	-	-	-	-	-	-	-	-	-	2,000
1a.1.8	Review plant dwgs & specs.	-	-	-	-	-	-	152	23	175	175	-	-	-	-	-	-	-	-	-	1,300
1a.1.9	Perform detailed rad survey									a											
1a.1.10	Estimate by-product inventory	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	End product description	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
1a.1.12	Detailed by-product inventory	-	-	-	-	-	-	175	26	202	202	-	-	-	-	-	-	-	-	-	1,500
1a.1.13	Define major work sequence	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
1a.1.14	Perform SER and EA	-	-	-	-	-	-	362	54	417	417	-	-	-	-	-	-	-	-	-	3,100
1a.1.15	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	877	131	1,008	1,008	-	-	-	-	-	-	-	-	-	7,500
1a.1.16	Perform Site-Specific Cost Study	-	-	-	-	-	-	584	88	672	672	-	-	-	-	-	-	-	-	-	5,000
1a.1.17	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
1a.1.18.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	575	86	661	661	-	-	-	-	-	-	-	-	-	4,920
1a.1.18.2	Plant systems	-	-	-	-	-	-	487	73	560	560	-	-	-	-	-	-	-	-	-	4,167
1a.1.18.3	Plant structures and buildings	-	-	-	-	-	-	365	55	419	419	-	-	-	-	-	-	-	-	-	3,120
1a.1.18.4	Waste management	-	-	-	-	-	-	234	35	269	269	-	-	-	-	-	-	-	-	-	2,000
1a.1.18.5	Facility and site dormancy	-	-	-	-	-	-	234	35	269	269	-	-	-	-	-	-	-	-	-	2,000
1a.1.18	Total	-	-	-	-	-	-	1,894	284	2,178	2,178	-	-	-	-	-	-	-	-	-	16,207
Detailed Work Procedures																					
1a.1.19.1	Plant systems	-	-	-	-	-	-	138	21	159	159	-	-	-	-	-	-	-	-	-	1,183
1a.1.19.2	Facility closeout & dormancy	-	-	-	-	-	-	140	21	161	161	-	-	-	-	-	-	-	-	-	1,200
1a.1.19	Total	-	-	-	-	-	-	279	42	320	320	-	-	-	-	-	-	-	-	-	2,383
1a.1.20	Procure vacuum drying system	-	-	-	-	-	-	12	2	13	13	-	-	-	-	-	-	-	-	-	100
1a.1.21	Drain/de-energize non-cont. systems									a											
1a.1.22	Drain & dry NSSS									a											
1a.1.23	Drain/de-energize contaminated systems									a											
1a.1.24	Decon/secure contaminated systems									a											
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	5,568	892	6,461	6,461	-	-	-	-	-	-	-	-	-	44,390
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Transfer (ISFSI to DOE)	-	-	-	-	-	-	1,134	170	1,304	-	1,304	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	1,134	170	1,304	-	1,304	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	3,754	375	4,130	4,130	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	2,274	227	2,502	2,502	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	515	-	-	-	-	-	129	644	644	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	567	-	-	-	-	-	85	652	652	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	13	3	-	33	-	10	59	59	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	2,111	317	2,428	2,428	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	1,110	111	1,221	1,221	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,225	122	1,347	-	1,347	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	333	50	383	383	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	803	120	923	-	923	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	103	15	119	-	119	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate Allocations	-	-	-	-	-	-	357	54	411	411	-	-	-	-	-	-	-	-	-	-
1a.4.13	NEI Annual Fees	-	-	-	-	-	-	530	79	609	609	-	-	-	-	-	-	-	-	-	-
1a.4.14	Security Staff Cost	-	-	-	-	-	-	19,401	2,910	22,311	22,311	-	-	-	-	-	-	-	-	-	316,295
1a.4.15	Utility Staff Cost	-	-	-	-	-	-	28,719	4,308	33,027	33,027	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,083	13	3	-	33	60,721	8,914	70,766	68,377	2,389	-	-	610	-	-	-	12,190	20	738,535
1a.0	TOTAL PERIOD 1a COST	-	1,083	13	3	-	33	67,423	9,976	78,531	74,838	3,694	-	-	610	-	-	-	12,190	20	782,925

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2017 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 1b - SAFSTOR Limited DECON Activities																					
Period 1b Direct Decommissioning Activities																					
Decontamination of Site Buildings																					
1b.1.1.1	Reactor	872	-	-	-	-	-	-	436	1,308	1,308	-	-	-	-	-	-	-	24,102	-	
1b.1.1.2	Auxiliary	436	-	-	-	-	-	-	218	653	653	-	-	-	-	-	-	-	12,527	-	
1b.1.1.3	Communication Corridor - Contaminated	10	-	-	-	-	-	-	5	14	14	-	-	-	-	-	-	-	276	-	
1b.1.1.4	Fuel Building	562	-	-	-	-	-	-	281	842	842	-	-	-	-	-	-	-	14,371	-	
1b.1.1.5	Hot Machine Shop	12	-	-	-	-	-	-	6	18	18	-	-	-	-	-	-	-	344	-	
1b.1.1.6	Radwaste	232	-	-	-	-	-	-	116	348	348	-	-	-	-	-	-	-	6,671	-	
1b.1.1.7	Radwaste Drum Storage	26	-	-	-	-	-	-	13	39	39	-	-	-	-	-	-	-	750	-	
1b.1.1.8	Radwaste Storage Building	61	-	-	-	-	-	-	30	91	91	-	-	-	-	-	-	-	1,690	-	
1b.1.1	Totals	2,209	-	-	-	-	-	-	1,105	3,314	3,314	-	-	-	-	-	-	-	60,731	-	
1b.1	Subtotal Period 1b Activity Costs	2,209	-	-	-	-	-	-	1,105	3,314	3,314	-	-	-	-	-	-	-	60,731	-	
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	973	-	-	-	-	-	-	146	1,119	1,119	-	-	-	-	-	-	-	-	-	
1b.3.2	Process decommissioning water waste	172	-	110	269	-	497	-	262	1,310	1,310	-	-	-	1,086	-	-	-	65,189	212	
1b.3.4	Small tool allowance	-	35	-	-	-	-	-	5	40	40	-	-	-	-	-	-	-	-	-	
1b.3.5	Spent Fuel Capital and Transfer	-	-	-	-	-	-	1,512	227	1,739	-	1,739	-	-	-	-	-	-	-	-	
1b.3	Subtotal Period 1b Collateral Costs	1,145	35	110	269	-	497	1,512	640	4,208	2,469	1,739	-	-	1,086	-	-	-	65,189	212	
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	1,502	-	-	-	-	-	-	376	1,878	1,878	-	-	-	-	-	-	-	-	-	
1b.4.2	Insurance	-	-	-	-	-	-	-	946	95	1,041	1,041	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	-	573	57	631	631	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	421	-	-	-	-	-	-	105	526	526	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	143	-	-	-	-	-	-	21	164	164	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	16	4	-	40	-	12	73	73	-	-	-	753	-	-	-	15,052	25	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	-	532	80	612	612	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	-	161	16	178	178	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	-	309	31	340	-	340	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	-	202	30	233	-	233	-	-	-	-	-	-	-	-
1b.4.11	ISFSI Operating Costs	-	-	-	-	-	-	-	26	4	30	-	30	-	-	-	-	-	-	-	-
1b.4.12	Corporate Allocations	-	-	-	-	-	-	-	90	14	104	104	-	-	-	-	-	-	-	-	-
1b.4.13	NEI Annual Fees	-	-	-	-	-	-	-	134	20	154	154	-	-	-	-	-	-	-	-	-
1b.4.14	Security Staff Cost	-	-	-	-	-	-	-	4,792	719	5,511	5,511	-	-	-	-	-	-	-	-	78,063
1b.4.15	Utility Staff Cost	-	-	-	-	-	-	-	7,239	1,086	8,325	8,325	-	-	-	-	-	-	-	-	106,428
1b.4	Subtotal Period 1b Period-Dependent Costs	1,502	564	16	4	-	40	15,005	2,666	19,797	19,195	602	-	-	753	-	-	-	15,052	25	184,491
1b.0	TOTAL PERIOD 1b COST	4,856	599	127	273	-	537	16,517	4,410	27,319	24,978	2,341	-	-	1,839	-	-	-	80,241	60,968	184,491
PERIOD 1c - Preparations for SAFSTOR Dormancy																					
Period 1c Direct Decommissioning Activities																					
1c.1.1	Prepare support equipment for storage	-	394	-	-	-	-	-	59	453	453	-	-	-	-	-	-	-	3,000	-	
1c.1.2	Install containment pressure equal. lines	-	26	-	-	-	-	-	4	30	30	-	-	-	-	-	-	-	700	-	
1c.1.3	Interim survey prior to dormancy	-	-	-	-	-	-	733	220	953	953	-	-	-	-	-	-	-	14,124	-	
1c.1.4	Secure building accesses									a											
1c.1.5	Prepare & submit interim report	-	-	-	-	-	-	68	10	78	78	-	-	-	-	-	-	-	-	583	
1c.1	Subtotal Period 1c Activity Costs	-	420	-	-	-	-	801	293	1,515	1,515	-	-	-	-	-	-	-	17,824	583	
Period 1c Additional Costs																					
1c.2.1	Spent fuel pool isolation	-	-	-	-	-	-	11,691	1,754	13,445	13,445	-	-	-	-	-	-	-	-	-	
1c.2.2	Misc/Hazardous Waste	-	-	76	20	16	-	-	13	125	125	-	-	2,151	-	-	-	-	137,800	740	-
1c.2	Subtotal Period 1c Additional Costs	-	-	76	20	16	-	11,691	1,767	13,570	13,570	-	-	2,151	-	-	-	-	137,800	740	-
Period 1c Collateral Costs																					
1c.3.1	Process decommissioning water waste	187	-	120	293	-	541	-	285	1,425	1,425	-	-	-	1,183	-	-	-	70,966	231	-
1c.3.3	Small tool allowance	-	2	-	-	-	-	-	0	3	3	-	-	-	-	-	-	-	-	-	-
1c.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	1,512	227	1,739	-	1,739	-	-	-	-	-	-	-	-	-
1c.3	Subtotal Period 1c Collateral Costs	187	2	120	293	-	541	1,512	512	3,167	1,428	1,739	-	-	1,183	-	-	-	70,966	231	-
Period 1c Period-Dependent Costs																					
1c.4.1	Insurance	-	-	-	-	-	-	946	95	1,041	1,041	-	-	-	-	-	-	-	-	-	-
1c.4.2	Property taxes	-	-	-	-	-	-	573	57	631	631	-	-	-	-	-	-	-	-	-	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2017 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 1c Period-Dependent Costs (continued)																					
1c.4.3	Health physics supplies	-	220	-	-	-	-	-	55	275	275	-	-	-	-	-	-	-	-	-	-
1c.4.4	Heavy equipment rental	-	143	-	-	-	-	-	21	164	164	-	-	-	-	-	-	-	-	-	-
1c.4.5	Disposal of DAW generated	-	-	3	1	-	8	-	3	15	15	-	-	-	154	-	-	-	3,073	5	-
1c.4.6	Plant energy budget	-	-	-	-	-	-	532	80	612	612	-	-	-	-	-	-	-	-	-	-
1c.4.7	NRC Fees	-	-	-	-	-	-	161	16	178	178	-	-	-	-	-	-	-	-	-	-
1c.4.8	Emergency Planning Fees	-	-	-	-	-	-	309	31	340	-	340	-	-	-	-	-	-	-	-	-
1c.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	202	30	233	-	233	-	-	-	-	-	-	-	-	-
1c.4.10	ISFSI Operating Costs	-	-	-	-	-	-	26	4	30	-	30	-	-	-	-	-	-	-	-	-
1c.4.11	Corporate Allocations	-	-	-	-	-	-	90	14	104	104	-	-	-	-	-	-	-	-	-	-
1c.4.12	NEI Annual Fees	-	-	-	-	-	-	134	20	154	154	-	-	-	-	-	-	-	-	-	-
1c.4.13	Security Staff Cost	-	-	-	-	-	-	4,785	718	5,503	5,503	-	-	-	-	-	-	-	-	-	77,954
1c.4.14	Utility Staff Cost	-	-	-	-	-	-	7,239	1,086	8,325	8,325	-	-	-	-	-	-	-	-	-	106,428
1c.4	Subtotal Period 1c Period-Dependent Costs	-	363	3	1	-	8	14,998	2,229	17,602	17,000	602	-	-	154	-	-	-	3,073	5	184,382
1c.0	TOTAL PERIOD 1c COST	187	785	199	313	16	549	29,003	4,801	35,854	33,512	2,341	-	2,151	1,336	-	-	-	211,838	18,799	184,965
PERIOD 1 TOTALS		5,043	2,467	339	590	16	1,119	112,943	19,187	141,704	133,328	8,376	-	2,151	3,785	-	-	-	304,269	79,787	1,152,381
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	-	-	-	-	-	-	408	61	469	469	-	-	-	-	-	-	-	-	-	-
2a.1.5	Maintenance supplies	-	-	-	-	-	-	564	141	706	706	-	-	-	-	-	-	-	-	-	-
2a.1	Subtotal Period 2a Activity Costs	-	-	-	-	-	-	973	202	1,175	1,175	-	-	-	-	-	-	-	-	-	-
Period 2a Collateral Costs																					
2a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	26,741	4,011	30,752	-	30,752	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	-	-	-	-	-	-	26,741	4,011	30,752	-	30,752	-	-	-	-	-	-	-	-	-
Period 2a Period-Dependent Costs																					
2a.4.1	Insurance	-	-	-	-	-	-	2,775	277	3,052	3,052	-	-	-	-	-	-	-	-	-	-
2a.4.2	Property taxes	-	-	-	-	-	-	9,104	910	10,014	10,014	-	-	-	-	-	-	-	-	-	-
2a.4.3	Health physics supplies	-	828	-	-	-	-	-	207	1,034	1,034	-	-	-	-	-	-	-	-	-	-
2a.4.4	Disposal of DAW generated	-	-	20	5	-	50	-	15	90	90	-	-	-	921	-	-	-	18,419	30	-
2a.4.5	Plant energy budget	-	-	-	-	-	-	1,690	254	1,944	972	972	-	-	-	-	-	-	-	-	-
2a.4.6	NRC Fees	-	-	-	-	-	-	1,027	103	1,130	1,130	-	-	-	-	-	-	-	-	-	-
2a.4.7	Emergency Planning Fees	-	-	-	-	-	-	2,806	281	3,086	-	3,086	-	-	-	-	-	-	-	-	-
2a.4.8	Spent Fuel Pool O&M	-	-	-	-	-	-	3,212	482	3,694	-	3,694	-	-	-	-	-	-	-	-	-
2a.4.9	ISFSI Operating Costs	-	-	-	-	-	-	413	62	475	-	475	-	-	-	-	-	-	-	-	-
2a.4.10	Corporate Allocations	-	-	-	-	-	-	278	42	320	162	158	-	-	-	-	-	-	-	-	-
2a.4.11	NEI Annual Fees	-	-	-	-	-	-	2,119	318	2,437	2,437	-	-	-	-	-	-	-	-	-	-
2a.4.12	Security Staff Cost	-	-	-	-	-	-	67,604	10,141	77,744	72,380	5,364	-	-	-	-	-	-	-	-	1,098,240
2a.4.13	Utility Staff Cost	-	-	-	-	-	-	23,197	3,480	26,677	21,528	5,149	-	-	-	-	-	-	-	-	328,865
2a.4	Subtotal Period 2a Period-Dependent Costs	-	828	20	5	-	50	114,226	16,570	131,698	112,799	18,899	-	-	921	-	-	-	18,419	30	1,427,105
2a.0	TOTAL PERIOD 2a COST	-	828	20	5	-	50	141,940	20,784	163,625	113,974	49,651	-	-	921	-	-	-	18,419	30	1,427,105
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	-	-	-	-	-	-	4,914	737	5,652	5,652	-	-	-	-	-	-	-	-	-	-
2c.1.5	Maintenance supplies	-	-	-	-	-	-	6,798	1,700	8,498	8,498	-	-	-	-	-	-	-	-	-	-
2c.1	Subtotal Period 2c Activity Costs	-	-	-	-	-	-	11,713	2,437	14,150	14,150	-	-	-	-	-	-	-	-	-	-
Period 2c Period-Dependent Costs																					
2c.4.1	Insurance	-	-	-	-	-	-	32,234	3,223	35,457	35,457	-	-	-	-	-	-	-	-	-	-
2c.4.2	Property taxes	-	-	-	-	-	-	15,605	1,561	17,166	17,166	-	-	-	-	-	-	-	-	-	-
2c.4.3	Health physics supplies	-	4,548	-	-	-	-	-	1,137	5,685	5,685	-	-	-	-	-	-	-	-	-	-
2c.4.4	Disposal of DAW generated	-	-	107	27	-	264	-	81	478	478	-	-	-	4,907	-	-	-	98,142	160	-
2c.4.5	Plant energy budget	-	-	-	-	-	-	10,179	1,527	11,705	11,705	-	-	-	-	-	-	-	-	-	-
2c.4.6	NRC Fees	-	-	-	-	-	-	10,722	1,072	11,795	11,795	-	-	-	-	-	-	-	-	-	-
2c.4.7	Corporate Allocations	-	-	-	-	-	-	743	111	854	854	-	-	-	-	-	-	-	-	-	-
2c.4.8	Security Staff Cost	-	-	-	-	-	-	83,336	12,500	95,837	95,837	-	-	-	-	-	-	-	-	-	1,504,097

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2017 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.4.9	Utility Staff Cost	-	-	-	-	-	-	57,514	8,627	66,141	66,141	-	-	-	-	-	-	-	-	-	877,390
2c.4	Subtotal Period 2c Period-Dependent Costs	-	4,548	107	27	-	264	210,333	29,839	245,117	245,117	-	-	-	4,907	-	-	-	98,142	160	2,381,486
2c.0	TOTAL PERIOD 2c COST	-	4,548	107	27	-	264	222,046	32,276	259,267	259,267	-	-	-	4,907	-	-	-	98,142	160	2,381,486
PERIOD 2 TOTALS		-	5,375	127	32	-	314	363,985	53,060	422,893	373,241	49,651	-	-	5,828	-	-	-	116,561	190	3,808,591
PERIOD 3a - Reactivate Site Following SAFSTOR Dormancy																					
Period 3a Direct Decommissioning Activities																					
3a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	152	23	175	175	-	-	-	-	-	-	-	-	-	1,300
3a.1.2	Review plant dwgs & specs.	-	-	-	-	-	-	538	81	618	618	-	-	-	-	-	-	-	-	-	4,600
3a.1.3	Perform detailed rad survey									a											
3a.1.4	End product description	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
3a.1.5	Detailed by-product inventory	-	-	-	-	-	-	152	23	175	175	-	-	-	-	-	-	-	-	-	1,300
3a.1.6	Define major work sequence	-	-	-	-	-	-	877	131	1,008	1,008	-	-	-	-	-	-	-	-	-	7,500
3a.1.7	Perform SER and EA	-	-	-	-	-	-	362	54	417	417	-	-	-	-	-	-	-	-	-	3,100
3a.1.8	Perform Site-Specific Cost Study	-	-	-	-	-	-	584	88	672	672	-	-	-	-	-	-	-	-	-	5,000
Activity Specifications																					
3a.1.9.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	861	129	991	892	-	99	-	-	-	-	-	-	-	7,370
3a.1.9.2	Plant systems	-	-	-	-	-	-	487	73	560	504	-	56	-	-	-	-	-	-	-	4,167
3a.1.9.3	Reactor internals	-	-	-	-	-	-	830	124	954	954	-	-	-	-	-	-	-	-	-	7,100
3a.1.9.4	Reactor vessel	-	-	-	-	-	-	760	114	874	874	-	-	-	-	-	-	-	-	-	6,500
3a.1.9.5	Biological shield	-	-	-	-	-	-	58	9	67	67	-	-	-	-	-	-	-	-	-	500
3a.1.9.6	Steam generators	-	-	-	-	-	-	365	55	419	419	-	-	-	-	-	-	-	-	-	3,120
3a.1.9.7	Reinforced concrete	-	-	-	-	-	-	187	28	215	108	-	108	-	-	-	-	-	-	-	1,600
3a.1.9.8	Main Turbine	-	-	-	-	-	-	47	7	54	-	-	54	-	-	-	-	-	-	-	400
3a.1.9.9	Main Condensers	-	-	-	-	-	-	47	7	54	-	-	54	-	-	-	-	-	-	-	400
3a.1.9.10	Plant structures & buildings	-	-	-	-	-	-	365	55	419	210	-	210	-	-	-	-	-	-	-	3,120
3a.1.9.11	Waste management	-	-	-	-	-	-	538	81	618	618	-	-	-	-	-	-	-	-	-	4,600
3a.1.9.12	Facility & site closeout	-	-	-	-	-	-	105	16	121	60	-	60	-	-	-	-	-	-	-	900
3a.1.9	Total	-	-	-	-	-	-	4,649	697	5,346	4,706	-	640	-	-	-	-	-	-	-	39,777
Planning & Site Preparations																					
3a.1.10	Prepare dismantling sequence	-	-	-	-	-	-	281	42	323	323	-	-	-	-	-	-	-	-	-	2,400
3a.1.11	Plant prep. & temp. svces	-	-	-	-	-	-	3,300	495	3,795	3,795	-	-	-	-	-	-	-	-	-	-
3a.1.12	Design water clean-up system	-	-	-	-	-	-	164	25	188	188	-	-	-	-	-	-	-	-	-	1,400
3a.1.13	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,300	345	2,645	2,645	-	-	-	-	-	-	-	-	-	-
3a.1.14	Procure casks/liners & containers	-	-	-	-	-	-	144	22	165	165	-	-	-	-	-	-	-	-	-	1,230
3a.1	Subtotal Period 3a Activity Costs	-	-	-	-	-	-	13,619	2,043	15,662	15,021	-	640	-	-	-	-	-	-	-	68,607
Period 3a Period-Dependent Costs																					
3a.4.1	Insurance	-	-	-	-	-	-	669	67	736	736	-	-	-	-	-	-	-	-	-	-
3a.4.2	Property taxes	-	-	-	-	-	-	324	32	356	356	-	-	-	-	-	-	-	-	-	-
3a.4.3	Health physics supplies	-	450	-	-	-	-	-	113	563	563	-	-	-	-	-	-	-	-	-	-
3a.4.4	Heavy equipment rental	-	567	-	-	-	-	-	85	652	652	-	-	-	-	-	-	-	-	-	-
3a.4.5	Disposal of DAW generated	-	-	11	3	-	28	-	8	50	50	-	-	-	514	-	-	-	10,287	17	-
3a.4.6	Plant energy budget	-	-	-	-	-	-	2,111	317	2,428	2,428	-	-	-	-	-	-	-	-	-	-
3a.4.7	NRC Fees	-	-	-	-	-	-	341	34	376	376	-	-	-	-	-	-	-	-	-	-
3a.4.8	Corporate Allocations	-	-	-	-	-	-	218	33	251	251	-	-	-	-	-	-	-	-	-	-
3a.4.9	Security Staff Cost	-	-	-	-	-	-	2,311	347	2,658	2,658	-	-	-	-	-	-	-	-	-	65,000
3a.4.10	Utility Staff Cost	-	-	-	-	-	-	17,990	2,699	20,689	20,689	-	-	-	-	-	-	-	-	-	257,920
3a.4	Subtotal Period 3a Period-Dependent Costs	-	1,018	11	3	-	28	23,965	3,734	28,758	28,758	-	-	-	514	-	-	-	10,287	17	322,920
3a.0	TOTAL PERIOD 3a COST	-	1,018	11	3	-	28	37,583	5,777	44,420	43,779	-	640	-	514	-	-	-	10,287	17	391,527
PERIOD 3b - Decommissioning Preparations																					
Period 3b Direct Decommissioning Activities																					
Detailed Work Procedures																					
3b.1.1.1	Plant systems	-	-	-	-	-	-	553	83	636	573	-	64	-	-	-	-	-	-	-	4,733
3b.1.1.2	Reactor internals	-	-	-	-	-	-	292	44	336	336	-	-	-	-	-	-	-	-	-	2,500
3b.1.1.3	Remaining buildings	-	-	-	-	-	-	158	24	181	45	-	136	-	-	-	-	-	-	-	1,350
3b.1.1.4	CRD cooling assembly	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.5	CRD housings & ICI tubes	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.6	Incore instrumentation	-	-	-	-	-	-	117	18	134	134	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.7	Reactor vessel	-	-	-	-	-	-	424	64	488	488	-	-	-	-	-	-	-	-	-	3,630

Table D
Wolf Creek Generating Station
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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			
Detailed Work Procedures (continued)																					
3b.1.1.8	Facility closeout	-	-	-	-	-	-	140	21	161	81	-	81	-	-	-	-	-	-	-	1,200
3b.1.1.9	Missile shields	-	-	-	-	-	-	53	8	60	60	-	-	-	-	-	-	-	-	-	450
3b.1.1.10	Biological shield	-	-	-	-	-	-	140	21	161	161	-	-	-	-	-	-	-	-	-	1,200
3b.1.1.11	Steam generators	-	-	-	-	-	-	538	81	618	618	-	-	-	-	-	-	-	-	-	4,600
3b.1.1.12	Reinforced concrete	-	-	-	-	-	-	117	18	134	67	-	67	-	-	-	-	-	-	-	1,000
3b.1.1.13	Main Turbine	-	-	-	-	-	-	182	27	210	-	-	210	-	-	-	-	-	-	-	1,560
3b.1.1.14	Main Condensers	-	-	-	-	-	-	182	27	210	-	-	210	-	-	-	-	-	-	-	1,560
3b.1.1.15	Auxiliary building	-	-	-	-	-	-	319	48	367	330	-	37	-	-	-	-	-	-	-	2,730
3b.1.1.16	Reactor building	-	-	-	-	-	-	319	48	367	330	-	37	-	-	-	-	-	-	-	2,730
3b.1.1	Total	-	-	-	-	-	-	3,769	565	4,334	3,494	-	840	-	-	-	-	-	-	-	32,243
3b.1	Subtotal Period 3b Activity Costs	-	-	-	-	-	-	3,769	565	4,334	3,494	-	840	-	-	-	-	-	-	-	32,243
Period 3b Additional Costs																					
3b.2.1	Site Characterization	-	-	-	-	-	-	2,984	895	3,880	3,880	-	-	-	-	-	-	-	-	19,100	7,852
3b.2	Subtotal Period 3b Additional Costs	-	-	-	-	-	-	2,984	895	3,880	3,880	-	-	-	-	-	-	-	-	19,100	7,852
Period 3b Collateral Costs																					
3b.3.1	Decon equipment	973	-	-	-	-	-	-	146	1,119	1,119	-	-	-	-	-	-	-	-	-	-
3b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,323	198	1,521	1,521	-	-	-	-	-	-	-	-	-	-
3b.3.3	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	973	1,200	-	-	-	-	1,323	524	4,020	4,020	-	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Decon supplies	36	-	-	-	-	-	-	9	44	44	-	-	-	-	-	-	-	-	-	-
3b.4.2	Insurance	-	-	-	-	-	-	349	35	384	384	-	-	-	-	-	-	-	-	-	-
3b.4.3	Property taxes	-	-	-	-	-	-	163	16	180	180	-	-	-	-	-	-	-	-	-	-
3b.4.4	Health physics supplies	-	250	-	-	-	-	-	63	313	313	-	-	-	-	-	-	-	-	-	-
3b.4.5	Heavy equipment rental	-	286	-	-	-	-	-	43	329	329	-	-	-	-	-	-	-	-	-	-
3b.4.6	Disposal of DAW generated	-	-	6	2	-	16	-	5	29	29	-	-	-	293	-	-	-	5,866	10	-
3b.4.7	Plant energy budget	-	-	-	-	-	-	1,064	160	1,224	1,224	-	-	-	-	-	-	-	-	-	-
3b.4.8	NRC Fees	-	-	-	-	-	-	172	17	189	189	-	-	-	-	-	-	-	-	-	-
3b.4.9	Corporate Allocations	-	-	-	-	-	-	110	17	127	127	-	-	-	-	-	-	-	-	-	-
3b.4.10	Security Staff Cost	-	-	-	-	-	-	1,165	175	1,340	1,340	-	-	-	-	-	-	-	-	-	32,767
3b.4.11	DOC Staff Cost	-	-	-	-	-	-	4,865	730	5,595	5,595	-	-	-	-	-	-	-	-	-	58,719
3b.4.12	Utility Staff Cost	-	-	-	-	-	-	9,069	1,360	10,429	10,429	-	-	-	-	-	-	-	-	-	130,020
3b.4	Subtotal Period 3b Period-Dependent Costs	36	536	6	2	-	16	16,958	2,629	20,182	20,182	-	-	-	293	-	-	-	5,866	10	221,506
3b.0	TOTAL PERIOD 3b COST	1,008	1,736	6	2	-	16	25,034	4,614	32,416	31,575	-	840	-	293	-	-	-	5,866	19,110	261,601
PERIOD 3 TOTALS		1,008	2,754	18	4	-	43	62,617	10,391	76,835	75,355	-	1,481	-	808	-	-	-	16,153	19,126	653,128
PERIOD 4a - Large Component Removal																					
Period 4a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
4a.1.1.1	Reactor Coolant Piping	25	129	42	28	137	271	-	142	775	775	-	-	967	1,023	-	-	-	135,750	3,982	-
4a.1.1.2	Pressurizer Relief Tank	4	16	12	8	39	77	-	34	190	190	-	-	273	289	-	-	-	38,367	602	-
4a.1.1.3	Reactor Coolant Pumps & Motors	16	65	62	199	-	1,061	-	326	1,728	1,728	-	-	-	3,386	-	-	-	816,140	2,700	80
4a.1.1.4	Pressurizer	7	37	420	147	-	1,171	-	370	2,152	2,152	-	-	-	3,739	-	-	-	241,053	1,539	1,500
4a.1.1.5	Steam Generators	54	5,183	2,904	3,116	2,688	7,063	-	4,249	25,257	25,257	-	-	40,845	22,546	-	-	-	3,356,336	22,021	4,500
4a.1.1.6	CRDMs/ICIs/Service Structure Removal	21	178	248	37	97	439	-	210	1,230	1,230	-	-	1,227	3,012	-	-	-	160,939	5,371	-
4a.1.1.7	Reactor Vessel Internals	87	6,283	7,575	1,270	-	10,290	337	12,163	38,006	38,006	-	-	-	2,504	501	393	-	329,177	28,573	1,301
4a.1.1.8	Vessel & Internals GTCC Disposal	-	-	-	-	-	11,615	-	1,742	13,357	13,357	-	-	-	-	-	-	2,217	433,180	-	-
4a.1.1.9	Reactor Vessel	-	7,807	2,219	496	-	4,897	337	9,033	24,788	24,788	-	-	-	15,631	-	-	-	979,036	28,573	1,301
4a.1.1	Totals	215	19,699	13,483	5,301	2,960	36,883	674	28,268	107,483	107,483	-	-	43,312	52,130	501	393	2,217	6,489,979	93,362	8,683
Removal of Major Equipment																					
4a.1.2	Main Turbine/Generator	-	297	283	37	652	-	-	206	1,475	1,475	-	-	5,099	-	-	-	-	305,952	8,585	-
4a.1.3	Main Condensers	-	842	176	45	777	-	-	351	2,191	2,191	-	-	8,106	-	-	-	-	364,767	24,802	-
Cascading Costs from Clean Building Demolition																					
4a.1.4.1	Reactor	-	443	-	-	-	-	-	66	510	510	-	-	-	-	-	-	-	-	4,871	-
4a.1.4.2	Auxiliary	-	229	-	-	-	-	-	34	264	264	-	-	-	-	-	-	-	-	2,194	-
4a.1.4.3	Fuel Building	-	97	-	-	-	-	-	15	112	112	-	-	-	-	-	-	-	-	773	-
4a.1.4.4	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	7	-
4a.1.4.5	Radwaste	-	44	-	-	-	-	-	7	51	51	-	-	-	-	-	-	-	-	387	-
4a.1.4	Totals	-	815	-	-	-	-	-	122	937	937	-	-	-	-	-	-	-	-	8,233	-

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Wolf Creek Generating Station
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Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems																					
4a.1.5.1	AB - Main Steam	-	163	-	-	-	-	-	24	187	-	-	187	-	-	-	-	-	-	5,833	-
4a.1.5.2	AB - Main Steam RCA	-	60	4	11	186	-	-	45	305	305	-	-	2,156	-	-	-	-	87,550	1,515	-
4a.1.5.3	AC - Main Turbine	-	163	-	-	-	-	-	24	187	-	-	187	-	-	-	-	-	-	5,641	-
4a.1.5.4	AD - Condensate	-	181	-	-	-	-	-	27	208	-	-	208	-	-	-	-	-	-	6,144	-
4a.1.5.5	AE - Feedwater	-	123	-	-	-	-	-	19	142	-	-	142	-	-	-	-	-	-	4,271	-
4a.1.5.6	AF - Feedwater Hter Extrction, Drn & Vnt	-	152	-	-	-	-	-	23	175	-	-	175	-	-	-	-	-	-	5,352	-
4a.1.5.7	AK - Condensate Demineralizer	-	56	-	-	-	-	-	8	65	-	-	65	-	-	-	-	-	-	1,944	-
4a.1.5.8	AL - Auxiliary Feedwater	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	1,174	-
4a.1.5.9	AL-Auxiliary Feedwater Surge Tanks	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	87	-
4a.1.5.10	AQ - Condensate & Feedwater Chem Additn	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	468	-
4a.1.5.11	AX - Acid Feed	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	754	-
4a.1.5.12	Auxiliary Bldg Non-System Specific	-	77	2	5	71	8	-	33	195	195	-	-	824	31	-	-	-	35,454	2,031	-
4a.1.5.13	Auxiliary Bldg Non-System Specific RCA	-	537	13	38	660	-	-	240	1,487	1,487	-	-	7,629	-	-	-	-	309,812	13,471	-
4a.1.5.14	BL - Reactor Makeup Water	-	203	15	18	219	102	-	113	670	670	-	-	2,529	418	-	-	-	129,620	5,227	-
4a.1.5.15	BM - Steam Generator Blowdown	-	413	8	26	446	-	-	175	1,069	1,069	-	-	5,160	-	-	-	-	209,560	10,703	-
4a.1.5.16	CA - Steam Seal	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	455	-
4a.1.5.17	CB - Main Turbine Lube Oil	-	38	-	-	-	-	-	6	43	-	-	43	-	-	-	-	-	-	1,207	-
4a.1.5.18	CC - Generator Hydrogen & CO2	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	198	-
4a.1.5.19	CD - Generator Seal Oil	-	8	-	-	-	-	-	1	10	-	-	10	-	-	-	-	-	-	287	-
4a.1.5.20	CE - Stator Cooling Water	-	7	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	241	-
4a.1.5.21	CF - Lube Oil Strg, Xfer & Purification	-	24	-	-	-	-	-	4	28	-	-	28	-	-	-	-	-	-	812	-
4a.1.5.22	CG - Condenser Air Removal	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	657	-
4a.1.5.23	CH - Main Turbine Control Oil	-	39	-	-	-	-	-	6	45	-	-	45	-	-	-	-	-	-	1,219	-
4a.1.5.24	CL - Chlorination	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	569	-
4a.1.5.25	CO - Carbon Dioxide	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	121	-
4a.1.5.26	CW - Circulating Water	-	219	-	-	-	-	-	33	252	-	-	252	-	-	-	-	-	-	7,858	-
4a.1.5.27	CZ - Caustic Acid	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	111	-
4a.1.5.28	DA - Circulating Water System	-	223	-	-	-	-	-	33	256	-	-	256	-	-	-	-	-	-	7,953	-
4a.1.5.29	DM - Equipment Drains	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,223	-
4a.1.5.30	DM - Equipment Drains RCA	-	111	26	77	1,336	-	-	242	1,793	1,793	-	-	15,445	-	-	-	-	627,223	2,840	-
4a.1.5.31	EG - Component Cooling Water RCA	-	557	24	70	1,225	-	-	336	2,213	2,213	-	-	14,161	-	-	-	-	575,071	13,646	-
4a.1.5.32	EJ - Residual Heat Removal	-	261	33	38	386	283	-	203	1,203	1,203	-	-	4,461	1,166	-	-	-	255,554	7,018	-
4a.1.5.33	EM - High Pressure Coolant Injection	-	220	4	11	187	-	-	85	506	506	-	-	2,159	-	-	-	-	87,663	5,527	-
4a.1.5.34	EN - Containment Spray	-	170	5	15	262	-	-	84	536	536	-	-	3,026	-	-	-	-	122,874	4,134	-
4a.1.5.35	FB - Auxiliary Steam	-	60	-	-	-	-	-	9	69	-	-	69	-	-	-	-	-	-	2,106	-
4a.1.5.36	FB - Auxiliary Steam RCA	-	66	1	4	71	-	-	28	169	169	-	-	816	-	-	-	-	33,148	1,537	-
4a.1.5.37	FC - Auxiliary Turbines	-	39	-	-	-	-	-	6	45	-	-	45	-	-	-	-	-	-	1,301	-
4a.1.5.38	FE - Auxiliary Steam Chemical Addition	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	105	-
4a.1.5.39	GE - Turbine Bldg HVAC	-	86	-	-	-	-	-	13	99	-	-	99	-	-	-	-	-	-	3,189	-
4a.1.5.40	GF - Miscellaneous Building HVAC	-	26	-	-	-	-	-	4	30	-	-	30	-	-	-	-	-	-	987	-
4a.1.5.41	GS - Containment Hydrogen Control	-	53	1	4	69	-	-	24	152	152	-	-	801	-	-	-	-	32,539	1,395	-
4a.1.5.42	HF - Secondary Liquid Waste	-	677	52	63	729	387	-	390	2,298	2,298	-	-	8,431	1,588	-	-	-	444,251	17,832	-
4a.1.5.43	HY - Hydrogen	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	223	-
4a.1.5.44	KH - Service Gas	-	20	-	-	-	-	-	3	23	-	-	23	-	-	-	-	-	-	644	-
4a.1.5.45	LE - Oily Waste	-	74	-	-	-	-	-	11	85	-	-	85	-	-	-	-	-	-	2,575	-
4a.1.5.46	LE - Oily Waste RCA	-	153	3	9	149	-	-	62	376	376	-	-	1,718	-	-	-	-	69,785	3,518	-
4a.1.5.47	NT - Nitrogen	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	149	-
4a.1.5.48	OX - Oxygen	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	171	-
4a.1.5.49	SW - Screen Wash	-	20	-	-	-	-	-	3	23	-	-	23	-	-	-	-	-	-	635	-
4a.1.5.50	Turbine Bldg Non-System Specific	-	471	-	-	-	-	-	71	542	-	-	542	-	-	-	-	-	-	15,405	-
4a.1.5.51	VH - Circ Water & Makeup Water Scrnhs	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	272	-
4a.1.5.52	VV - Misc Bldg HVAC	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	148	-
4a.1.5.53	WG - Gland Water & Motor Cooling Water	-	16	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	593	-
4a.1.5.54	WL - Cooling Lake Makeup & Blowdown	-	22	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	745	-
4a.1.5	Totals	-	5,989	191	387	5,996	779	-	2,426	15,768	12,973	-	2,795	69,317	3,203	-	-	-	3,020,102	174,218	-
4a.1.6	Scaffolding in support of decommissioning	-	947	29	8	116	26	-	265	1,390	1,390	-	-	1,206	106	-	-	-	61,032	33,925	-
4a.1	Subtotal Period 4a Activity Costs	215	28,590	14,162	5,778	10,501	37,688	674	31,638	129,245	126,450	-	2,795	127,040	55,440	501	393	2,217	10,241,830	343,124	8,683
Period 4a Additional Costs																					
4a.2.1	Remedial Action Surveys	-	-	-	-	-	-	1,580	474	2,054	2,054	-	-	-	-	-	-	-	-	32,347	-
4a.2	Subtotal Period 4a Additional Costs	-	-	-	-	-	-	1,580	474	2,054	2,054	-	-	-	-	-	-	-	-	32,347	-
Period 4a Collateral Costs																					
4a.3.1	Process decommissioning water waste	5	-	8	19	-	36	-	15	82	82	-	-	-	78	-	-	-	4,664	15	-
4a.3.3	Small tool allowance	-	236	-	-	-	-	-	35	271	244	-	27	-	-	-	-	-	-	-	-
4a.3.4	On-site survey and release of 116.8 tons clean metallic waste	-	-	-	-	-	-	166	17	182	182	-	-	-	-	-	-	-	-	-	-
4a.3	Subtotal Period 4a Collateral Costs	5	236	8	19	-	36	166	67	536	509	-	27	-	78	-	-	-	4,664	15	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2017 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 4a Period-Dependent Costs																					
4a.4.1	Decon supplies	110	-	-	-	-	-	-	27	137	137	-	-	-	-	-	-	-	-	-	-
4a.4.2	Insurance	-	-	-	-	-	-	1,079	108	1,187	1,187	-	-	-	-	-	-	-	-	-	-
4a.4.3	Property taxes	-	-	-	-	-	-	504	50	554	554	-	-	-	-	-	-	-	-	-	-
4a.4.4	Health physics supplies	-	2,583	-	-	-	-	-	646	3,229	3,229	-	-	-	-	-	-	-	-	-	-
4a.4.5	Heavy equipment rental	-	3,417	-	-	-	-	-	513	3,929	3,929	-	-	-	-	-	-	-	-	-	-
4a.4.6	Disposal of DAW generated	-	-	115	29	-	284	-	87	513	513	-	-	-	5,271	-	-	-	105,415	172	-
4a.4.7	Plant energy budget	-	-	-	-	-	-	3,121	468	3,590	3,590	-	-	-	-	-	-	-	-	-	-
4a.4.8	NRC Fees	-	-	-	-	-	-	867	87	954	954	-	-	-	-	-	-	-	-	-	-
4a.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	630	94	724	724	-	-	-	-	-	-	-	-	-	-
4a.4.10	Corporate Allocations	-	-	-	-	-	-	343	51	394	394	-	-	-	-	-	-	-	-	-	-
4a.4.11	Security Staff Cost	-	-	-	-	-	-	3,596	539	4,136	4,136	-	-	-	-	-	-	-	-	-	101,151
4a.4.12	DOC Staff Cost	-	-	-	-	-	-	17,745	2,662	20,407	20,407	-	-	-	-	-	-	-	-	-	223,341
4a.4.13	Utility Staff Cost	-	-	-	-	-	-	28,338	4,251	32,589	32,589	-	-	-	-	-	-	-	-	-	404,603
4a.4	Subtotal Period 4a Period-Dependent Costs	110	6,000	115	29	-	284	56,223	9,583	72,343	72,343	-	-	-	5,271	-	-	-	105,415	172	729,094
4a.0	TOTAL PERIOD 4a COST	329	34,826	14,284	5,826	10,501	38,007	58,643	41,762	204,177	201,355	-	2,822	127,040	60,788	501	393	2,217	10,351,910	375,658	737,777
PERIOD 4b - Site Decontamination																					
Period 4b Direct Decommissioning Activities																					
4b.1.1	Remove spent fuel racks	475	50	281	83	-	1,509	-	668	3,065	3,065	-	-	-	6,250	-	-	-	397,077	1,722	-
Disposal of Plant Systems																					
4b.1.2.1	AN - Demineralized Wtr Storage & xfer	-	45	-	-	-	-	-	7	51	-	-	51	-	-	-	-	-	-	1,548	-
4b.1.2.2	AN - Demineralized Wtr Strg & xfer RCA	-	15	0	1	10	-	-	5	32	32	-	-	120	-	-	-	-	4,855	334	-
4b.1.2.3	AP - Condensate Storage & Transfer	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	1,660	-
4b.1.2.4	BB - Reactor Coolant	-	205	28	27	217	271	-	158	907	907	-	-	2,511	1,121	-	-	-	173,293	5,731	-
4b.1.2.5	BG - Chemical & Volume Control	-	661	74	75	705	630	-	447	2,592	2,592	-	-	8,155	2,586	-	-	-	496,849	17,005	-
4b.1.2.6	BN - Borated Refueling Water Storage	-	222	10	31	541	-	-	142	946	946	-	-	6,255	-	-	-	-	254,024	6,161	-
4b.1.2.7	Control Bldg Non-System Specific	-	139	4	11	185	-	-	64	402	402	-	-	2,139	-	-	-	-	86,849	3,413	-
4b.1.2.8	Control Bldg Non-System Specific Cln	-	988	-	-	-	-	-	148	1,137	-	-	1,137	-	-	-	-	-	-	29,076	-
4b.1.2.9	DO - Diesel Oil	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	48	-
4b.1.2.10	EA - Service Water	-	74	-	-	-	-	-	11	85	-	-	85	-	-	-	-	-	-	2,592	-
4b.1.2.11	EB - Closed Cooling Water	-	36	-	-	-	-	-	5	42	-	-	42	-	-	-	-	-	-	1,267	-
4b.1.2.12	EC - Fuel Pool Cooling & Cleanup	-	279	7	20	356	-	-	127	789	789	-	-	4,115	-	-	-	-	167,129	7,154	-
4b.1.2.13	EF - Essential Service Water	-	108	-	-	-	-	-	16	124	-	-	124	-	-	-	-	-	-	3,800	-
4b.1.2.14	EF - Essential Service Water RCA	-	70	2	7	123	-	-	37	240	240	-	-	1,427	-	-	-	-	57,959	1,734	-
4b.1.2.15	EP - Accumulator Safety Injection	-	113	3	10	169	-	-	56	351	351	-	-	1,958	-	-	-	-	79,502	2,904	-
4b.1.2.16	FA - Auxiliary Steam Generator	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	521	-
4b.1.2.17	FO - Fuel Oil	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	486	-
4b.1.2.18	FP - Fire Protection	-	107	-	-	-	-	-	16	123	-	-	123	-	-	-	-	-	-	3,826	-
4b.1.2.19	FP - Fire Protection RCA	-	150	8	22	389	-	-	100	669	669	-	-	4,492	-	-	-	-	182,411	3,541	-
4b.1.2.20	Fuel Bldg Non-System Specific	-	34	1	2	28	3	-	14	81	81	-	-	322	12	-	-	-	13,829	850	-
4b.1.2.21	Fuel Bldg Non-System Specific RCA	-	245	5	16	277	-	-	106	649	649	-	-	3,200	-	-	-	-	129,974	5,859	-
4b.1.2.22	Fuel Building Fire Protection	-	119	5	15	254	-	-	71	463	463	-	-	2,941	-	-	-	-	119,444	2,802	-
4b.1.2.23	GA - Plant Heating	-	55	-	-	-	-	-	8	63	-	-	63	-	-	-	-	-	-	1,912	-
4b.1.2.24	GA - Plant Heating RCA	-	92	1	4	64	-	-	33	194	194	-	-	746	-	-	-	-	30,275	2,072	-
4b.1.2.25	GB - Central Chilled Water	-	52	-	-	-	-	-	8	59	-	-	59	-	-	-	-	-	-	1,803	-
4b.1.2.26	GB - Central Chilled Water RCA	-	21	0	1	16	-	-	8	47	47	-	-	187	-	-	-	-	7,591	482	-
4b.1.2.27	GD - Esstl Srvc Wtr Pumphs Bldg HVAC	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	284	-
4b.1.2.28	GG - Fuel Building HVAC	-	183	6	20	341	-	-	100	650	650	-	-	3,945	-	-	-	-	160,195	4,052	-
4b.1.2.29	GH - Radwaste Building HVAC	-	133	4	13	222	-	-	69	440	440	-	-	2,561	-	-	-	-	104,012	3,004	-
4b.1.2.30	GK - Control Building HVAC	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	3,959	-
4b.1.2.31	GL - Auxiliary Building HVAC	-	332	9	27	465	-	-	158	991	991	-	-	5,381	-	-	-	-	218,514	7,364	-
4b.1.2.32	GM - Diesel Generator Building HVAC	-	17	-	-	-	-	-	3	20	-	-	20	-	-	-	-	-	-	695	-
4b.1.2.33	GN - Containment Cooling	-	359	14	41	714	-	-	204	1,331	1,331	-	-	8,250	-	-	-	-	335,052	8,317	-
4b.1.2.34	GP - Containmnt Integratd Leak Rate Test	-	30	1	3	50	-	-	16	100	100	-	-	580	-	-	-	-	23,570	750	-
4b.1.2.35	GR - Containment Atmospheric Control	-	13	2	6	99	-	-	19	138	138	-	-	1,143	-	-	-	-	46,407	350	-
4b.1.2.36	GT - Contaiment Purge HVAC	-	84	4	11	189	-	-	51	339	339	-	-	2,185	-	-	-	-	88,746	1,973	-
4b.1.2.37	HA - Gaseous Radwaste	-	256	6	18	320	-	-	115	716	716	-	-	3,699	-	-	-	-	150,219	6,296	-
4b.1.2.38	HB - Liquid Radwaste	-	602	50	56	635	356	-	348	2,047	2,047	-	-	7,343	1,450	-	-	-	391,794	15,380	-
4b.1.2.39	HC - Solid Radwaste	-	339	35	36	345	295	-	219	1,269	1,269	-	-	3,986	1,211	-	-	-	239,489	8,570	-
4b.1.2.40	HD - Decontamination	-	71	2	6	106	-	-	35	219	219	-	-	1,220	-	-	-	-	49,558	1,828	-
4b.1.2.41	HE - Boron Recycle	-	351	25	28	299	194	-	188	1,086	1,086	-	-	3,460	794	-	-	-	191,531	8,970	-
4b.1.2.42	JE - Emergency Fuel Oil	-	40	-	-	-	-	-	6	46	-	-	46	-	-	-	-	-	-	1,260	-
4b.1.2.43	KA - Compressed Air and Instrument	-	178	-	-	-	-	-	27	205	-	-	205	-	-	-	-	-	-	6,089	-
4b.1.2.44	KB - Breathing Air	-	31	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	1,075	-
4b.1.2.45	KC - Fire Protection	-	262	-	-	-	-	-	39	301	-	-	301	-	-	-	-	-	-	9,256	-
4b.1.2.46	KC - Fire Protection RCA	-	271	10	30	514	-	-	150	975	975	-	-	5,944	-	-	-	-	241,384	6,383	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2017 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems (continued)																					
4b.1.2.47	KD - Domestic Water	-	50	-	-	-	-	-	7	57	-	-	57	-	-	-	-	-	-	1,708	-
4b.1.2.48	KE - Fuel Hndlg & Strg Reactor Vssl Serv	-	12	1	4	76	-	-	15	110	110	-	-	882	-	-	-	-	35,813	332	-
4b.1.2.49	KJ - Standby Diesel Engine	-	208	-	-	-	-	-	31	239	-	-	239	-	-	-	-	-	-	6,749	-
4b.1.2.50	LA - Sanitary Drains	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	290	-
4b.1.2.51	LA - Sanitary Drains RCA	-	21	0	1	24	-	-	9	55	55	-	-	272	-	-	-	-	11,053	422	-
4b.1.2.52	LB - Roof Drains	-	37	-	-	-	-	-	5	42	-	-	42	-	-	-	-	-	-	1,276	-
4b.1.2.53	LB - Roof Drains RCA	-	113	4	11	185	-	-	58	371	371	-	-	2,139	-	-	-	-	86,858	2,694	-
4b.1.2.54	LC - Yard Drains	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	96	-
4b.1.2.55	LD - Chemical & Detergent Waste	-	83	1	4	69	-	-	32	190	190	-	-	797	-	-	-	-	32,369	2,139	-
4b.1.2.56	LF - Floor & Equipment Drains	-	1,036	88	81	576	878	-	586	3,245	3,245	-	-	6,660	3,627	-	-	-	501,387	26,164	-
4b.1.2.57	RM - Process Sampling & Analysis	-	90	2	5	86	-	-	36	219	219	-	-	990	-	-	-	-	40,200	2,450	-
4b.1.2.58	Radwaste Bldg Non-System Specific	-	126	3	7	115	12	-	53	317	317	-	-	1,329	50	-	-	-	57,145	3,253	-
4b.1.2.59	Radwaste Bldg Non-System Specific RCA	-	893	22	63	1,097	-	-	400	2,475	2,475	-	-	12,684	-	-	-	-	515,103	21,919	-
4b.1.2.60	Reactor Bldg Non-System Specific	-	65	1	3	43	5	-	24	141	141	-	-	502	19	-	-	-	21,590	1,569	-
4b.1.2.61	Reactor Bldg Non-System Specific RCA	-	460	8	24	412	-	-	181	1,086	1,086	-	-	4,768	-	-	-	-	193,612	10,425	-
4b.1.2.62	SBO Diesel Generator	-	113	-	-	-	-	-	17	130	-	-	130	-	-	-	-	-	-	3,610	-
4b.1.2.63	SJ - Nuclear Sampling	-	51	1	3	59	-	-	22	136	136	-	-	677	-	-	-	-	27,501	1,430	-
4b.1.2.64	ST - Sewage Treatment	-	67	-	-	-	-	-	10	77	-	-	77	-	-	-	-	-	-	2,316	-
4b.1.2.65	SZ - Service Air	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	1,892	-
4b.1.2.66	VA - I&C Shop HVAC	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	155	-
4b.1.2.67	VB - I&C Shop Computer Room HVAC	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	106	-
4b.1.2.68	VC - Health Physics Computer Room HVAC	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	208	-
4b.1.2.69	VJ - Shop Bldg Machine Shop Area Vent	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	57	-
4b.1.2.70	VL - Shop Building HVAC	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	101	-
4b.1.2.71	VS - Admin Bldg HVAC	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	262	-
4b.1.2.72	VT - Tech Support Building HVAC	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	87	-
4b.1.2.73	VW - Waste Water Treatment Ventilation	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	52	-
4b.1.2.74	WD - Domestic Water	-	24	-	-	-	-	-	4	28	-	-	28	-	-	-	-	-	-	870	-
4b.1.2.75	WM - Makeup Demineralizer	-	113	-	-	-	-	-	17	130	-	-	130	-	-	-	-	-	-	3,929	-
4b.1.2.76	WS - Plant Services Water	-	93	-	-	-	-	-	14	107	-	-	107	-	-	-	-	-	-	3,297	-
4b.1.2.77	WS - Plant Services Water RCA	-	29	3	9	159	-	-	33	233	233	-	-	1,838	-	-	-	-	74,625	782	-
4b.1.2.78	WT - Waste Water Treatment	-	22	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	769	-
4b.1.2.79	WZ - Radioactive Liquid Waste	-	32	4	3	21	40	-	22	124	124	-	-	247	167	-	-	-	20,647	783	-
4b.1.2.80	Yard Non-System Specific	-	18	-	-	-	-	-	3	21	-	-	21	-	-	-	-	-	-	603	-
4b.1.2	Totals	-	11,425	456	753	10,557	2,683	-	4,967	30,840	27,363	-	3,477	122,048	11,036	-	-	-	5,662,357	307,229	-
4b.1.3	Scaffolding in support of decommissioning	-	1,421	43	12	173	39	-	397	2,085	2,085	-	-	1,809	160	-	-	-	91,548	50,887	-
Decontamination of Site Buildings																					
4b.1.4.1	Reactor	797	692	51	186	515	494	-	805	3,541	3,541	-	-	5,955	13,318	-	-	-	874,477	38,225	-
4b.1.4.2	Auxiliary	410	180	15	52	189	135	-	321	1,301	1,301	-	-	2,185	3,518	-	-	-	255,780	15,363	-
4b.1.4.3	Communication Corridor - Contaminated	9	3	0	1	1	3	-	6	23	23	-	-	17	76	-	-	-	4,296	306	-
4b.1.4.4	Fuel Building	508	516	10	24	234	55	-	437	1,784	1,784	-	-	2,705	984	-	-	-	158,200	27,457	-
4b.1.4.5	Hot Machine Shop	11	5	0	1	-	3	-	8	28	28	-	-	-	94	-	-	-	4,446	421	-
4b.1.4.6	RWST Foundation Decon	-	3	0	2	-	6	-	3	14	14	-	-	-	168	-	-	-	7,920	48	-
4b.1.4.7	Radwaste	218	81	7	26	73	69	-	162	636	636	-	-	844	1,857	-	-	-	122,469	7,815	-
4b.1.4.8	Radwaste Drum Storage	25	8	1	3	6	7	-	17	67	67	-	-	66	208	-	-	-	12,565	850	-
4b.1.4.9	Radwaste Storage Building	62	14	1	7	-	18	-	41	144	144	-	-	-	545	-	-	-	25,740	2,013	-
4b.1.4	Totals	2,041	1,501	86	301	1,018	790	-	1,800	7,538	7,538	-	-	11,773	20,770	-	-	-	1,465,893	92,498	-
4b.1.5	Prepare/submit License Termination Plan	-	-	-	-	-	-	479	72	551	551	-	-	-	-	-	-	-	-	-	4,096
4b.1.6	Receive NRC approval of termination plan									a											
4b.1	Subtotal Period 4b Activity Costs	2,516	14,397	865	1,149	11,749	5,020	479	7,903	44,079	40,602	-	3,477	135,630	38,216	-	-	-	7,616,876	452,336	4,096
Period 4b Additional Costs																					
4b.2.1	Final Survey Program Management	-	-	-	-	-	-	1,340	402	1,742	1,742	-	-	-	-	-	-	-	-	-	12,480
4b.2.2	Remedial Action Surveys	-	-	-	-	-	-	2,528	759	3,287	3,287	-	-	-	-	-	-	-	-	51,767	-
4b.2.3	Operational Equipment	-	-	19	49	624	-	-	103	794	794	-	-	11,710	-	-	-	-	292,750	32	-
4b.2.4	License Termination ISFSI	-	155	205	500	-	2,529	1,964	1,338	6,691	6,691	-	-	-	36,660	-	-	-	1,893,161	5,152	10,496
4b.2	Subtotal Period 4b Additional Costs	-	155	224	549	624	2,529	5,833	2,601	12,514	12,514	-	-	11,710	36,660	-	-	-	2,185,911	56,950	22,976
Period 4b Collateral Costs																					
4b.3.1	Process decommissioning water waste	12	-	21	51	-	93	-	39	216	216	-	-	-	204	-	-	-	12,264	40	-
4b.3.3	Small tool allowance	-	257	-	-	-	-	-	39	295	295	-	-	-	-	-	-	-	-	-	-
4b.3.4	Decommissioning Equipment Disposition	-	-	143	45	575	128	-	139	1,030	1,030	-	-	6,000	529	-	-	-	303,608	147	-
4b.3.5	On-site survey and release of 44.30 tons clean metallic waste	-	-	-	-	-	-	63	6	69	69	-	-	-	-	-	-	-	-	-	-
4b.3	Subtotal Period 4b Collateral Costs	12	257	163	96	575	221	63	223	1,611	1,611	-	-	6,000	733	-	-	-	315,872	187	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2017 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																					
4b.4.1	Decon supplies	1,660	-	-	-	-	-	-	415	2,075	2,075	-	-	-	-	-	-	-	-	-	-
4b.4.2	Insurance	-	-	-	-	-	-	1,726	173	1,899	1,899	-	-	-	-	-	-	-	-	-	-
4b.4.3	Property taxes	-	-	-	-	-	-	806	81	887	887	-	-	-	-	-	-	-	-	-	-
4b.4.4	Health physics supplies	-	3,679	-	-	-	-	-	920	4,599	4,599	-	-	-	-	-	-	-	-	-	-
4b.4.5	Heavy equipment rental	-	5,623	-	-	-	-	-	843	6,466	6,466	-	-	-	-	-	-	-	-	-	-
4b.4.6	Disposal of DAW generated	-	-	141	35	-	349	-	107	633	633	-	-	-	6,495	-	-	-	129,908	212	-
4b.4.7	Plant energy budget	-	-	-	-	-	-	3,944	592	4,535	4,535	-	-	-	-	-	-	-	-	-	-
4b.4.8	NRC Fees	-	-	-	-	-	-	1,388	139	1,527	1,527	-	-	-	-	-	-	-	-	-	-
4b.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	1,008	151	1,159	1,159	-	-	-	-	-	-	-	-	-	-
4b.4.10	Corporate Allocations	-	-	-	-	-	-	517	78	595	595	-	-	-	-	-	-	-	-	-	-
4b.4.11	Security Staff Cost	-	-	-	-	-	-	5,755	863	6,618	6,618	-	-	-	-	-	-	-	-	-	161,877
4b.4.12	DOC Staff Cost	-	-	-	-	-	-	27,705	4,156	31,861	31,861	-	-	-	-	-	-	-	-	-	347,064
4b.4.13	Utility Staff Cost	-	-	-	-	-	-	43,042	6,456	49,498	49,498	-	-	-	-	-	-	-	-	-	611,247
4b.4	Subtotal Period 4b Period-Dependent Costs	1,660	9,302	141	35	-	349	85,891	14,973	112,352	112,352	-	-	-	6,495	-	-	-	129,908	212	1,120,187
4b.0	TOTAL PERIOD 4b COST	4,189	24,111	1,394	1,829	12,948	8,120	92,266	25,701	170,556	167,079	-	3,477	153,340	82,105	-	-	-	10,248,570	509,684	1,147,259
PERIOD 4f - License Termination																					
Period 4f Direct Decommissioning Activities																					
4f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	159	48	207	207	-	-	-	-	-	-	-	-	-	-
4f.1.2	Terminate license									a											
4f.1	Subtotal Period 4f Activity Costs	-	-	-	-	-	-	159	48	207	207	-	-	-	-	-	-	-	-	-	-
Period 4f Additional Costs																					
4f.2.1	Final Site survey	-	-	-	-	-	-	6,489	1,947	8,436	8,436	-	-	-	-	-	-	-	152,819	6,240	
4f.2	Subtotal Period 4f Additional Costs	-	-	-	-	-	-	6,489	1,947	8,436	8,436	-	-	-	-	-	-	-	-	152,819	6,240
Period 4f Collateral Costs																					
4f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,323	198	1,521	1,521	-	-	-	-	-	-	-	-	-	-
4f.3	Subtotal Period 4f Collateral Costs	-	-	-	-	-	-	1,323	198	1,521	1,521	-	-	-	-	-	-	-	-	-	-
Period 4f Period-Dependent Costs																					
4f.4.1	Insurance	-	-	-	-	-	-	536	54	589	589	-	-	-	-	-	-	-	-	-	-
4f.4.2	Property taxes	-	-	-	-	-	-	250	25	275	275	-	-	-	-	-	-	-	-	-	-
4f.4.3	Health physics supplies	-	768	-	-	-	-	-	192	960	960	-	-	-	-	-	-	-	-	-	-
4f.4.4	Disposal of DAW generated	-	-	8	2	-	19	-	6	35	35	-	-	-	360	-	-	-	7,203	12	-
4f.4.5	Plant energy budget	-	-	-	-	-	-	326	49	375	375	-	-	-	-	-	-	-	-	-	-
4f.4.6	NRC Fees	-	-	-	-	-	-	431	43	474	474	-	-	-	-	-	-	-	-	-	-
4f.4.7	Corporate Allocations	-	-	-	-	-	-	65	10	74	74	-	-	-	-	-	-	-	-	-	-
4f.4.8	Security Staff Cost	-	-	-	-	-	-	900	135	1,036	1,036	-	-	-	-	-	-	-	-	-	19,284
4f.4.9	DOC Staff Cost	-	-	-	-	-	-	5,038	756	5,794	5,794	-	-	-	-	-	-	-	-	-	58,656
4f.4.10	Utility Staff Cost	-	-	-	-	-	-	6,051	908	6,959	6,959	-	-	-	-	-	-	-	-	-	76,333
4f.4	Subtotal Period 4f Period-Dependent Costs	-	768	8	2	-	19	13,597	2,177	16,571	16,571	-	-	-	360	-	-	-	7,203	12	154,273
4f.0	TOTAL PERIOD 4f COST	-	768	8	2	-	19	21,568	4,369	26,734	26,734	-	-	-	360	-	-	-	7,203	152,831	160,513
PERIOD 4 TOTALS		4,518	59,704	15,686	7,657	23,448	46,146	172,476	71,832	401,467	395,168	-	6,299	280,380	143,253	501	393	2,217	20,607,680	1,038,173	2,045,549
PERIOD 5b - Site Restoration																					
Period 5b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
5b.1.1.1	Reactor	-	2,518	-	-	-	-	-	378	2,896	-	-	2,896	-	-	-	-	-	-	27,724	-
5b.1.1.2	Access Vaults	-	10	-	-	-	-	-	1	11	-	-	11	-	-	-	-	-	-	59	-
5b.1.1.3	Administration	-	118	-	-	-	-	-	18	135	-	-	135	-	-	-	-	-	-	1,724	-
5b.1.1.4	Auxiliary	-	2,063	-	-	-	-	-	309	2,373	-	-	2,373	-	-	-	-	-	-	19,753	-
5b.1.1.5	Auxiliary Boiler	-	16	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	248	-
5b.1.1.6	Chemical Addition Structure	-	33	-	-	-	-	-	5	37	-	-	37	-	-	-	-	-	-	469	-
5b.1.1.7	Circ Water Pump Enclosure	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	164	-
5b.1.1.8	Circ Water Travel Screen Enclosure	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	160	-
5b.1.1.9	Circulating Water Discharge Structure	-	90	-	-	-	-	-	13	103	-	-	103	-	-	-	-	-	-	542	-
5b.1.1.10	Circulating Water Intake & Screenhouse	-	83	-	-	-	-	-	12	95	-	-	95	-	-	-	-	-	-	683	-
5b.1.1.11	Communication Corridor - Clean	-	683	-	-	-	-	-	102	785	-	-	785	-	-	-	-	-	-	8,280	-
5b.1.1.12	Communication Corridor - Contaminated	-	30	-	-	-	-	-	4	34	-	-	34	-	-	-	-	-	-	184	-
5b.1.1.13	Covered Walkways	-	11	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	242	-
5b.1.1.14	Diesel Generator	-	239	-	-	-	-	-	36	274	-	-	274	-	-	-	-	-	-	2,185	-
5b.1.1.15	E.S.W.S. Pumphouse	-	124	-	-	-	-	-	19	143	-	-	143	-	-	-	-	-	-	801	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2017 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.1.1.16	ESWS Valve House	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	42	-
5b.1.1.17	FLEX Building NO. 1 & 2	-	347	-	-	-	-	-	52	399	-	-	399	-	-	-	-	-	-	2,880	-
5b.1.1.18	Fuel Building	-	909	-	-	-	-	-	136	1,045	-	-	1,045	-	-	-	-	-	-	7,983	-
5b.1.1.19	GOB - Administration Building	-	193	-	-	-	-	-	29	222	-	-	222	-	-	-	-	-	-	2,962	-
5b.1.1.20	Hot Machine Shop	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	243	-
5b.1.1.21	M.M.O. Building	-	225	-	-	-	-	-	34	259	-	-	259	-	-	-	-	-	-	2,389	-
5b.1.1.22	Material Center West	-	72	-	-	-	-	-	11	83	-	-	83	-	-	-	-	-	-	1,379	-
5b.1.1.23	Misc Structures and Additions	-	57	-	-	-	-	-	9	66	-	-	66	-	-	-	-	-	-	910	-
5b.1.1.24	Miscellaneous Site Foundations	-	204	-	-	-	-	-	31	234	-	-	234	-	-	-	-	-	-	1,242	-
5b.1.1.25	Miscellaneous Site Structures	-	1,284	-	-	-	-	-	193	1,477	-	-	1,477	-	-	-	-	-	-	13,693	-
5b.1.1.26	New Covered Walkway	-	6	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	79	-
5b.1.1.27	Oil Separator and Waste Tank	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	8	-
5b.1.1.28	Radwaste	-	864	-	-	-	-	-	130	993	-	-	993	-	-	-	-	-	-	8,111	-
5b.1.1.29	Radwaste Drum Storage	-	126	-	-	-	-	-	19	144	-	-	144	-	-	-	-	-	-	1,504	-
5b.1.1.30	Radwaste Storage Building	-	67	-	-	-	-	-	10	77	-	-	77	-	-	-	-	-	-	1,028	-
5b.1.1.31	SBO Diesel Generator	-	240	-	-	-	-	-	36	276	-	-	276	-	-	-	-	-	-	3,079	-
5b.1.1.32	Security Main Gate North	-	70	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	1,123	-
5b.1.1.33	Security Additions	-	30	-	-	-	-	-	4	34	-	-	34	-	-	-	-	-	-	405	-
5b.1.1.34	Security/Guardhouse	-	30	-	-	-	-	-	5	35	-	-	35	-	-	-	-	-	-	342	-
5b.1.1.35	Site Diesel Generator	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	18	-
5b.1.1.36	Support Complex	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	389	-
5b.1.1.37	Turbine Building	-	2,393	-	-	-	-	-	359	2,752	-	-	2,752	-	-	-	-	-	-	47,184	-
5b.1.1.38	Turbine Pedestal	-	478	-	-	-	-	-	72	549	-	-	549	-	-	-	-	-	-	2,934	-
5b.1.1.39	Waste Water Treatment	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	172	-
5b.1.1.40	Water Treatment Building North (Z110)	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	608	-
5b.1.1	Totals	-	13,727	-	-	-	-	-	2,059	15,787	-	-	15,787	-	-	-	-	-	-	163,924	-
Site Closeout Activities																					
5b.1.2	Remove Rubble	-	948	-	-	-	-	-	142	1,090	-	-	1,090	-	-	-	-	-	-	5,352	-
5b.1.3	Grade & landscape site	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	512	-
5b.1.4	Final report to NRC	-	-	-	-	-	-	182	27	210	210	-	-	-	-	-	-	-	-	-	1,560
5b.1	Subtotal Period 5b Activity Costs	-	14,776	-	-	-	-	182	2,244	17,202	210	-	16,992	-	-	-	-	-	-	169,788	1,560
Period 5b Additional Costs																					
5b.2.1	Concrete Crushing	-	880	-	-	-	-	11	134	1,025	-	-	1,025	-	-	-	-	-	-	4,585	-
5b.2.2	Circulating Water Intake Cofferdam	-	308	-	-	-	-	-	46	354	-	-	354	-	-	-	-	-	-	2,584	-
5b.2.3	E.S.W.S. Pumphouse Cofferdam	-	404	-	-	-	-	-	61	465	-	-	465	-	-	-	-	-	-	3,552	-
5b.2.4	Excavation of Underground Services	-	2,001	-	-	-	-	907	636	3,545	3,545	-	-	-	-	-	-	-	-	15,949	-
5b.2.5	Construction Debris	-	-	-	-	-	-	1,730	260	1,990	-	-	1,990	-	-	-	-	-	-	-	-
5b.2.6	Site Restoration ISFSI	-	462	-	-	-	-	111	86	659	-	-	659	-	-	-	-	-	-	4,099	160
5b.2.7	Firing Range Closure	-	-	-	-	-	-	692	104	796	-	-	796	-	-	-	-	-	-	-	-
5b.2	Subtotal Period 5b Additional Costs	-	4,056	-	-	-	-	3,451	1,326	8,833	3,545	-	5,289	-	-	-	-	-	-	30,770	160
Period 5b Collateral Costs																					
5b.3.1	Small tool allowance	-	110	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	-	-
5b.3	Subtotal Period 5b Collateral Costs	-	110	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	-	-
Period 5b Period-Dependent Costs																					
5b.4.2	Property taxes	-	-	-	-	-	-	482	48	530	-	-	530	-	-	-	-	-	-	-	-
5b.4.3	Heavy equipment rental	-	4,679	-	-	-	-	-	702	5,381	-	-	5,381	-	-	-	-	-	-	-	-
5b.4.4	Plant energy budget	-	-	-	-	-	-	314	47	361	-	-	361	-	-	-	-	-	-	-	-
5b.4.5	Corporate Allocations	-	-	-	-	-	-	51	8	59	-	-	59	-	-	-	-	-	-	-	-
5b.4.6	Security Staff Cost	-	-	-	-	-	-	1,734	260	1,994	-	-	1,994	-	-	-	-	-	-	-	37,132
5b.4.7	DOC Staff Cost	-	-	-	-	-	-	9,107	1,366	10,473	-	-	10,473	-	-	-	-	-	-	-	105,208
5b.4.8	Utility Staff Cost	-	-	-	-	-	-	4,573	686	5,259	-	-	5,259	-	-	-	-	-	-	-	60,340
5b.4	Subtotal Period 5b Period-Dependent Costs	-	4,679	-	-	-	-	16,260	3,117	24,056	-	-	24,056	-	-	-	-	-	-	-	202,680
5b.0	TOTAL PERIOD 5b COST	-	23,621	-	-	-	-	19,894	6,703	50,218	3,754	-	46,464	-	-	-	-	-	-	200,558	204,400
PERIOD 5 TOTALS		-	23,621	-	-	-	-	19,894	6,703	50,218	3,754	-	46,464	-	-	-	-	-	-	200,558	204,400
TOTAL COST TO DECOMMISSION		**10,570**	**93,922**	**16,170**	**8,282**	**23,465**	**47,622**	**731,915**	**161,173**	**1,093,117**	**980,846**	**58,028**	**54,243**	**282,530**	**153,674**	**501**	**393**	**2,217**	**21,044,660**	**1,337,834**	**7,864,049**

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2017 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 17.29% CONTINGENCY:	**$1,093,117**	**thousands of 2017 dollars**
TOTAL NRC LICENSE TERMINATION COST IS 89.73% OR:	**$980,846**	**thousands of 2017 dollars**
SPENT FUEL MANAGEMENT COST IS 5.31% OR:	**$58,028**	**thousands of 2017 dollars**
NON-NUCLEAR DEMOLITION COST IS 4.96% OR:	**$54,243**	**thousands of 2017 dollars**
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	**154,567**	**cubic feet**
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	**2,217**	**cubic feet**
TOTAL SCRAP METAL REMOVED:	**69,526**	**tons**
TOTAL CRAFT LABOR REQUIREMENTS:	**1,337,834**	**man-hours**

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

APPENDIX E

COST SENSITIVITY OF LONG-TERM, ON-SITE SPENT FUEL STORAGE

APPENDIX E

COST SENSITIVITY OF LONG-TERM, ON-SITE SPENT FUEL STORAGE

Introduction

As discussed in the last Decommissioning Cost Analysis for Wolf Creek issued in August 2014, developments in the area of spent nuclear fuel disposal suggest a possibility that the federal government may not have removed all of Wolf Creek's spent nuclear fuel and high-level radioactive waste (hereafter, simply "spent fuel") from the station by the time the plant has been decommissioned. There still is much uncertainty in this area. However, WCNOC asked TLG to consider that possibility, to make some assumptions regarding potential effects of the government's delayed removal of spent fuel from Wolf Creek, and to conduct a cost sensitivity analysis reflecting those assumptions. The following discussion is the result of that analysis. Because the assumptions used in this Appendix E analysis are so speculative at this point, the hypothetical cost effects shown here have not been included in the overall updated cost estimate in this report.

Congress passed the "Nuclear Waste Policy Act"[1] (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 Department of Energy (DOE). The NWPA provided that DOE would enter into contracts with generators in which DOE would promise to take the generator's spent fuel and high-level radioactive waste and the generators would pay the cost of the disposition services for that material. The NWPA, along with the individual contracts with the generators, 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 its contracts. Delays continue and, as a result, generators are no closer to shipping spent fuel today than in 1998.

Politically, the country is at an impasse on high-level waste disposal. The current administration has cut the budget for the geological repository program while promising to "conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle … make recommendations for a new plan."[2] Towards this goal,

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

2 Charter of the Blue Ribbon Commission on America's Nuclear Future, "Objectives and Scope of

the administration appointed a *Blue Ribbon Commission on America's Nuclear Future* (Blue Ribbon Commission) to make recommendations for a new plan for nuclear waste disposal. The Blue Ribbon Commission's charter includes a requirement that it consider "[O]ptions for safe storage of used nuclear fuel while final disposition pathways are selected and deployed."[3]

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

- "[T]he United States [should] establish a program that leads to the timely development of one or more consolidated storage facilities[4]
- "[T]he United States should undertake an integrated nuclear waste management program that leads to the timely development of one or more permanent deep geological facilities for the safe disposal of spent fuel and high-level nuclear waste."[5]

In January 2013, the DOE issued the "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," in response to the recommendations made by the Blue Ribbon Commission and as "a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel..."[6] This document states: "With the appropriate authorizations from Congress, the Administration currently plans to implement a program over the next 10 years that:

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

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Activities," http://www.brc.gov/index.php?q=page/charter

3 Ibid.

4 "Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy," http://www.brc.gov/sites/default/files/documents/brc_finalreport_jan2012.pdf, p. 32, January 2012

5 Ibid., p.27

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

- Makes demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository by 2048."

Completion of the decommissioning process (release of the entire site for unrestricted use) is highly dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program is currently based upon the premise that spent fuel allocations would be accepted for disposal from the nation's commercial nuclear plants, with limited exceptions, in the order in which it was discharged from the reactor (i.e., establishing a national "queue"). Even if spent fuel could be transferred to a federal facility for interim storage (in the absence of a permanent disposal facility), the nature of the queue would be expected to result in a long backlog of spent fuel at each site. Under the current system, as can be seen at sites where reactors have been decommissioned, the owner(s) can anticipate several decades of continuing, on-site storage of the spent fuel before the transfer could be expected to be complete.

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

Nonetheless, the NRC requires licensees to establish a program to manage and provide funding for the management of all irradiated fuel at the reactor site until title to the fuel is transferred to the Secretary of Energy.[7] The post-shutdown costs incurred to satisfy this requirement are described below.

Base Analyses

The estimates described in the main report (and detailed in Appendix C and D) are based in general upon 1) a 2025 start date for DOE initiating transfer of commercial spent fuel to a federal facility, and 2) a 2032 start date for the transfer of spent fuel from the Wolf Creek site based on an "oldest fuel first" priority, and the DOE

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

achieving an annual rate of transfer (3,000 metric tons of uranium per year) as reflected in DOE's latest Acceptance Priority Ranking and Annual Capacity Report.[8]

The assumed 2025 DOE start date is nominally based on the last position stated by the DOE. More importantly, the estimates assume that the DOE would give priority to fuel at shutdown sites,[9] i.e., it assumed that Congress would "(1)…direct the Department to take spent nuclear fuel from decommissioned commercial nuclear power reactors as soon as possible; (2) to establish an expedited siting process; and (3) to authorize the Department to construct and operate the facility under its regulatory authority, or, if the facility were to be constructed and operated under a U.S. Nuclear Regulatory Commission license, to provide for an expedited siting and licensing process."[10]

Under this scenario, once Wolf Creek permanently ceases operation, DOE would expedite the removal of spent fuel from the site. The cost estimates described in the main body of this report assumed that:

- The spent fuel pool would be at capacity following the final core off-load and contain freshly discharged assemblies (from the most recent refueling cycles) as well as the final reactor core
- DOE would give priority to the spent fuel stored in the pool
- The spent fuel pool would be emptied within the first five and one-half years following plant shutdown.[11] This would allow decommissioning to be completed and the site released for unrestricted use within a relatively short time (see Figure 4.2) or placed into long-term storage without the need of maintaining/operating a spent fuel storage facility

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8 "Acceptance Priority Ranking and Annual Capacity Report," U.S. DOE, Office of Civilian Radioactive Waste Management, DOE/RW-0567, July 2004

9 "Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy," http://www.brc.gov/sites/default/files/documents/brc_finalreport_jan2012.pdf, p. 42, January 2012: "[A]ccepting spent fuel according to the OFF priority ranking instead of giving priority to shutdown reactor sites could greatly reduce the cost savings that could be achieved through consolidated storage if priority could be given to accepting spent fuel from shutdown reactor sites before accepting fuel from still-operating plants. …. The magnitude of the cost savings that could be achieved by giving priority to shutdown sites appears to be large enough (i.e., in the billions of dollars) to warrant DOE exercising its right under the Standard Contract to move this fuel first."

10 "Report to Congress on the Demonstration of the Interim Storage of Spent Nuclear Fuel from Decommissioned Nuclear Power Reactor Sites" DOE/RW-0596, December 2008

11 It is assumed that the five and one-half years provides the necessary cooling for the final core to meet transport requirements for decay heat

- The DOE is assumed to use its Transport, Aging and Disposal canister to empty the wet storage pool.[12] The canisters would be provided to WCNOC at no cost, however, Wolf Creek staff/or contractors would load, seal and transfer the multi-purpose canisters into a DOE-provided transport cask.
- Once the pool is emptied, the DOE would remove the spent fuel stored at the Wolf Creek Independent Spent Fuel Storage Installation (ISFSI). The current analysis assumes that 592 assemblies would be placed in dry storage during plant operations (i.e., maintain full core off-load capability in the spent fuel pool); 16 equivalent dry storage system modules.
- The ISFSI would be decommissioned in conjunction with the dismantling of the adjacent power block structures.
- Greater-than-Class C (GTCC)[13] material would be transferred directly to the DOE following the segmentation of the reactor internals.

Alternative Analysis

In 2008, the DOE issued a report to Congress in which it concluded that it did not have authority, under present law, to accept spent nuclear fuel for interim storage from decommissioned commercial nuclear power reactor sites.[14] It also concluded that legislation would be required that would eliminate the limitations in the Nuclear Waste Policy Act of 1982, as amended, on taking commercial spent nuclear fuel for interim storage prior to the opening of the Yucca Mountain repository.

For illustrative purposes only, this alternative analysis examines the impact of the status quo (i.e., the queue), on decommissioning and the resulting cost for long-term, on-site storage of the spent fuel generated during plant operations.[15] Under this scenario:

- DOE pickup of spent fuel would continue beyond the cessation of plant operations at the rates published for the Kansas Gas and Electric Company in the latest Acceptance Priority Ranking and Annual Capacity Report

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12 "Transport, Aging and Disposal Canister System Performance Specification," U.S. DOE, Civilian Radioactive Waste Management System, DOC ID: WMO-TADCS-000001, Rev.1, March 2008

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

14 "Report to Congress on the Demonstration of the Interim Storage of Spent Nuclear Fuel from Decommissioned Nuclear Power Reactor Sites" DOE/RW-0596, December 2008

15 This analysis does not consider that the cost incurred would most likely be reimbursable as a result of DOE's breach of contract due to it non-performance

- Pickup of spent fuel beyond the last published date would be based upon the plant average of the previous ten years
- The residual inventory in the spent fuel pool after the five and one-half years of cooling would be transferred to the ISFSI
- Wolf Creek would utilize a dry storage system that can accommodate 37 assemblies per module
- The ISFSI would be expanded to accommodate the additional dry fuel storage modules needed to empty the spent fuel pool and the GTCC generated during the decommissioning (on the premise that the GTCC would not be accepted by the DOE until after the transfer of the spent fuel was completed)[16]
- WCNOC would operate the ISFSI and manage the spent fuel until such time that the DOE could complete the transfer to an off-site facility
- The DOE would accept the multi-purpose canister without the need for repackaging the assemblies, i.e., the DOE transport cask could accommodate the multi-purpose canister without modification
- WCNOC staff or WCNOC contracted staff would transfer the multi- purpose canister into the DOE-provided transport cask
- The concrete storage overpack and ISFSI pad would be decommissioned once the transfer is completed (2074)

The impact of these assumptions, as compared to the Base Analysis, is summarized as follows.

	Base Case	Alternative
Spent fuel pool inventory at shutdown (assemblies)	1,771	1,771
ISFSI inventory at shutdown (assemblies)	592	592
Spent fuel transferred to the DOE during plant ops	1,009	1,009
Spent fuel transferred to the DOE from pool during decommissioning (assemblies)	1,771	337
Spent fuel transferred to the ISFSI for interim storage within 5½ years after shutdown (assemblies)	0	1,434
Number of additional dry-storage modules need to support decommissioning (excluding GTCC)	0	39
Transfer of Spent Fuel to DOE Complete (year)	2050	2074

16 GTCC is assumed to be disposed of as it is generated in the base analysis, avoiding the need for interim storage

In essence, spent fuel is on site for additional 21 years after plant decommissioning (completion of site restoration), during which time WCNOC maintains and operates the ISFSI under a General (10 CFR Part 50) or Site-Specific (Part 72) license.

The alternative estimate is based upon a nominal value of $1.0 million for the capital cost of a dry storage module and an associated loading cost and transfer cost of $300,000 (from the wet pool to the ISFSI). A unit cost of $150,000 (one half the wet loading cost) was used for transferring the multipurpose canisters from the concrete overpacks at the ISFSI into the DOE-provided transport cask. All such numbers are based on comparative data. The alternative estimate does not include any costs for expanding the 16 cask-capacity ISFSI pad to the 60 casks capacity required for the alternative estimate.

The cost of operating an ISFSI, once decommissioning is complete, is shown in the following schedule, particularly in the years 2054 through 2074 following the decommissioning of Wolf Creek. Annual expenditures include the costs for:

- Periodic Spent Fuel Transfer
- Nuclear Insurance
- Property Taxes
- NRC ISFSI Licensing Fees and Oversight Costs
- Emergency Planning Fees
- ISFSI Operating Costs (maintenance budget, including energy, lighting, and remote surveillance systems)
- Security Staff (full time, round-the-clock)
- WCNOC Staff (for ISFSI operations, maintenance, and fuel transfer activities)

The schedule of expenditure in the following table delineates the cost contributors by year of expenditures as well as cost contributor (e.g., labor, materials, and waste disposal). Costs are reported in 2017 dollars and are not inflated, escalated, or discounted over the period of expenditure.

Since it is assumed that the DOE would not accept GTCC waste prior to completing the transfer of spent fuel, the cost of GTCC disposal is shown in the final year of ISFSI operation (2074). This same cost is included during the decommissioning phase in the base analyses (e.g., in Table 3.1, during years 2046-2048 for the DECON alternative).

While this analysis attempts to capture the cost for long-term spent fuel management at the Wolf Creek site, under the scenario outlined above, it is WCNOC's position that

the DOE has a contractual obligation to accept Wolf Creek's fuel earlier than the projections set out above consistent with its contract commitments. No assumption made in this analysis should be interpreted to be inconsistent with this claim.

TABLE E
DECON ALTERNATIVE WITH LONG-TERM SPENT FUEL MANAGEMENT
SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	58,996	4,282	1,969	33	9,446	74,727
2046	82,734	30,407	3,615	14,402	25,407	156,565
2047	78,739	38,176	2,307	32,769	12,765	164,756
2048	73,774	28,281	2,066	21,513	10,999	136,633
2049	68,573	18,553	1,821	10,505	9,232	108,683
2050	61,728	15,396	1,560	9,676	8,297	96,657
2051	43,584	5,662	664	2,885	4,615	57,409
2052	25,088	12,930	277	4	4,163	42,464
2053	16,174	9,051	179	0	3,750	29,154
2054	6,034	298	73	0	2,961	9,366
2055	6,034	298	73	0	2,961	9,366
2056	6,051	299	73	0	2,969	9,392
2057	6,034	298	73	0	2,961	9,366
2058	6,034	298	73	0	2,961	9,366
2059	6,034	298	73	0	2,961	9,366
2060	6,051	299	73	0	2,969	9,392
2061	6,034	298	73	0	2,961	9,366
2062	6,034	298	73	0	2,961	9,366
2063	6,034	298	73	0	2,961	9,366
2064	6,051	299	73	0	2,969	9,392
2065	6,034	298	73	0	2,961	9,366
2066	6,034	298	73	0	2,961	9,366
2067	6,034	298	73	0	2,961	9,366
2068	6,051	299	73	0	2,969	9,392
2069	6,034	298	73	0	2,961	9,366
2070	6,034	298	73	0	2,961	9,366
2071	6,034	298	73	0	2,961	9,366
2072	6,051	299	73	0	2,969	9,392
2073	6,034	298	73	0	2,961	9,366
2074	5,874	1,249	76	444	16,582	24,225
2075	2,636	1,130	58	2,717	3,081	9,621

TABLE E (continued)
DECON ALTERNATIVE WITH LONG-TERM SPENT FUEL MANAGEMENT
SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2017 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
Total	638,669	171,087	16,049	94,948	167,591	1,088,344