DECOMMISSIONING COST ANALYSIS

for the

WOLF CREEK GENERATING STATION

prepared for

Wolf Creek Nuclear Operating Corporation

prepared by

TLG Services, Inc.
Bridgewater, Connecticut

August 2011

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0		08-30-11		Original Issue

EXECUTIVE SUMMARY

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 analysis relies upon site-specific, technical information from an evaluation prepared in 2008,[1] updated to reflect current assumptions pertaining to the disposition of the nuclear unit and relevant industry experience in undertaking such projects. The current estimates are designed to provide 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. It is not a detailed engineering study, but a financial analysis prepared in advance of the detailed engineering that will be required to carry out the decommissioning.

The currently projected cost to decommission the station, assuming the DECON alternative, is estimated at $630.1 million, as reported in 2011 dollars. An estimate for the SAFSTOR alternative is also provided.

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 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

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1 "Decommissioning Cost Analysis for the Wolf Creek Generating Station," Document No. W11-1598-002, Rev. 0, TLG Services, Inc., August 2008

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

environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB.

> DECON is defined as "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations."[3]
>
> SAFSTOR is defined as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use."[4] 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.
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> The 60-year restriction has limited the practicality for the ENTOMB alternative at commercial reactors that generate significant amounts of long-lived radioactive material. In 1997, the Commission directed its staff to re-evaluate this alternative and identify the technical requirements and regulatory actions that would be necessary for entombment to become a viable option. The resulting evaluation provided several recommendations; however, rulemaking has been deferred pending the completion of additional research studies, for example, on engineered barriers.

In 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the

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3 Ibid. Page FR24022, Column 3
4 Ibid.
5 Ibid. Page FR24023, Column 2

decommissioning process.[6] The amendments allow for greater public participation and better define the transition process from operations to decommissioning. Regulatory Guide 1.184,[7] issued in July 2000, further described the methods and procedures acceptable to the NRC staff for implementing the requirements of the 1996 revised rule relating to the initial activities and major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and processes described in the amended regulations. The format and content of the estimates is also consistent with the recommendations of Regulatory Guide 1.202,[8] issued in February 2005.

Methodology

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

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

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

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

7 "Decommissioning of Nuclear Power Reactors," Regulatory Guide 1.184, Nuclear Regulatory Commission, July 2000

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

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

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

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

Low-Level Radioactive Waste Disposal

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[11] and its Amendments of 1985,[12] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders. With the exception of Texas (which has issued a license to Waste Control Specialists for the construction of a new facility in Andrews, Texas), no new compact facilities have been successfully sited, licensed, and constructed.

The disposal facility in Barnwell, South Carolina is currently closed to generators outside the Atlantic Compact (comprising the states of Connecticut, New Jersey and South Carolina). The commercial disposal facility on the Hanford Nuclear Reservation near Richland, Washington accepts low-level radioactive waste from the Northwest (Alaska, Hawaii, Idaho, Montana, Oregon, Utah, Washington and Wyoming) and Rocky Mountain (Colorado, Nevada, and New Mexico) Compact states. This leaves Energy*Solutions*' disposal facility in Clive, Utah as the only available option for the disposal of the majority of the low-level radioactive waste generated in decommissioning Wolf Creek.

For the purpose of this analysis, WCNOC's "Long Term Waste Disposal Agreement" with Energy*Solutions* is used as the basis for estimating the disposal cost for the majority of the radioactive waste (Class A [13]). Energy*Solutions* does not have a license to dispose of the more highly radioactive waste (Classes B and C), for example, generated in the dismantling of the reactor vessel. As a proxy, the disposal cost for this material is based upon the last published rate schedule for non-compact waste for the Barnwell facility.

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

The dismantling of the components residing closest to the reactor core generates radioactive waste 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 (Greater-than-Class C or 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 study, GTCC is packaged in the same canisters used for spent fuel. The GTCC material is shipped directly to a DOE facility as it is generated.

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This waste can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring disposal in a licensed low-level radioactive waste disposal facility can be accomplished through a variety of methods, including analyses and surveys or decontamination to eliminate the portion of waste that does not require disposal as radioactive waste, compaction, incineration or metal melt. The estimates for Wolf Creek 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 NWPA provided that DOE would enter into contracts with utilities in which DOE would promise to take the utilities' spent fuel and high-level radioactive waste and utilities would pay the cost of the disposition services for that material. NWPA, along with the individual contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

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

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

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 2020 start date for DOE initiating transfer of commercial spent fuel to a federal facility, and 2) a 2028 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.[15]

The assumed 2020 DOE start date is nominally based on the last position stated by the DOE. On July 15, 2008, the then-Director of the DOE's Office of Civilian Radioactive Waste Management testified before Congress that DOE "could be ready to begin accepting spent nuclear fuel by 2020,"[16] based on continued program funding. The current administration has cut the budget for the geological repository program, but the administration has also appointed a Blue Ribbon Commission on America's Nuclear Future to make recommendations for a new plan for nuclear waste disposal. WCNOC believes that one or more monitored retrievable storage facilities could be put into place following a Blue Ribbon Commission recommendation for the same, within a reasonable time frame.

More importantly, the estimates assume that the DOE would give priority to fuel at shutdown sites,[17] 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." [18]

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

16 Statement of Edward F. Sproat, III, Director Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Before the Subcommittee on Energy and Air Quality Committee on Energy and Commerce U.S. House of Representatives, July 15, 2008

17 Draft Report of the Blue Ribbon Commission, p. 47: "[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."

18 "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 Secretary of Energy, pursuant to 10 CFR Part 50.54(bb).[19] The post-shutdown costs incurred to satisfy this requirement include the isolation and continued operation of the spent fuel pool and the Independent Spent Fuel Storage Installation (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

[19] 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

Prompt dismantling of site structures (once the facilities are decontaminated) is clearly the most appropriate and cost-effective option. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized on site is more efficient than if the process is deferred. Site facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and the demolition work force. Consequently, this study assumes that site structures are removed to a nominal depth of three feet below the local grade level wherever possible. The site is then to be graded and stabilized.

Summary

The costs to decommission 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. Regardless of the timing of the decommissioning activities, the estimates assume the eventual removal of all the contaminated and activated plant components and structural materials, such that the facility operator may then have unrestricted use of the site with no further requirement for an operating license.

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

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

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

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

It should be noted that the costs assigned to these subcategories are allocations. Delegation of cost elements is for the purposes of comparison (e.g., with NRC financial guidelines) or to permit specific financial treatment (e.g., Asset Retirement 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 2011 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 2011 dollars)

Cost Element	Cost
Decontamination	14,403
Removal	103,023
Packaging	22,742
Transportation	10,359
Waste Disposal	61,457
Off-site Waste Processing	23,110
Program Management [1]	245,392
Security	47,017
Spent Fuel Pool Isolation	11,822
Spent Fuel Management - Direct Costs [2]	39,421
Insurance and Regulatory Fees	11,946
Energy	7,145
Characterization and Licensing Surveys	13,053
Property Taxes	10,411
Corporate Allocations	1,883
Miscellaneous Equipment	6,952
Total [3]	630,135

Cost Element	Cost
License Termination	536,530
Spent Fuel Management	39,908
Site Restoration	53,697
Total [3]	630,135

[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 2011 dollars)

Cost Element	Cost
Decontamination	12,732
Removal	105,395
Packaging	17,149
Transportation	7,627
Waste Disposal	42,983
Off-site Waste Processing	25,197
Program Management [1]	330,000
Security	163,895
Spent Fuel Pool Isolation	11,822
Spent Fuel Management - Direct Costs [2]	39,421
Insurance and Regulatory Fees	53,656
Energy	14,778
Characterization and Licensing Surveys	14,225
Property Taxes	20,459
Corporate Allocations	3,093
Miscellaneous Equipment	22,245
Total [3]	884,677

Cost Element	Cost
License Termination	749,075
Spent Fuel Management	82,133
Site Restoration	53,470
Total [3]	884,677

[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 costs to decommission the Wolf Creek Generating Station, (Wolf Creek) following a scheduled cessation of plant operations. The analysis relies upon site-specific, technical information from an earlier evaluation prepared in 2008,[1]* updated to reflect current assumptions pertaining to the disposition of the nuclear unit and relevant industry experience in undertaking such projects. The current estimates are designed to provide 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. It is not a detailed engineering study, but a financial analysis prepared in advance of the detailed engineering that will be required to carry out the decommissioning.

1.1 OBJECTIVES OF STUDY

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

An operating license was originally issued for Wolf Creek in June of 1985. A license renewal application was filed for the nuclear unit 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. This date was used as input to scheduling the decommissioning activities.

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.

* References provided in Section 7 of the document

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 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants.[6] When the decommissioning regulations were adopted in 1988, it was assumed that the majority of licensees would decommission at the end of the facility's operating licensed life. Since that time, several licensees permanently and prematurely ceased operations. Exemptions from certain operating requirements were required

once the reactor was defueled to facilitate the decommissioning. Each case was handled individually, without clearly defined generic requirements. The NRC amended the decommissioning regulations in 1996 to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The amendments allow for greater public participation and better define the transition process from operations to decommissioning.

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

1.3.1 Nuclear Waste Policy Act

Congress passed the "Nuclear Waste Policy Act"[7] (NWPA) in 1982, assigning the federal government's long-standing responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. The NWPA provided that DOE would enter into contracts with utilities in which DOE would promise to take the utilities' spent fuel and high-level radioactive waste and utilities would pay the cost of the disposition services for that material. NWPA, along with the individual contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

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

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 2020 start date for DOE initiating transfer of commercial spent fuel to a federal facility, and 2) a 2028 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.[8]

The assumed 2020 DOE start date is nominally based on the last position stated by the DOE. On July 15, 2008, the then-Director of the DOE's Office of Civilian Radioactive Waste Management testified before Congress that DOE "could be ready to begin accepting spent nuclear fuel by 2020,"[9] based on continued program funding. The current administration has cut the budget for the geological repository program, but the administration has also appointed a Blue Ribbon Commission on America's Nuclear Future to make recommendations for a new plan for nuclear waste disposal. WCNOC believes that one or more monitored retrievable storage facilities could be put into place following a Blue Ribbon Commission recommendation for the same, within a reasonable time frame.

More importantly, the estimates assume that the DOE would give priority to fuel at shutdown sites,[10] i.e., it assumed that Congress would "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."

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 Secretary of Energy, pursuant to 10 CFR Part 50.54(bb).[11] The post-shutdown costs incurred to satisfy this requirement include the isolation and continued operation of the spent fuel pool and the Independent Spent Fuel Storage Installation

(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 Acts

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[12] and its Amendments of 1985,[13] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders. With the exception of Texas (which has issued a license to Waste Control Specialists for the construction of a new facility in Andrews, Texas), no new compact facilities have been successfully sited, licensed, and constructed.

The disposal facility in Barnwell, South Carolina is currently closed to generators outside the Atlantic Compact (comprising the states of Connecticut, New Jersey and South Carolina). The commercial disposal facility on the Hanford Nuclear Reservation near Richland, Washington accepts low-level radioactive waste from the Northwest (Alaska, Hawaii, Idaho, Montana, Oregon, Utah, Washington and Wyoming) and Rocky Mountain (Colorado, Nevada, and New Mexico) Compact states. This leaves EnergySolutions' disposal facility in Clive, Utah as the only available option for the disposal of the majority of the low-level radioactive waste generated in decommissioning Wolf Creek.

For the purpose of this analysis, WCNOC's "Long Term Waste Disposal Agreement" with Energy*Solutions* is used as the basis for estimating the disposal cost for the majority of the radioactive waste (Class A [14]). Energy*Solutions* does not have a license to dispose of the more highly radioactive waste (Classes B and C), for example, generated in the dismantling of the reactor vessel. As a proxy, the disposal cost for this material is based upon the last published rate schedule for non-compact waste for the Barnwell facility.

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 (Greater-than-Class C or 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 study, GTCC is packaged in the same canisters used for spent fuel. The GTCC material is shipped directly to a DOE facility as it is generated.

A significant portion of the waste material generated during decommissioning may only be potentially contaminated by radioactive materials. This waste can be analyzed on site or shipped off site to licensed facilities for further analysis, for processing and/or for conditioning/recovery. Reduction in the volume of low-level radioactive waste requiring disposal in a licensed low-level radioactive waste disposal facility can be accomplished through a variety of methods, including analyses and surveys or decontamination to eliminate the portion of waste that does not require disposal as radioactive waste, compaction, incineration or metal melt. The estimates for Wolf Creek 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,"[15] 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).[16] An additional and separate limit of 4 millirem per year, as defined in 40 CFR §141.16, is applied to drinking water.[17]

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)[18] 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.

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

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

Existing operational technical specifications are reviewed and modified to reflect plant conditions and the safety concerns associated with permanent cessation of operations. The environmental impact associated with the planned decommissioning activities is also considered.

Typically, a licensee will not be allowed to proceed if the consequences of a particular decommissioning activity are greater than that bounded by previously evaluated environmental assessments or impact statements. In this instance, the licensee would have to submit a license amendment for the specific activity and update the environmental report.

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

Site Preparations

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

- Characterization of the site and surrounding environs. This includes radiation surveys of work areas, major components (including the reactor vessel and its internals), internal piping, and primary shield cores.
- Isolation of the spent fuel storage pool and fuel handling systems, such that decommissioning operations can commence on the balance of the plant. The pool will remain operational for approximately 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)."[19] 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.

Prompt dismantling of site structures is clearly the most appropriate and cost-effective option. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized on site is more efficient than if the process were deferred. Site facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public as well as to future workers. Abandonment creates a breeding ground for vermin infestation as well as other biological hazards.

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

restored and the plant area graded as required to prevent ponding and inhibit the refloating of subsurface materials.

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

2.2 SAFSTOR

The NRC defines SAFSTOR as "the alternative in which the nuclear facility is placed and maintained in a condition that allows the nuclear facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use." The facility is left intact (during the dormancy period), with structures maintained in a sound condition. Systems that are not required to support the spent fuel pool or site surveillance and security are drained, de-energized, and secured. Minimal cleaning/removal of loose contamination and/or fixation and sealing of remaining contamination 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.
- Draining and de-energizing of the non-contaminated systems not required to support continued site operations or maintenance.
- Disposing of contaminated filter elements and resin beds not required for processing wastes from layup activities for future operations.
- Draining of the reactor vessel, with the internals left in place and the vessel head secured.
- Draining and de-energizing non-essential, contaminated systems with decontamination as required for future maintenance and inspection.
- Preparing lighting and alarm systems whose continued use is required; de-energizing portions of fire protection, electric power, and HVAC systems whose continued use is not required.
- Cleaning of the loose surface contamination from building access pathways.
- Performing an interim radiation survey of plant, posting warning signs where appropriate.
- Erecting physical barriers and/or securing all access to radioactive or contaminated areas, except as required for inspection and maintenance.
- Installing security and surveillance monitoring equipment and relocating security fence around secured structures, as required.

2.2.2 Period 2 - Dormancy

The second phase identified by the NRC in its rule addresses licensed activities during a storage period and is applicable to the dormancy phases of the deferred decommissioning alternatives. Dormancy activities include a 24-hour security force, preventive and corrective maintenance on security systems, area lighting, general building maintenance, heating and ventilation of buildings, routine radiological inspections of contaminated structures, maintenance of structural integrity, and a site environmental and radiation monitoring program. Resident maintenance personnel perform equipment maintenance, inspection activities, routine services to maintain safe conditions,

adequate lighting, heating, and ventilation, and periodic preventive maintenance on essential site services.

An environmental surveillance program is carried out during the dormancy period to ensure that releases of radioactive material to the environment are prevented and/or detected and controlled. Appropriate emergency procedures are established and initiated for potential releases that exceed prescribed limits. The environmental surveillance program constitutes an abbreviated version of the program in effect during normal plant operations.

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

Consistent with the DECON scenario, the spent fuel storage pool is emptied within 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 an optional period of storage (such that license termination is accomplished within 60 years of final shutdown), it is required that the licensee submit an application to terminate the license, along with an LTP (described in Section 2.1.2), thereby initiating the third phase.

2.2.3 Periods 3 and 4 - Delayed Decommissioning

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

Much of the work in developing a termination plan is relevant to the development of the detailed engineering plans and procedures. The activities associated with this phase and the follow-on decontamination and dismantling processes are detailed in Sections 2.1.1 and 2.1.2. The primary difference between the sequences anticipated for the DECON

and this deferred scenario is the absence, in the latter, of any constraint on the availability of the fuel storage facilities for decommissioning.

Variations in the length of the dormancy period are expected to have little effect upon the quantities of radioactive wastes generated from system and structure removal operations. Given the levels of radioactivity and spectrum of radionuclides expected from 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 NSSS, power generation systems, support services, site buildings, and ancillary facilities. The basis of the estimates, including the sources of information relied upon, the estimating methodology employed, site-specific considerations, and other pertinent assumptions, is described in this section.

3.1 BASIS OF ESTIMATE

The estimates were developed using the site-specific, technical information from the 2008 analysis. This information was reviewed for the current analysis and updated as deemed appropriate. The site-specific considerations and assumptions used in the previous evaluation were also revisited. Modifications were incorporated where new information was available or experience from previously completed 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,"[20] and the DOE "Decommissioning Handbook."[21] These documents present a unit factor method for estimating decommissioning activity costs, which simplifies the estimating calculations. Unit factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/inch) are developed using local labor rates. The activity-dependent costs are estimated with the item quantities (cubic yards and tons), developed from plant drawings and inventory documents. Removal rates and material costs for the conventional disposition of components and structures rely upon information available in the industry publication, "Building Construction Cost Data," published by R.S. Means.[22]

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

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

Work Difficulty Factors

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

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

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

Scheduling Program Durations

The unit factors, adjusted by the WDFs as described above, are applied against the inventory of materials to be removed in the 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"[23] as "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." The cost elements in this analysis are based upon ideal conditions and maximum efficiency; therefore, consistent with industry practice, contingency is included. In the AIF/NESP-036 study, the types of unforeseeable events that are likely to occur in decommissioning are discussed and guidelines are provided for percentage contingency in each category. It should be noted that contingency, as used in this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

Contingency funds are an integral part of the total cost to complete the decommissioning process. Exclusion of this component puts at risk a

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

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

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

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

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

The contingency values are applied to the appropriate components of the estimates on a line item basis. A composite value is then reported at the end of each detailed estimate (as provided in Appendix C and D). For example, the composite contingency value reported for the DECON alternative in Appendix C is approximately 18.5%.

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, the disposal cost is financed by a 1 mill/kWhr surcharge paid into the DOE's waste fund during operations. However, the NRC requires licensees to establish a program to manage and provide funding for the management of all irradiated fuel at the reactor until title of the fuel is transferred to the Secretary of Energy. This funding requirement is fulfilled through inclusion of certain high-level waste cost elements within the estimates, as described below.

For estimating purposes, 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 Independent Spent Fuel Storage Installation (ISFSI) is constructed during operations and that 444 spent fuel assemblies (12 equivalent dry storage system modules) are transferred to the ISFSI during plant operations. 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

A cost of $240,000, per canister, is used for the labor 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. A cost of $120,000 (one-half the previous value) is used as the cost to transfer each canister stored at the ISFSI into the DOE transport vehicle.

Operations and Maintenance

An annual cost of approximately $764,000 is used for operation and maintenance of the spent fuel pool. Pool operations are expected to continue approximately five and one-half years after the cessation of operations. An annual cost of approximately $90,000 is used for operation and maintenance of the ISFSI during decommissioning.

GTCC

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

federal government has not identified a cost for disposing of GTCC or a schedule for acceptance.

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. A decontamination factor (average reduction) of 10 is assumed for the process. In the SAFSTOR scenario, radionuclide decay is expected to provide the same benefit and, therefore, a chemical decontamination is not included.

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

A trolley crane is set up for the removal of the generators. It can also be used to move portions of the steam generator cubicle walls and floor slabs from the reactor building to a location where they can be decontaminated and transported to the material handling area. Interferences within the work area, such as grating, piping, and other components are removed to create sufficient laydown space for processing these large components.

The generators are rigged for removal, disconnected from the surrounding piping and supports, and maneuvered into the open area where they are lowered onto a dolly. Each generator is rotated into the horizontal position for extraction from the containment and placed onto a multi-wheeled vehicle for transport to an on-site processing and storage area.

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

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

3.4.4 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.[24] The contaminated material will be packaged in Industrial Packages (IP-1, IP-2, or IP-3, as defined in subpart 173.411) for transport unless demonstrated to qualify as their own shipping containers. The reactor vessel and internal components are expected to be transported in accordance with Part 71, as Type B. It is conceivable that the reactor, due to its limited specific activity, could qualify as LSA II or III. However, the high radiation levels on the outer surface would require that additional shielding be incorporated within the packaging so as to attenuate the dose to levels acceptable for transport.

Any fuel cladding failure that occurred during the lifetime of the plant is assumed to have released fission products at sufficiently low levels that the buildup of quantities of long-lived isotopes (e.g., ^{137}Cs, ^{90}Sr, or

transuranics) has been prevented from reaching levels exceeding those that permit the major reactor components to be shipped under current transportation regulations and disposal requirements.

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

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

Transportation costs for material requiring controlled disposal are based upon the mileage to the Energy*Solutions* facility in Clive, Utah. 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.[25]

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 detailed Appendices C and D, and summarized in Section 5. The quantified waste summaries shown in these tables are consistent with 10 CFR Part 61 classifications. Commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations. The volumes are calculated based on the exterior package dimensions for

containerized material or a specific calculation for components serving as their own waste containers.

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

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

3.4.7 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."

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. This assumption may be affected by continued plant operations and/or future regulatory actions, such as the development of site-specific release criteria.

3.5 ASSUMPTIONS

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

3.5.1 Estimating Basis

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

3.5.2 Labor Costs

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

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.

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

3.5.3 Design Conditions

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

The curie contents of the vessel and internals at final shutdown are derived from those listed in NUREG/CR-3474.[26] 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[27] and CR-0672,[28] and benchmarked to the long-lived values from CR-3474.

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

Activation of the containment building structure is confined to the biological shield. More extensive activation (at very low levels) of the interior structures within containment has been detected at several reactors and the owners have elected to dispose of the affected material at a controlled facility rather than reuse the material as fill on site or send it to a landfill. The ultimate disposition of the material removed from the containment building will depend upon the site release criteria selected, as well as the designated end use for the site.

3.5.4 General

Transition Activities

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

Insurance

Costs for continuing coverage (nuclear liability and property insurance) following cessation of plant operations and during decommissioning are included and based upon current operating premiums. Reductions in premiums, throughout the decommissioning process, are based upon the guidance and the limits for coverage defined in the NRC's proposed rulemaking "Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors."[29] 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 unit's operating license, recognizing that there may be some additional cost impact from spent fuel management. These costs are identified in Tables 3.1a and 3.2a.

The "Spent Fuel Management" subcategory contains costs associated with the five and one-half years of post-shutdown pool operations, and the 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.

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

Decommissioning costs are reported in 2011 dollars. Costs are not inflated, escalated, or discounted over the period of expenditure (or projected lifetime of the plant). The schedules are based upon the detailed activity costs reported in Appendices C and D, along with the timelines presented in Section 4.

TABLE 3.1
DECON ALTERNATIVE
SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	42,369	2,017	982	30	6,001	51,400
2046	60,836	18,880	1,803	12,143	22,854	116,517
2047	59,287	29,034	1,151	26,886	18,635	134,993
2048	52,009	16,327	979	13,427	9,590	92,332
2049	49,001	11,356	909	8,176	6,059	75,500
2050	44,111	9,953	777	7,724	5,776	68,340
2051	30,334	3,530	331	2,465	2,740	39,399
2052	20,603	10,720	138	4	426	31,890
2053	11,977	7,539	75	0	172	19,763
Total	370,528	109,356	7,145	70,855	72,252	630,135

Note: Columns may not add due to rounding

TABLE 3.1a
DECON ALTERNATIVE
SCHEDULE OF LICENSE TERMINATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	41,686	1,383	982	30	4,279	48,360
2046	58,288	15,355	1,803	12,143	20,850	108,440
2047	56,393	24,831	1,151	26,886	16,901	126,162
2048	49,217	11,707	979	13,427	7,976	83,306
2049	46,258	6,592	909	8,176	4,497	66,432
2050	42,122	6,393	777	7,676	4,063	61,031
2051	30,222	3,211	331	2,409	1,993	38,165
2052	4,047	225	33	4	219	4,527
2053	84	0	0	0	23	107
Total	328,316	69,697	6,965	70,752	60,801	536,530

Note: Columns may not add due to rounding

TABLE 3.1b
DECON ALTERNATIVE
SCHEDULE OF SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	212	635	0	0	1,722	2,568
2046	1,168	3,505	0	0	1,951	6,624
2047	1,379	4,138	0	0	1,562	7,079
2048	1,525	4,576	0	0	1,566	7,668
2049	1,576	4,729	0	0	1,562	7,866
2050	1,184	3,536	0	47	1,712	6,480
2051	113	319	0	56	747	1,234
2052	87	107	0	0	32	226
2053	63	77	0	0	23	163
Total	7,307	21,622	0	103	10,876	39,908

Note: Columns may not add due to rounding

TABLE 3.1c
DECON ALTERNATIVE
SCHEDULE OF SITE RESTORATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	472	0	0	0	0	472
2046	1,380	20	0	0	53	1,453
2047	1,515	64	0	0	173	1,752
2048	1,267	43	0	0	48	1,359
2049	1,166	35	0	0	0	1,201
2050	805	24	0	0	0	829
2051	0	0	0	0	0	0
2052	16,469	10,388	105	0	175	27,137
2053	11,831	7,462	75	0	126	19,494
Total	34,905	18,037	180	0	575	53,697

Note: Columns may not add due to rounding

TABLE 3.2
SAFSTOR ALTERNATIVE
SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	34,509	1,624	982	30	6,003	43,148
2046	35,570	9,103	914	1,217	18,712	65,517
2047	13,654	5,073	242	14	4,272	23,254
2048	13,691	5,087	243	14	4,283	23,318
2049	13,654	5,073	242	14	4,272	23,254
2050	10,464	3,596	205	12	3,261	17,537
2051	3,350	302	121	6	1,009	4,788
2052	3,359	303	121	6	1,012	4,801
2053	3,350	302	121	6	1,009	4,788
2054	3,350	302	121	6	1,009	4,788
2055	3,350	302	121	6	1,009	4,788
2056	3,359	303	121	6	1,012	4,801
2057	3,350	302	121	6	1,009	4,788
2058	3,350	302	121	6	1,009	4,788
2059	3,350	302	121	6	1,009	4,788
2060	3,359	303	121	6	1,012	4,801
2061	3,350	302	121	6	1,009	4,788
2062	3,350	302	121	6	1,009	4,788
2063	3,350	302	121	6	1,009	4,788
2064	3,359	303	121	6	1,012	4,801
2065	3,350	302	121	6	1,009	4,788
2066	3,350	302	121	6	1,009	4,788
2067	3,350	302	121	6	1,009	4,788
2068	3,359	303	121	6	1,012	4,801
2069	3,350	302	121	6	1,009	4,788
2070	3,350	302	121	6	1,009	4,788
2071	3,350	302	121	6	1,009	4,788
2072	3,359	303	121	6	1,012	4,801
2073	3,350	302	121	6	1,009	4,788
2074	3,350	302	121	6	1,009	4,788
2075	3,350	302	121	6	1,009	4,788
2076	3,359	303	121	6	1,012	4,801

TABLE 3.2 (continued)
SAFSTOR ALTERNATIVE
SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2077	3,350	302	121	6	1,009	4,788
2078	3,350	302	121	6	1,009	4,788
2079	3,350	302	121	6	1,009	4,788
2080	3,359	303	121	6	1,012	4,801
2081	3,350	302	121	6	1,009	4,788
2082	3,350	302	121	6	1,009	4,788
2083	3,350	302	121	6	1,009	4,788
2084	3,359	303	121	6	1,012	4,801
2085	3,350	302	121	6	1,009	4,788
2086	3,350	302	121	6	1,009	4,788
2087	3,350	302	121	6	1,009	4,788
2088	3,359	303	121	6	1,012	4,801
2089	3,350	302	121	6	1,009	4,788
2090	3,350	302	121	6	1,009	4,788
2091	3,350	302	121	6	1,009	4,788
2092	3,359	303	121	6	1,012	4,801
2093	3,350	302	121	6	1,009	4,788
2094	3,350	302	121	6	1,009	4,788
2095	3,350	302	121	6	1,009	4,788
2096	3,359	303	121	6	1,012	4,801
2097	3,350	302	121	6	1,009	4,788
2098	8,191	494	232	9	1,038	9,963
2099	44,303	4,020	1,211	34	1,350	50,918
2100	46,071	18,452	1,175	15,793	11,195	92,685
2101	46,691	19,914	1,066	19,712	12,755	100,139
2102	39,824	5,973	909	7,145	3,282	57,134
2103	39,824	5,973	909	7,145	3,282	57,134
2104	33,149	3,473	524	3,031	2,045	42,223
2105	20,961	10,111	144	5	441	31,663
2106	13,084	8,236	82	0	188	21,590
Total	571,182	120,423	14,778	54,469	123,824	884,676

TABLE 3.2a
SAFSTOR ALTERNATIVE
SCHEDULE OF LICENSE TERMINATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	34,298	989	982	30	4,281	40,581
2046	31,664	5,445	877	1,217	16,246	55,449
2047	3,350	434	121	14	1,033	4,952
2048	3,359	435	121	14	1,036	4,965
2049	3,350	434	121	14	1,033	4,952
2050	3,350	393	121	12	1,025	4,901
2051	3,350	302	121	6	1,009	4,788
2052	3,359	303	121	6	1,012	4,801
2053	3,350	302	121	6	1,009	4,788
2054	3,350	302	121	6	1,009	4,788
2055	3,350	302	121	6	1,009	4,788
2056	3,359	303	121	6	1,012	4,801
2057	3,350	302	121	6	1,009	4,788
2058	3,350	302	121	6	1,009	4,788
2059	3,350	302	121	6	1,009	4,788
2060	3,359	303	121	6	1,012	4,801
2061	3,350	302	121	6	1,009	4,788
2062	3,350	302	121	6	1,009	4,788
2063	3,350	302	121	6	1,009	4,788
2064	3,359	303	121	6	1,012	4,801
2065	3,350	302	121	6	1,009	4,788
2066	3,350	302	121	6	1,009	4,788
2067	3,350	302	121	6	1,009	4,788
2068	3,359	303	121	6	1,012	4,801
2069	3,350	302	121	6	1,009	4,788
2070	3,350	302	121	6	1,009	4,788
2071	3,350	302	121	6	1,009	4,788
2072	3,359	303	121	6	1,012	4,801
2073	3,350	302	121	6	1,009	4,788
2074	3,350	302	121	6	1,009	4,788
2075	3,350	302	121	6	1,009	4,788
2076	3,359	303	121	6	1,012	4,801

TABLE 3.2a (continued)
SAFSTOR ALTERNATIVE
SCHEDULE OF LICENSE TERMINATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2077	3,350	302	121	6	1,009	4,788
2078	3,350	302	121	6	1,009	4,788
2079	3,350	302	121	6	1,009	4,788
2080	3,359	303	121	6	1,012	4,801
2081	3,350	302	121	6	1,009	4,788
2082	3,350	302	121	6	1,009	4,788
2083	3,350	302	121	6	1,009	4,788
2084	3,359	303	121	6	1,012	4,801
2085	3,350	302	121	6	1,009	4,788
2086	3,350	302	121	6	1,009	4,788
2087	3,350	302	121	6	1,009	4,788
2088	3,359	303	121	6	1,012	4,801
2089	3,350	302	121	6	1,009	4,788
2090	3,350	302	121	6	1,009	4,788
2091	3,350	302	121	6	1,009	4,788
2092	3,359	303	121	6	1,012	4,801
2093	3,350	302	121	6	1,009	4,788
2094	3,350	302	121	6	1,009	4,788
2095	3,350	302	121	6	1,009	4,788
2096	3,359	303	121	6	1,012	4,801
2097	3,350	302	121	6	1,009	4,788
2098	8,067	494	232	9	1,038	9,840
2099	43,332	4,020	1,211	34	1,350	49,947
2100	44,597	18,405	1,175	15,793	11,183	91,154
2101	45,081	19,851	1,066	19,699	12,569	98,267
2102	38,803	5,938	909	7,108	2,784	55,541
2103	38,803	5,938	909	7,108	2,784	55,541
2104	32,718	3,458	524	3,015	1,835	41,551
2105	5,507	315	46	5	248	6,121
2106	92	0	0	0	25	117
Total	493,910	80,772	14,114	54,366	105,914	749,075

TABLE 3.2b
SAFSTOR ALTERNATIVE
SCHEDULE OF SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	212	635	0	0	1,722	2,568
2046	3,907	3,658	37	0	2,466	10,068
2047	10,304	4,639	121	0	3,239	18,303
2048	10,332	4,651	121	0	3,248	18,353
2049	10,304	4,639	121	0	3,239	18,303
2050	7,114	3,203	84	0	2,236	12,636
2051	0	0	0	0	0	0
2052	0	0	0	0	0	0
2053	0	0	0	0	0	0
2054	0	0	0	0	0	0
2055	0	0	0	0	0	0
2056	0	0	0	0	0	0
2057	0	0	0	0	0	0
2058	0	0	0	0	0	0
2059	0	0	0	0	0	0
2060	0	0	0	0	0	0
2061	0	0	0	0	0	0
2062	0	0	0	0	0	0
2063	0	0	0	0	0	0
2064	0	0	0	0	0	0
2065	0	0	0	0	0	0
2066	0	0	0	0	0	0
2067	0	0	0	0	0	0
2068	0	0	0	0	0	0
2069	0	0	0	0	0	0
2070	0	0	0	0	0	0
2071	0	0	0	0	0	0
2072	0	0	0	0	0	0
2073	0	0	0	0	0	0
2074	0	0	0	0	0	0
2075	0	0	0	0	0	0
2076	0	0	0	0	0	0

TABLE 3.2b (continued)
SAFSTOR ALTERNATIVE
SCHEDULE OF SPENT FUEL MANAGEMENT EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2077	0	0	0	0	0	0
2078	0	0	0	0	0	0
2079	0	0	0	0	0	0
2080	0	0	0	0	0	0
2081	0	0	0	0	0	0
2082	0	0	0	0	0	0
2083	0	0	0	0	0	0
2084	0	0	0	0	0	0
2085	0	0	0	0	0	0
2086	0	0	0	0	0	0
2087	0	0	0	0	0	0
2088	0	0	0	0	0	0
2089	0	0	0	0	0	0
2090	0	0	0	0	0	0
2091	0	0	0	0	0	0
2092	0	0	0	0	0	0
2093	0	0	0	0	0	0
2094	0	0	0	0	0	0
2095	0	0	0	0	0	0
2096	0	0	0	0	0	0
2097	0	0	0	0	0	0
2098	0	0	0	0	0	0
2099	0	0	0	0	0	0
2100	0	0	0	0	0	0
2101	16	13	0	103	1,381	1,513
2102	0	0	0	0	0	0
2103	0	0	0	0	0	0
2104	0	0	0	0	0	0
2105	150	184	0	0	55	389
2106	0	0	0	0	0	0
Total	42,338	21,622	485	103	17,585	82,133

TABLE 3.2c
SAFSTOR ALTERNATIVE
SCHEDULE OF SITE RESTORATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	0	0	0	0	0	0
2046	0	0	0	0	0	0
2047	0	0	0	0	0	0
2048	0	0	0	0	0	0
2049	0	0	0	0	0	0
2050	0	0	0	0	0	0
2051	0	0	0	0	0	0
2052	0	0	0	0	0	0
2053	0	0	0	0	0	0
2054	0	0	0	0	0	0
2055	0	0	0	0	0	0
2056	0	0	0	0	0	0
2057	0	0	0	0	0	0
2058	0	0	0	0	0	0
2059	0	0	0	0	0	0
2060	0	0	0	0	0	0
2061	0	0	0	0	0	0
2062	0	0	0	0	0	0
2063	0	0	0	0	0	0
2064	0	0	0	0	0	0
2065	0	0	0	0	0	0
2066	0	0	0	0	0	0
2067	0	0	0	0	0	0
2068	0	0	0	0	0	0
2069	0	0	0	0	0	0
2070	0	0	0	0	0	0
2071	0	0	0	0	0	0
2072	0	0	0	0	0	0
2073	0	0	0	0	0	0
2074	0	0	0	0	0	0
2075	0	0	0	0	0	0
2076	0	0	0	0	0	0

TABLE 3.2c (continued)
SAFSTOR ALTERNATIVE
SCHEDULE OF SITE RESTORATION EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2077	0	0	0	0	0	0
2078	0	0	0	0	0	0
2079	0	0	0	0	0	0
2080	0	0	0	0	0	0
2081	0	0	0	0	0	0
2082	0	0	0	0	0	0
2083	0	0	0	0	0	0
2084	0	0	0	0	0	0
2085	0	0	0	0	0	0
2086	0	0	0	0	0	0
2087	0	0	0	0	0	0
2088	0	0	0	0	0	0
2089	0	0	0	0	0	0
2090	0	0	0	0	0	0
2091	0	0	0	0	0	0
2092	0	0	0	0	0	0
2093	0	0	0	0	0	0
2094	0	0	0	0	0	0
2095	0	0	0	0	0	0
2096	0	0	0	0	0	0
2097	0	0	0	0	0	0
2098	123	0	0	0	0	123
2099	971	0	0	0	0	971
2100	1,474	46	0	0	12	1,532
2101	1,608	61	0	0	13	1,682
2102	1,016	31	0	0	0	1,047
2103	1,016	31	0	0	0	1,047
2104	429	13	0	0	0	442
2105	15,373	9,696	98	0	163	25,331
2106	12,924	8,151	82	0	137	21,295
Total	34,935	18,029	180	0	325	53,470

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 2010" computer software.[30]

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.

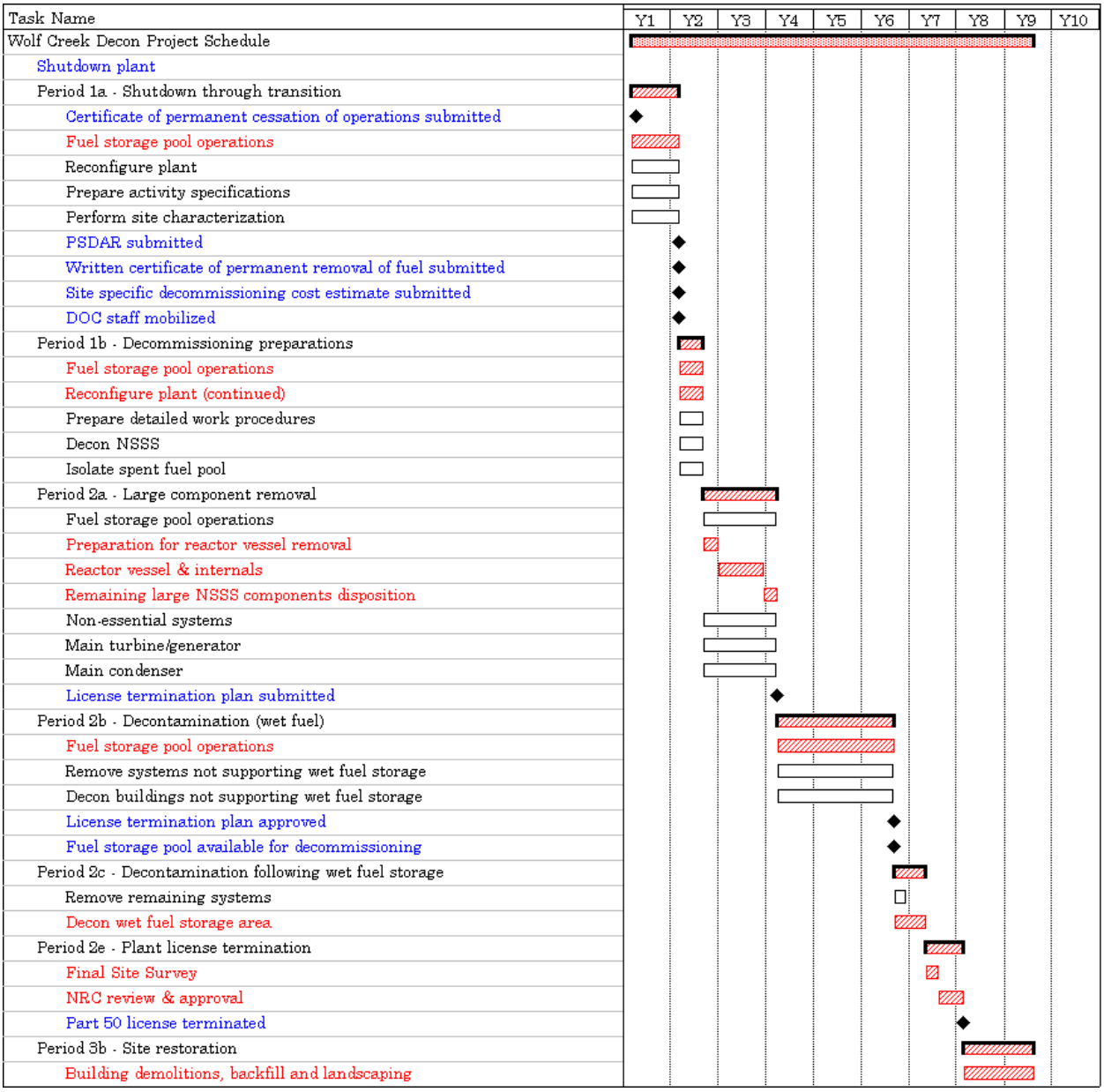
- For plant systems removal, the systems with the longest removal durations in areas on the critical path are considered to determine the duration of the activity.

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.

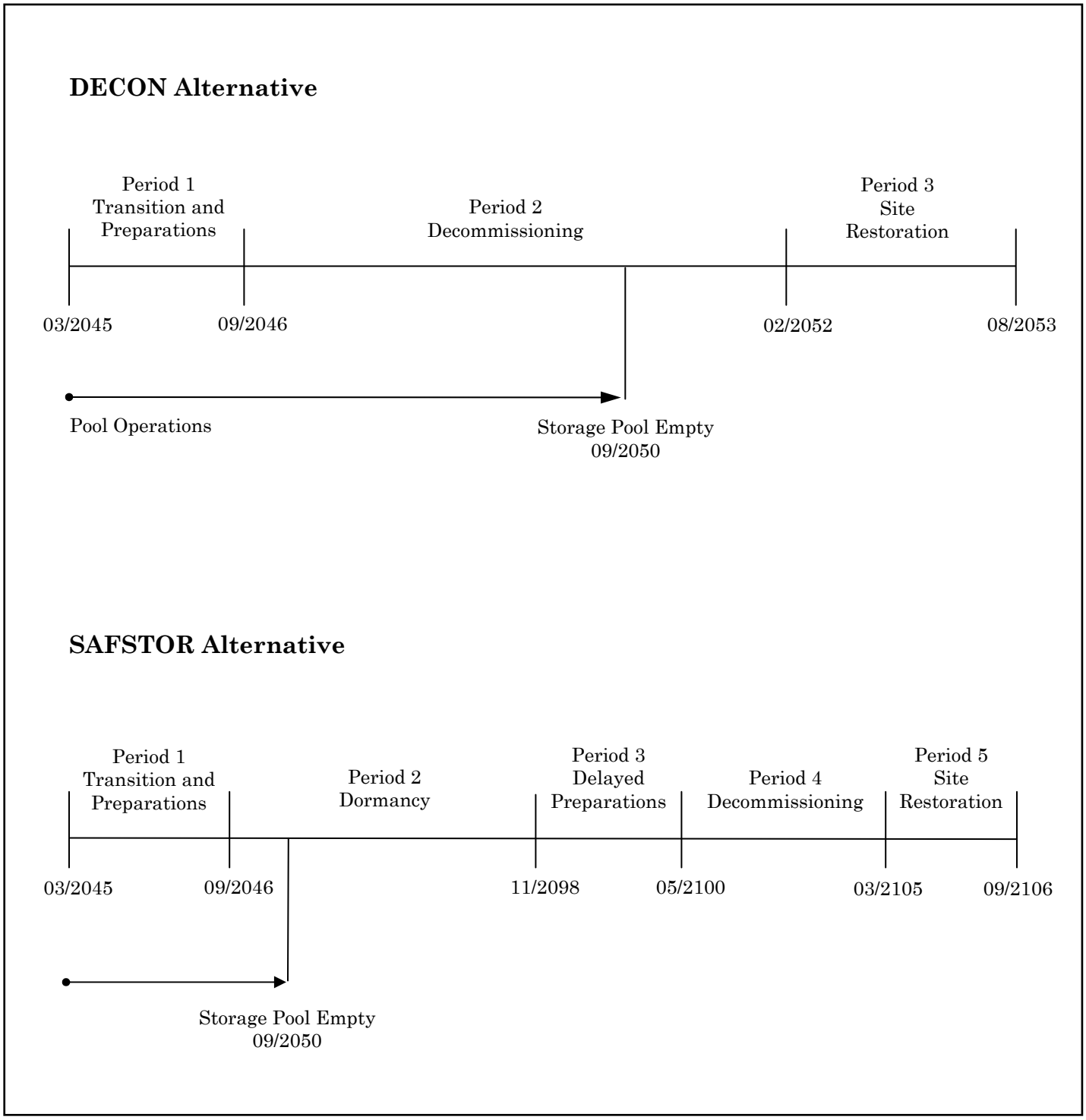
Project timelines are provided in Figures 4.2 and 4.3 with milestone dates based on a 2045 shutdown date. The fuel pool is emptied approximately five and one-half years after shutdown. Deferred decommissioning in the SAFSTOR scenarios is assumed to commence so that the operating license is terminated within a 60-year period from the cessation of plant operations.

FIGURE 4.1
ACTIVITY SCHEDULE



Red text indicates critical path activities
Blue text indicates milestones

FIGURE 4.2
DECOMMISSIONING TIMELINES
(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,[31] the NRC is responsible for protecting the public from sources of ionizing radiation. Title 10 of the Code of Federal Regulations delineates the production, utilization, and disposal of radioactive materials and processes. In particular, Part 71 defines radioactive material as it pertains to transportation and Part 61 specifies its disposition.

Most of the materials being transported for controlled burial are categorized as Low Specific Activity (LSA) or Surface Contaminated Object (SCO) materials containing Type A quantities, as defined in 49 CFR Parts 173-178. Shipping containers are required to be Industrial Packages (IP-1, IP-2 or IP-3, as defined in 10 CFR §173.411). For this study, commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations.

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

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

No process system containing/handling radioactive substances at shutdown is presumed to meet material release criteria by decay alone (i.e., systems radioactive at shutdown will still be radioactive over the time period during which the decommissioning is accomplished, due to the presence of long-lived radionuclides). While the dose rates decrease with time, radionuclides such as ^{137}Cs will still control the disposition requirements.

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

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

Since Energy*Solutions* is not currently able to receive the more highly radioactive components generated in the decontamination and dismantling of the reactor, disposal costs for the Class B and C material were based upon the last published rate schedule for non-compact waste for the Barnwell facility (as a proxy). Additional surcharges were included for activity, dose rate, and/or handling added as appropriate for the particular package.

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.

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	122,372	10,039,293
	Barnwell	B	1,690	191,293
	Barnwell	C	459	48,448
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,142	422,146
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	248,812	10,005,470
Totals [2]			375,475	20,706,650

[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	98,165	7,538,862
	Barnwell	B	376	49,054
	Barnwell	C	470	47,758
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,142	422,146
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	270,114	10,904,040
Totals [2]			371,266	18,961,860

[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 2008. 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 $630.1 million. The majority of this cost (approximately 85.2%) is associated with the physical decontamination and dismantling of the nuclear unit so that the operating license can be terminated. Another 6.3% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 8.5% is for the demolition of the designated structures and limited restoration of the site.

The cost projected for deferred decommissioning (SAFSTOR) is estimated to be $884.7 million. The majority of this cost (approximately 84.7%) is associated with placing the unit in storage, ongoing caretaking of the unit during dormancy, and the eventual physical decontamination and dismantling of the nuclear unit so that the operating license can be terminated. Another 9.3% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 6.0% 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 unit.

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

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

TABLE 6.1
DECON ALTERNATIVE
DECOMMISSIONING COST ELEMENTS
(thousands of 2011 dollars)

Cost Element	Total	Percentage
Decontamination	14,403	2.3
Removal	103,023	16.3
Packaging	22,742	3.6
Transportation	10,359	1.6
Waste Disposal	61,457	9.8
Off-site Waste Processing	23,110	3.7
Program Management [1]	245,392	38.9
Security	47,017	7.5
Spent Fuel Pool Isolation	11,822	1.9
Spent Fuel Management - Direct Costs [2]	39,421	6.3
Insurance and Regulatory Fees	11,946	1.9
Energy	7,145	1.1
Characterization and Licensing Surveys	13,053	2.1
Property Taxes	10,411	1.7
Corporate Allocations	1,883	0.3
Miscellaneous Equipment	6,952	1.1
Total [3]	630,135	100

Cost Element	Total	Percentage
License Termination	536,530	85.2
Spent Fuel Management	39,908	6.3
Site Restoration	53,697	8.5
Total [3]	630,135	100

[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 2011 dollars)

Cost Element	Total	Percentage
Decontamination	12,732	1.4
Removal	105,395	11.9
Packaging	17,149	1.9
Transportation	7,627	0.9
Waste Disposal	42,983	4.9
Off-site Waste Processing	25,197	2.8
Program Management [1]	330,000	37.3
Security	163,895	18.5
Spent Fuel Pool Isolation	11,822	1.3
Spent Fuel Management - Direct Costs [2]	39,421	4.5
Insurance and Regulatory Fees	53,656	6.1
Energy	14,778	1.7
Characterization and Licensing Surveys	14,225	1.6
Property Taxes	20,459	2.3
Corporate Allocations	3,093	0.3
Miscellaneous Equipment	22,245	2.5
Total [3]	884,677	100

Cost Element	Total	Percentage
License Termination	749,075	84.7
Spent Fuel Management	82,133	9.3
Site Restoration	53,470	6.0
Total [3]	884,677	100

[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. W11-1598-002, Rev. 0, TLG Services, Inc., August 2008

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

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

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

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

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

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

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

9. Statement of Edward F. Sproat, III, Director Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Before the Subcommittee on Energy and Air Quality Committee on Energy and Commerce U.S. House of Representatives, July 15, 2008

10. Recommendation of the Transportation and Storage Subcommittee: "Consistent with priorities of safety, significant cost savings could be achieved by re-prioritizing the current "queue" of federal commitments to accept commercial spent fuel from nuclear plant owners and operators. DOE should exercise its rights to remove spent fuel from decommissioned reactor sites, where the cost savings are greatest."

7. REFERENCES
(continued)

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

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

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

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

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

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

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

18. "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

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

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

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

22. "Building Construction Cost Data 2011," Robert Snow Means Company, Inc., Kingston, Massachusetts

7. REFERENCES
(continued)

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

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

25. Tri-State Motor Transit Company, published tariffs, Interstate Commerce Commission (ICC), Docket No. MC-427719 Rules Tariff, March 2004, Radioactive Materials Tariff, February 2011

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

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

28. 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

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

30. "Microsoft Project Professional 2010," Microsoft Corporation, Redmond, WA.

31. "Atomic Energy Act of 1954," (68 Stat. 919)

APPENDIX A

UNIT COST FACTOR DEVELOPMENT

APPENDIX A
UNIT COST FACTOR DEVELOPMENT

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

1. SCOPE

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

2. CALCULATIONS

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

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

***** Total duration = 11.217 hr *****

* alpha designators indicate activities that can be performed in parallel

APPENDIX A
(continued)

3. LABOR REQUIRED

Crew	Number	Duration (hours)	Rate ($/hr)	Cost
Laborers	3.00	11.217	$17.35	$583.84
Craftsmen	2.00	11.217	$36.09	$809.64
Foreman	1.00	11.217	$39.73	$445.65
General Foreman	0.25	11.217	$44.51	$124.82
Fire Watch	0.05	11.217	$17.35	$9.73
Health Physics Technician	1.00	11.217	$44.00	$493.55
Total Labor Cost				$2,467.23

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
• Universal Polypropylene Sorbent 50 @ $0.58/sq ft [1]	$29.00
• Tarpaulin, oil resistant, fire retardant 50 @ $0.43/sq ft [2]	$21.50
• Gas torch consumables 1 @ $11.14 x 1 /hr [3]	$11.14
Subtotal cost of equipment and materials	$61.64
Overhead & profit on equipment and materials @ 15.30 %	$9.43
Total costs, equipment & material	$71.07

TOTAL COST:

Removal of contaminated **heat exchanger <3000 pounds:**	**$2,538.30**
Total labor cost:	$2,467.23
Total equipment/material costs:	$71.07
Total craft labor man-hours required per unit:	81.88

5. NOTES AND REFERENCES

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

- References for equipment & consumables costs:

    1. www.mcmaster.com online catalog, McMaster Carr Spill Control (7193T88)
    2. R.S. Means (2011) Division 01 56, Section 13.60-0600, page 20
    3. R.S. Means (2011) Division 01 54 33, Section 40-6360, page 664

- 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	0.23
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	2.30
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	3.52
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	7.53
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	13.84
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	18.06
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	26.55
Removal of clean pipe >36 inches diameter, $/linear foot	31.52
Removal of clean valve >2 to 4 inches	49.65
Removal of clean valve >4 to 8 inches	75.33
Removal of clean valve >8 to 14 inches	138.39
Removal of clean valve >14 to 20 inches	180.59
Removal of clean valve >20 to 36 inches	265.53
Removal of clean valve >36 inches	315.21
Removal of clean pipe hanger for small bore piping	16.61
Removal of clean pipe hanger for large bore piping	53.87
Removal of clean pump, <300 pound	128.37
Removal of clean pump, 300-1000 pound	370.41
Removal of clean pump, 1000-10,000 pound	1,431.18
Removal of clean pump, >10,000 pound	2,772.23
Removal of clean pump motor, 300-1000 pound	154.39
Removal of clean pump motor, 1000-10,000 pound	594.17
Removal of clean pump motor, >10,000 pound	1,336.89
Removal of clean heat exchanger <3000 pound	775.26
Removal of clean heat exchanger >3000 pound	1,957.51
Removal of clean feedwater heater/deaerator	5,470.60
Removal of clean moisture separator/reheater	11,184.69
Removal of clean tank, <300 gallons	164.97
Removal of clean tank, 300-3000 gallon	517.69
Removal of clean tank, >3000 gallons, $/square foot surface area	4.56

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean electrical equipment, <300 pound	68.99
Removal of clean electrical equipment, 300-1000 pound	251.38
Removal of clean electrical equipment, 1000-10,000 pound	502.77
Removal of clean electrical equipment, >10,000 pound	1,230.34
Removal of clean electrical transformer < 30 tons	854.47
Removal of clean electrical transformer > 30 tons	2,460.71
Removal of clean standby diesel generator, <100 kW	872.77
Removal of clean standby diesel generator, 100 kW to 1 MW	1,948.06
Removal of clean standby diesel generator, >1 MW	4,032.88
Removal of clean electrical cable tray, $/linear foot	6.52
Removal of clean electrical conduit, $/linear foot	2.85
Removal of clean mechanical equipment, <300 pound	68.99
Removal of clean mechanical equipment, 300-1000 pound	251.38
Removal of clean mechanical equipment, 1000-10,000 pound	502.77
Removal of clean mechanical equipment, >10,000 pound	1,230.34
Removal of clean HVAC equipment, <300 pound	83.41
Removal of clean HVAC equipment, 300-1000 pound	302.06
Removal of clean HVAC equipment, 1000-10,000 pound	602.02
Removal of clean HVAC equipment, >10,000 pound	1,230.34
Removal of clean HVAC ductwork, $/pound	0.24
Removal of contaminated instrument and sampling tubing, $/linear foot	0.89
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	14.30
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	22.76
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	37.95
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	69.85
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	82.74
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	112.16
Removal of contaminated pipe >36 inches diameter, $/linear foot	131.42
Removal of contaminated valve >2 to 4 inches	277.57
Removal of contaminated valve >4 to 8 inches	328.66

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated valve >8 to 14 inches	640.27
Removal of contaminated valve >14 to 20 inches	806.09
Removal of contaminated valve >20 to 36 inches	1,063.35
Removal of contaminated valve >36 inches	1,255.99
Removal of contaminated pipe hanger for small bore piping	88.79
Removal of contaminated pipe hanger for large bore piping	277.39
Removal of contaminated pump, <300 pound	590.27
Removal of contaminated pump, 300-1000 pound	1,368.27
Removal of contaminated pump, 1000-10,000 pound	4,111.85
Removal of contaminated pump, >10,000 pound	10,006.08
Removal of contaminated pump motor, 300-1000 pound	615.94
Removal of contaminated pump motor, 1000-10,000 pound	1,710.74
Removal of contaminated pump motor, >10,000 pound	3,841.12
Removal of contaminated heat exchanger <3000 pound	2,538.30
Removal of contaminated heat exchanger >3000 pound	7,454.05
Removal of contaminated tank, <300 gallons	990.57
Removal of contaminated tank, >300 gallons, $/square foot	18.61
Removal of contaminated electrical equipment, <300 pound	442.44
Removal of contaminated electrical equipment, 300-1000 pound	1,095.62
Removal of contaminated electrical equipment, 1000-10,000 pound	2,112.08
Removal of contaminated electrical equipment, >10,000 pound	4,215.45
Removal of contaminated electrical cable tray, $/linear foot	21.31
Removal of contaminated electrical conduit, $/linear foot	11.52
Removal of contaminated mechanical equipment, <300 pound	491.52
Removal of contaminated mechanical equipment, 300-1000 pound	1,207.40
Removal of contaminated mechanical equipment, 1000-10,000 pound	2,323.66
Removal of contaminated mechanical equipment, >10,000 pound	4,215.45
Removal of contaminated HVAC equipment, <300 pound	491.52
Removal of contaminated HVAC equipment, 300-1000 pound	1,207.40
Removal of contaminated HVAC equipment, 1000-10,000 pound	2,323.66

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated HVAC equipment, >10,000 pound	4,215.45
Removal of contaminated HVAC ductwork, $/pound	1.43
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	2.32
Additional decontamination of surface by washing, $/square foot	4.81
Additional decontamination of surfaces by hydrolasing, $/square foot	23.31
Decontamination rig hook up and flush, $/ 250 foot length	4,092.00
Chemical flush of components/systems, $/gallon	18.26
Removal of clean standard reinforced concrete, $/cubic yard	99.95
Removal of grade slab concrete, $/cubic yard	121.81
Removal of clean concrete floors, $/cubic yard	268.01
Removal of sections of clean concrete floors, $/cubic yard	766.46
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	184.27
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	1,457.81
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	232.98
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	1,924.38
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cubic yard	334.84
Removal of below-grade suspended floors, $/cubic yard	268.01
Removal of clean monolithic concrete structures, $/cubic yard	609.77
Removal of contaminated monolithic concrete structures, $/cubic yard	1,442.20
Removal of clean foundation concrete, $/cubic yard	481.92
Removal of contaminated foundation concrete, $/cubic yard	1,344.31
Explosive demolition of bulk concrete, $/cubic yard	22.57
Removal of clean hollow masonry block wall, $/cubic yard	59.69
Removal of contaminated hollow masonry block wall, $/cubic yard	222.07
Removal of clean solid masonry block wall, $/cubic yard	59.69
Removal of contaminated solid masonry block wall, $/cubic yard	222.07
Backfill of below-grade voids, $/cubic yard	31.37
Removal of subterranean tunnels/voids, $/linear foot	74.31
Placement of concrete for below-grade voids, $/cubic yard	125.46
Excavation of clean material, $/cubic yard	2.88

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Excavation of contaminated material, $/cubic yard	33.59
Removal of clean concrete rubble (tipping fee included), $/cubic yard	20.87
Removal of contaminated concrete rubble, $/cubic yard	19.58
Removal of building by volume, $/cubic foot	0.23
Removal of clean building metal siding, $/square foot	0.62
Removal of contaminated building metal siding, $/square foot	2.58
Removal of standard asphalt roofing, $/square foot	1.08
Removal of transite panels, $/square foot	1.40
Scarifying contaminated concrete surfaces (drill & spall), $/square foot	9.59
Scabbling contaminated concrete floors, $/square foot	5.16
Scabbling contaminated concrete walls, $/square foot	13.01
Scabbling contaminated ceilings, $/square foot	44.04
Scabbling structural steel, $/square foot	4.38
Removal of clean overhead crane/monorail < 10 ton capacity	373.62
Removal of contaminated overhead crane/monorail < 10 ton capacity	1,160.40
Removal of clean overhead crane/monorail >10-50 ton capacity	896.68
Removal of contaminated overhead crane/monorail >10-50 ton capacity	2,784.49
Removal of polar crane > 50 ton capacity	3,832.57
Removal of gantry crane > 50 ton capacity	15,379.40
Removal of structural steel, $/pound	0.14
Removal of clean steel floor grating, $/square foot	2.99
Removal of contaminated steel floor grating, $/square foot	9.13
Removal of clean free standing steel liner, $/square foot	6.84
Removal of contaminated free standing steel liner, $/square foot	21.61
Removal of clean concrete-anchored steel liner, $/square foot	3.42
Removal of contaminated concrete-anchored steel liner, $/square foot	25.18
Placement of scaffolding in clean areas, $/square foot	15.16
Placement of scaffolding in contaminated areas, $/square foot	21.20
Landscaping with topsoil, $/acre	28,445.24
Cost of CPC B-88 LSA box & preparation for use	2,147.59

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	1,959.01
Cost of CPC B-12V 12 gauge LSA box & preparation for use	1,576.92
Cost of CPC B-144 LSA box & preparation for use	11,247.50
Cost of LSA drum & preparation for use	170.87
Cost of cask liner for CNSI 8 120A cask (resins)	7,556.18
Cost of cask liner for CNSI 8 120A cask (filters)	7,933.12
Decontamination of surfaces with vacuuming, $/square foot	0.51

APPENDIX C

DETAILED COST ANALYSIS

DECON

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2011 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	-	-	-	-	-	-	146	22	167	167	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	224	34	258	258	-	-	-	-	-	-	-	-	-	2,000
1a.1.7	Review plant dwgs & specs.	-	-	-	-	-	-	515	77	593	593	-	-	-	-	-	-	-	-	-	4,600
1a.1.8	Perform detailed rad survey									a											
1a.1.9	Estimate by-product inventory	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
1a.1.10	End product description	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	Detailed by-product inventory	-	-	-	-	-	-	146	22	167	167	-	-	-	-	-	-	-	-	-	1,300
1a.1.12	Define major work sequence	-	-	-	-	-	-	840	126	966	966	-	-	-	-	-	-	-	-	-	7,500
1a.1.13	Perform SER and EA	-	-	-	-	-	-	347	52	399	399	-	-	-	-	-	-	-	-	-	3,100
1a.1.14	Perform Site-Specific Cost Study	-	-	-	-	-	-	560	84	644	644	-	-	-	-	-	-	-	-	-	5,000
1a.1.15	Prepare/submit License Termination Plan	-	-	-	-	-	-	459	69	528	528	-	-	-	-	-	-	-	-	-	4,096
1a.1.16	Receive NRC approval of termination plan									a											
Activity Specifications																					
1a.1.17.1	Plant & temporary facilities	-	-	-	-	-	-	551	83	634	570	-	63	-	-	-	-	-	-	-	4,920
1a.1.17.2	Plant systems	-	-	-	-	-	-	467	70	537	483	-	54	-	-	-	-	-	-	-	4,167
1a.1.17.3	NSSS Decontamination Flush	-	-	-	-	-	-	56	8	64	64	-	-	-	-	-	-	-	-	-	500
1a.1.17.4	Reactor internals	-	-	-	-	-	-	795	119	915	915	-	-	-	-	-	-	-	-	-	7,100
1a.1.17.5	Reactor vessel	-	-	-	-	-	-	728	109	837	837	-	-	-	-	-	-	-	-	-	6,500
1a.1.17.6	Biological shield	-	-	-	-	-	-	56	8	64	64	-	-	-	-	-	-	-	-	-	500
1a.1.17.7	Steam generators	-	-	-	-	-	-	349	52	402	402	-	-	-	-	-	-	-	-	-	3,120
1a.1.17.8	Reinforced concrete	-	-	-	-	-	-	179	27	206	103	-	103	-	-	-	-	-	-	-	1,600
1a.1.17.9	Main Turbine	-	-	-	-	-	-	45	7	52	-	-	52	-	-	-	-	-	-	-	400
1a.1.17.10	Main Condensers	-	-	-	-	-	-	45	7	52	-	-	52	-	-	-	-	-	-	-	400
1a.1.17.11	Plant structures & buildings	-	-	-	-	-	-	349	52	402	201	-	201	-	-	-	-	-	-	-	3,120
1a.1.17.12	Waste management	-	-	-	-	-	-	515	77	593	593	-	-	-	-	-	-	-	-	-	4,600
1a.1.17.13	Facility & site closeout	-	-	-	-	-	-	101	15	116	58	-	58	-	-	-	-	-	-	-	900
1a.1.17	Total	-	-	-	-	-	-	4,237	636	4,873	4,290	-	582	-	-	-	-	-	-	-	37,827
Planning & Site Preparations																					
1a.1.18	Prepare dismantling sequence	-	-	-	-	-	-	269	40	309	309	-	-	-	-	-	-	-	-	-	2,400
1a.1.19	Plant prep. & temp. svces	-	-	-	-	-	-	2,800	420	3,220	3,220	-	-	-	-	-	-	-	-	-	-
1a.1.20	Design water clean-up system	-	-	-	-	-	-	157	24	180	180	-	-	-	-	-	-	-	-	-	1,400
1a.1.21	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,200	330	2,530	2,530	-	-	-	-	-	-	-	-	-	-
1a.1.22	Procure casks/liners & containers	-	-	-	-	-	-	138	21	158	158	-	-	-	-	-	-	-	-	-	1,230
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	13,261	1,989	15,250	14,668	-	582	-	-	-	-	-	-	-	73,753
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	907	136	1,044	-	1,044	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	907	136	1,044	-	1,044	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	1,786	179	1,965	1,965	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	1,571	157	1,728	1,728	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	472	-	-	-	-	-	118	589	589	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	458	-	-	-	-	-	69	526	526	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	13	3	-	30	-	9	55	55	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,053	158	1,211	1,211	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	769	77	846	846	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,133	113	1,246	-	1,246	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	302	45	348	348	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	763	114	878	-	878	-	-	-	-	-	-	-	-	-
1a.4.11	Corporate Allocations	-	-	-	-	-	-	337	51	387	387	-	-	-	-	-	-	-	-	-	-
1a.4.12	Security Staff Cost	-	-	-	-	-	-	7,200	1,080	8,280	8,280	-	-	-	-	-	-	-	-	-	157,471
1a.4.13	Utility Staff Cost	-	-	-	-	-	-	25,243	3,786	29,029	29,029	-	-	-	-	-	-	-	-	-	423,400
1a.4	Subtotal Period 1a Period-Dependent Costs	-	929	13	3	-	30	40,157	5,956	47,088	44,965	2,123	-	-	610	-	-	-	12,190	20	580,871
1a.0	TOTAL PERIOD 1a COST	-	929	13	3	-	30	54,325	8,082	63,382	59,633	3,167	582	-	610	-	-	-	12,190	20	654,624

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2011 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	-	-	-	-	-	-	530	80	610	549	-	61	-	-	-	-	-	-	-	4,733
1b.1.1.2	NSSS Decontamination Flush	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.3	Reactor internals	-	-	-	-	-	-	280	42	322	322	-	-	-	-	-	-	-	-	-	2,500
1b.1.1.4	Remaining buildings	-	-	-	-	-	-	151	23	174	43	-	130	-	-	-	-	-	-	-	1,350
1b.1.1.5	CRD cooling assembly	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.6	CRD housings & ICI tubes	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.7	Incore instrumentation	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.8	Reactor vessel	-	-	-	-	-	-	407	61	468	468	-	-	-	-	-	-	-	-	-	3,630
1b.1.1.9	Facility closeout	-	-	-	-	-	-	134	20	155	77	-	77	-	-	-	-	-	-	-	1,200
1b.1.1.10	Missile shields	-	-	-	-	-	-	50	8	58	58	-	-	-	-	-	-	-	-	-	450
1b.1.1.11	Biological shield	-	-	-	-	-	-	134	20	155	155	-	-	-	-	-	-	-	-	-	1,200
1b.1.1.12	Steam generators	-	-	-	-	-	-	515	77	593	593	-	-	-	-	-	-	-	-	-	4,600
1b.1.1.13	Reinforced concrete	-	-	-	-	-	-	112	17	129	64	-	64	-	-	-	-	-	-	-	1,000
1b.1.1.14	Main Turbine	-	-	-	-	-	-	175	26	201	-	-	201	-	-	-	-	-	-	-	1,560
1b.1.1.15	Main Condensers	-	-	-	-	-	-	175	26	201	-	-	201	-	-	-	-	-	-	-	1,560
1b.1.1.16	Auxiliary building	-	-	-	-	-	-	306	46	352	316	-	35	-	-	-	-	-	-	-	2,730
1b.1.1.17	Reactor building	-	-	-	-	-	-	306	46	352	316	-	35	-	-	-	-	-	-	-	2,730
1b.1.1	Total	-	-	-	-	-	-	3,724	559	4,282	3,477	-	805	-	-	-	-	-	-	-	33,243
1b.1.2	Decon primary loop	620	-	-	-	-	-	-	310	930	930	-	-	-	-	-	-	-	-	1,067	-
1b.1	Subtotal Period 1b Activity Costs	620	-	-	-	-	-	3,724	869	5,212	4,407	-	805	-	-	-	-	-	-	1,067	33,243
Period 1b Additional Costs																					
1b.2.1	Spent fuel pool isolation	-	-	-	-	-	-	10,280	1,542	11,822	11,822	-	-	-	-	-	-	-	-	-	-
1b.2.2	Site Characterization	-	-	-	-	-	-	2,614	784	3,398	3,398	-	-	-	-	-	-	-	-	19,100	7,852
1b.2.3	Misc/Hazardous Waste	-	-	63	18	69	-	-	19	170	170	-	-	2,067	-	-	-	-	133,598	716	-
1b.2	Subtotal Period 1b Additional Costs	-	-	63	18	69	-	12,893	2,346	15,390	15,390	-	-	2,067	-	-	-	-	133,598	19,816	7,852
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	907	-	-	-	-	-	-	136	1,043	1,043	-	-	-	-	-	-	-	-	-	-
1b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,214	182	1,396	1,396	-	-	-	-	-	-	-	-	-	-
1b.3.3	Process decommissioning water waste	45	-	18	65	-	107	-	61	295	295	-	-	-	283	-	-	-	16,989	55	-
1b.3.4	Process decommissioning chemical flush waste	2	-	48	229	-	2,920	-	770	3,968	3,968	-	-	-	-	788	-	-	83,917	147	-
1b.3.5	Small tool allowance	-	2	-	-	-	-	-	0	2	2	-	-	-	-	-	-	-	-	-	-
1b.3.6	Pipe cutting equipment	-	1,100	-	-	-	-	-	165	1,265	1,265	-	-	-	-	-	-	-	-	-	-
1b.3.7	Decon rig	1,500	-	-	-	-	-	-	225	1,725	1,725	-	-	-	-	-	-	-	-	-	-
1b.3.8	Spent Fuel Capital and Transfer	-	-	-	-	-	-	2,420	363	2,783	-	2,783	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	2,453	1,102	65	294	-	3,027	3,633	1,902	12,477	9,694	2,783	-	-	283	788	-	-	100,906	203	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	28	-	-	-	-	-	-	7	35	35	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	900	90	990	990	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	792	79	871	871	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	270	-	-	-	-	-	67	337	337	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	231	-	-	-	-	-	35	265	265	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	8	2	-	18	-	5	33	33	-	-	-	360	-	-	-	7,197	12	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	1,062	159	1,221	1,221	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	388	39	426	426	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	571	57	628	-	628	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	385	58	442	-	442	-	-	-	-	-	-	-	-	-
1b.4.11	Corporate Allocations	-	-	-	-	-	-	171	26	196	196	-	-	-	-	-	-	-	-	-	-
1b.4.12	Security Staff Cost	-	-	-	-	-	-	3,630	544	4,174	4,174	-	-	-	-	-	-	-	-	-	79,383
1b.4.13	DOC Staff Cost	-	-	-	-	-	-	4,956	743	5,700	5,700	-	-	-	-	-	-	-	-	-	64,137
1b.4.14	Utility Staff Cost	-	-	-	-	-	-	12,794	1,919	14,713	14,713	-	-	-	-	-	-	-	-	-	214,491
1b.4	Subtotal Period 1b Period-Dependent Costs	28	501	8	2	-	18	25,648	3,829	30,033	28,963	1,070	-	-	360	-	-	-	7,197	12	358,011
1b.0	TOTAL PERIOD 1b COST	3,101	1,602	136	314	69	3,045	45,899	8,945	63,112	58,454	3,853	805	2,067	643	788	-	-	241,701	21,097	399,106
PERIOD 1 TOTALS		3,101	2,532	150	317	69	3,075	100,224	17,027	126,494	118,087	7,020	1,387	2,067	1,253	788	-	-	253,892	21,117	1,053,731

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
PERIOD 2a - Large Component Removal																					
Period 2a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
2a.1.1.1	Reactor Coolant Piping	123	126	25	24	-	394	-	198	890	890	-	-	-	1,227	-	-	-	140,300	6,838	-
2a.1.1.2	Pressurizer Relief Tank	21	17	7	7	-	102	-	42	195	195	-	-	-	328	-	-	-	36,395	1,068	-
2a.1.1.3	Reactor Coolant Pumps & Motors	63	60	67	187	-	964	-	322	1,663	1,663	-	-	-	3,386	-	-	-	816,140	4,188	100
2a.1.1.4	Pressurizer	33	36	491	141	-	1,064	-	362	2,128	2,128	-	-	-	3,739	-	-	-	267,393	2,534	1,875
2a.1.1.5	Steam Generators	262	4,795	3,665	2,995	2,549	6,607	-	4,179	25,052	25,052	-	-	40,845	23,217	-	-	-	3,577,181	23,234	5,750
2a.1.1.6	CRDMs/ICIs/Service Structure Removal	104	69	265	44	-	305	-	179	966	966	-	-	-	4,534	-	-	-	108,572	4,446	-
2a.1.1.7	Reactor Vessel Internals	81	3,284	9,501	1,309	-	8,308	270	9,401	32,154	32,154	-	-	-	1,377	903	459	-	326,029	29,600	1,316
2a.1.1.8	Vessel & Internals GTCC Disposal	-	-	-	-	-	11,924	-	1,789	13,712	13,712	-	-	-	-	-	-	2,142	422,146	-	-
2a.1.1.9	Reactor Vessel	58	6,291	2,145	777	-	2,272	270	6,654	18,467	18,467	-	-	-	8,735	-	-	-	954,909	29,600	1,316
2a.1.1	Totals	745	14,677	16,166	5,485	2,549	31,940	541	23,125	95,228	95,228	-	-	40,845	46,543	903	459	2,142	6,649,065	101,508	10,357
Removal of Major Equipment																					
2a.1.2	Main Turbine/Generator	-	313	419	69	783	606	-	400	2,590	2,590	-	-	4,844	2,698	-	-	-	616,839	9,734	-
2a.1.3	Main Condensers	-	867	223	75	700	576	-	499	2,941	2,941	-	-	7,701	2,412	-	-	-	551,564	27,762	-
Cascading Costs from Clean Building Demolition																					
2a.1.4.1	Reactor	-	700	-	-	-	-	-	105	805	805	-	-	-	-	-	-	-	-	10,579	-
2a.1.4.2	Auxiliary	-	350	-	-	-	-	-	52	402	402	-	-	-	-	-	-	-	-	5,551	-
2a.1.4.3	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	16	-
2a.1.4.4	Radwaste	-	73	-	-	-	-	-	11	84	84	-	-	-	-	-	-	-	-	1,108	-
2a.1.4.5	Fuel Building	-	175	-	-	-	-	-	26	202	202	-	-	-	-	-	-	-	-	2,395	-
2a.1.4	Totals	-	1,299	-	-	-	-	-	195	1,494	1,494	-	-	-	-	-	-	-	-	19,649	-
Disposal of Plant Systems																					
2a.1.5.1	AB - Main Steam	-	144	-	-	-	-	-	22	165	-	-	165	-	-	-	-	-	-	5,833	-
2a.1.5.2	AB - Main Steam RCA	-	53	3	10	177	-	-	42	285	285	-	-	2,156	-	-	-	-	87,550	1,515	-
2a.1.5.3	AC - Main Turbine	-	144	-	-	-	-	-	22	165	-	-	165	-	-	-	-	-	-	5,641	-
2a.1.5.4	AD - Condensate	-	162	-	-	-	-	-	24	187	-	-	187	-	-	-	-	-	-	6,144	-
2a.1.5.5	AE - Feedwater	-	110	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	4,271	-
2a.1.5.6	AF - Feedwater Hter Extrction, Drn & Vnt	-	133	-	-	-	-	-	20	153	-	-	153	-	-	-	-	-	-	5,352	-
2a.1.5.7	AK - Condensate Demineralizer	-	50	-	-	-	-	-	7	57	-	-	57	-	-	-	-	-	-	1,944	-
2a.1.5.8	AL - Auxiliary Feedwater	-	22	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	852	-
2a.1.5.9	AL-Auxiliary Feedwater Surge Tanks	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	72	-
2a.1.5.10	AQ - Condensate & Feedwater Chem Additn	-	12	-	-	-	-	-	2	14	-	-	14	-	-	-	-	-	-	468	-
2a.1.5.11	AX - Acid Feed	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	754	-
2a.1.5.12	Auxiliary Bldg Non-System Specific	-	77	5	5	39	50	-	39	216	216	-	-	474	211	-	-	-	37,227	2,280	-
2a.1.5.13	Auxiliary Bldg Non-System Specific RCA	-	484	12	35	626	-	-	221	1,379	1,379	-	-	7,629	-	-	-	-	309,812	13,471	-
2a.1.5.14	BL - Reactor Makeup Water	-	199	20	18	158	152	-	116	664	664	-	-	1,928	720	-	-	-	132,297	5,867	-
2a.1.5.15	BM - Steam Generator Blowdown	-	404	8	24	423	-	-	169	1,028	1,028	-	-	5,160	-	-	-	-	209,560	11,982	-
2a.1.5.16	CA - Steam Seal	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	455	-
2a.1.5.17	CB - Main Turbine Lube Oil	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	1,207	-
2a.1.5.18	CC - Generator Hydrogen & CO2	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	198	-
2a.1.5.19	CD - Generator Seal Oil	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	287	-
2a.1.5.20	CE - Stator Cooling Water	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	241	-
2a.1.5.21	CF - Lube Oil Strg, Xfer & Purification	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	812	-
2a.1.5.22	CG - Condenser Air Removal	-	17	-	-	-	-	-	3	20	-	-	20	-	-	-	-	-	-	657	-
2a.1.5.23	CH - Main Turbine Control Oil	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,219	-
2a.1.5.24	CL - Chlorination	-	15	-	-	-	-	-	2	17	-	-	17	-	-	-	-	-	-	569	-
2a.1.5.25	CO - Carbon Dioxide	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	121	-
2a.1.5.26	CW - Circulating Water	-	196	-	-	-	-	-	29	226	-	-	226	-	-	-	-	-	-	7,858	-
2a.1.5.27	CZ - Caustic Acid	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	111	-
2a.1.5.28	DA - Circulating Water System	-	199	-	-	-	-	-	30	229	-	-	229	-	-	-	-	-	-	7,953	-
2a.1.5.29	DM - Equipment Drains	-	33	-	-	-	-	-	5	38	-	-	38	-	-	-	-	-	-	1,223	-
2a.1.5.30	DM - Equipment Drains RCA	-	100	23	72	1,267	-	-	228	1,690	1,690	-	-	15,445	-	-	-	-	627,223	2,840	-
2a.1.5.31	EG - Component Cooling Water RCA	-	494	21	66	1,162	-	-	310	2,053	2,053	-	-	14,161	-	-	-	-	575,071	13,646	-
2a.1.5.32	EJ - Residual Heat Removal	-	257	44	39	224	432	-	216	1,212	1,212	-	-	2,727	1,818	-	-	-	264,399	7,876	-
2a.1.5.33	EM - High Pressure Coolant Injection	-	212	14	13	103	116	-	101	560	560	-	-	1,260	487	-	-	-	92,481	6,195	-
2a.1.5.34	EN - Containment Spray	-	150	5	14	248	-	-	77	495	495	-	-	3,026	-	-	-	-	122,874	4,134	-
2a.1.5.35	FB - Auxiliary Steam	-	52	-	-	-	-	-	8	60	-	-	60	-	-	-	-	-	-	2,106	-
2a.1.5.36	FB - Auxiliary Steam RCA	-	58	1	4	67	-	-	25	155	155	-	-	816	-	-	-	-	33,148	1,537	-
2a.1.5.37	FC - Auxiliary Turbines	-	35	-	-	-	-	-	5	40	-	-	40	-	-	-	-	-	-	1,301	-
2a.1.5.38	FE - Auxiliary Steam Chemical Addition	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	105	-
2a.1.5.39	GE - Turbine Bldg HVAC	-	78	-	-	-	-	-	12	89	-	-	89	-	-	-	-	-	-	3,189	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2011 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.1.5.40	GF - Miscellaneous Building HVAC	-	23	-	-	-	-	-	4	27	-	-	27	-	-	-	-	-	-	987	-
2a.1.5.41	GS - Containment Hydrogen Control	-	52	3	4	54	19	-	27	159	159	-	-	658	78	-	-	-	33,357	1,558	-
2a.1.5.42	HF - Secondary Liquid Waste	504	665	71	64	507	572	-	654	3,037	3,037	-	-	6,186	2,619	-	-	-	454,900	31,872	-
2a.1.5.43	HY - Hydrogen	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	223	-
2a.1.5.44	KH - Service Gas	-	16	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	644	-
2a.1.5.45	LE - Oily Waste	-	64	-	-	-	-	-	10	73	-	-	73	-	-	-	-	-	-	2,575	-
2a.1.5.46	LE - Oily Waste RCA	-	135	3	8	141	-	-	56	344	344	-	-	1,718	-	-	-	-	69,785	3,518	-
2a.1.5.47	NT - Nitrogen	-	4	-	-	-	-	-	1	4	-	-	4	-	-	-	-	-	-	149	-
2a.1.5.48	OX - Oxygen	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	171	-
2a.1.5.49	SW - Screen Wash	-	18	-	-	-	-	-	3	21	-	-	21	-	-	-	-	-	-	635	-
2a.1.5.50	Turbine Bldg Non-System Specific	-	423	-	-	-	-	-	63	487	-	-	487	-	-	-	-	-	-	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	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	593	-
2a.1.5.54	WL - Cooling Lake Makeup & Blowdown	-	20	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	745	-
2a.1.5	Totals	504	5,497	233	377	5,196	1,341	-	2,605	15,753	13,276	-	2,477	63,344	5,933	-	-	-	3,049,684	191,779	-
2a.1.6	Scaffolding in support of decommissioning	-	919	28	7	110	19	-	255	1,338	1,338	-	-	1,206	80	-	-	-	61,056	36,964	-
2a.1	Subtotal Period 2a Activity Costs	1,249	23,572	17,069	6,014	9,338	34,482	541	27,079	119,344	116,867	-	2,477	117,940	57,665	903	459	2,142	10,928,210	387,395	10,357
Period 2a Collateral Costs																					
2a.3.1	Process decommissioning water waste	164	-	66	241	-	398	-	224	1,094	1,094	-	-	-	1,054	-	-	-	63,230	205	-
2a.3.2	Process decommissioning chemical flush waste	1	-	16	77	-	179	-	58	331	331	-	-	-	266	-	-	-	28,388	50	-
2a.3.3	Small tool allowance	-	252	-	-	-	-	-	38	289	260	-	29	-	-	-	-	-	-	-	-
2a.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	7,611	1,142	8,752	-	8,752	-	-	-	-	-	-	-	-	-
2a.3.5	On-site survey and release of 112.5 tons clean metallic waste	-	-	-	-	-	-	151	15	166	166	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	165	252	82	319	-	576	7,761	1,477	10,632	1,851	8,752	29	-	1,320	-	-	-	91,618	255	-
Period 2a Period-Dependent Costs																					
2a.4.1	Decon supplies	88	-	-	-	-	-	-	22	110	110	-	-	-	-	-	-	-	-	-	-
2a.4.2	Insurance	-	-	-	-	-	-	935	93	1,028	1,028	-	-	-	-	-	-	-	-	-	-
2a.4.3	Property taxes	-	-	-	-	-	-	2,492	249	2,741	2,467	-	274	-	-	-	-	-	-	-	-
2a.4.4	Health physics supplies	-	2,459	-	-	-	-	-	615	3,073	3,073	-	-	-	-	-	-	-	-	-	-
2a.4.5	Heavy equipment rental	-	3,159	-	-	-	-	-	474	3,633	3,633	-	-	-	-	-	-	-	-	-	-
2a.4.6	Disposal of DAW generated	-	-	123	29	-	278	-	86	517	517	-	-	-	5,678	-	-	-	113,558	185	-
2a.4.7	Plant energy budget	-	-	-	-	-	-	1,587	238	1,825	1,825	-	-	-	-	-	-	-	-	-	-
2a.4.8	NRC Fees	-	-	-	-	-	-	1,138	114	1,252	1,252	-	-	-	-	-	-	-	-	-	-
2a.4.9	Emergency Planning Fees	-	-	-	-	-	-	986	99	1,085	-	1,085	-	-	-	-	-	-	-	-	-
2a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,211	182	1,392	-	1,392	-	-	-	-	-	-	-	-	-
2a.4.11	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	307	46	354	354	-	-	-	-	-	-	-	-	-	-
2a.4.12	Corporate Allocations	-	-	-	-	-	-	372	56	428	428	-	-	-	-	-	-	-	-	-	-
2a.4.13	Security Staff Cost	-	-	-	-	-	-	9,777	1,467	11,244	11,244	-	-	-	-	-	-	-	-	-	209,267
2a.4.14	DOC Staff Cost	-	-	-	-	-	-	18,941	2,841	21,783	21,783	-	-	-	-	-	-	-	-	-	251,451
2a.4.15	Utility Staff Cost	-	-	-	-	-	-	29,304	4,396	33,700	33,700	-	-	-	-	-	-	-	-	-	468,163
2a.4	Subtotal Period 2a Period-Dependent Costs	88	5,618	123	29	-	278	67,052	10,977	84,165	81,413	2,477	274	-	5,678	-	-	-	113,558	185	928,881
2a.0	TOTAL PERIOD 2a COST	1,501	29,442	17,275	6,361	9,338	35,337	75,353	39,533	214,140	200,131	11,229	2,780	117,940	64,664	903	459	2,142	11,133,380	387,835	939,238
PERIOD 2b - Site Decontamination																					
Period 2b Direct Decommissioning Activities																					
Disposal of Plant Systems																					
2b.1.1.1	AN - Demineralized Wtr Storage & xfer	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	1,548	-
2b.1.1.2	AN - Demineralized Wtr Strg & xfer RCA	-	13	0	1	10	-	-	5	29	29	-	-	120	-	-	-	-	4,855	334	-
2b.1.1.3	AP - Condensate Storage & Transfer	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	1,660	-
2b.1.1.4	BB - Reactor Coolant	-	203	33	27	143	298	-	154	857	857	-	-	1,746	1,426	-	-	-	176,971	6,404	-
2b.1.1.5	BG - Chemical & Volume Control	638	641	94	77	402	882	-	781	3,514	3,514	-	-	4,899	3,762	-	-	-	512,700	27,803	-
2b.1.1.6	BN - Borated Refueling Water Storage	-	224	17	31	452	95	-	154	975	975	-	-	5,512	433	-	-	-	257,752	6,935	-
2b.1.1.7	Control Bldg Non-System Specific	-	125	3	10	175	-	-	59	373	373	-	-	2,139	-	-	-	-	86,849	3,413	-
2b.1.1.8	Control Bldg Non-System Specific Cln	-	894	-	-	-	-	-	134	1,028	-	-	1,028	-	-	-	-	-	-	29,076	-
2b.1.1.9	DO - Diesel Oil	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	48	-
2b.1.1.10	EA - Service Water	-	65	-	-	-	-	-	10	75	-	-	75	-	-	-	-	-	-	2,592	-
2b.1.1.11	EB - Closed Cooling Water	-	31	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	1,267	-
2b.1.1.12	EF - Essential Service Water	-	73	-	-	-	-	-	11	84	-	-	84	-	-	-	-	-	-	2,951	-
2b.1.1.13	EF - Essential Service Water RCA	-	62	2	7	117	-	-	34	222	222	-	-	1,427	-	-	-	-	57,959	1,734	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
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Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
	Disposal of Plant Systems (continued)																				
2b.1.1.14	EP - Accumulator Safety Injection	-	111	8	10	129	51	-	62	370	370	-	-	1,568	219	-	-	-	81,650	3,242	-
2b.1.1.15	FA - Auxiliary Steam Generator	-	12	-	-	-	-	-	2	14	-	-	14	-	-	-	-	-	-	521	-
2b.1.1.16	FO - Fuel Oil	-	12	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	486	-
2b.1.1.17	FP - Fire Protection	-	97	-	-	-	-	-	14	111	-	-	111	-	-	-	-	-	-	3,826	-
2b.1.1.18	FP - Fire Protection RCA	-	135	7	21	368	-	-	93	624	624	-	-	4,492	-	-	-	-	182,411	3,541	-
2b.1.1.19	GA - Plant Heating	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	1,912	-
2b.1.1.20	GA - Plant Heating RCA	-	80	1	3	61	-	-	30	176	176	-	-	746	-	-	-	-	30,275	2,072	-
2b.1.1.21	GB - Central Chilled Water	-	44	-	-	-	-	-	7	50	-	-	50	-	-	-	-	-	-	1,803	-
2b.1.1.22	GB - Central Chilled Water RCA	-	19	0	1	15	-	-	7	42	42	-	-	187	-	-	-	-	7,591	482	-
2b.1.1.23	GD - Esstl Srvc Wtr Pumphs Bldg HVAC	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	284	-
2b.1.1.24	GH - Radwaste Building HVAC	-	130	5	12	199	18	-	69	434	434	-	-	2,425	73	-	-	-	104,709	3,454	-
2b.1.1.25	GK - Control Building HVAC	-	89	-	-	-	-	-	13	102	-	-	102	-	-	-	-	-	-	3,959	-
2b.1.1.26	GL - Auxiliary Building HVAC	-	325	11	26	415	41	-	159	978	978	-	-	5,064	171	-	-	-	220,163	8,489	-
2b.1.1.27	GM - Diesel Generator Building HVAC	-	15	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	695	-
2b.1.1.28	GN - Containment Cooling	-	351	21	41	603	115	-	215	1,347	1,347	-	-	7,354	482	-	-	-	339,626	9,496	-
2b.1.1.29	GP - Containmnt Integratd Leak Rate Test	-	27	1	3	48	-	-	14	93	93	-	-	580	-	-	-	-	23,570	750	-
2b.1.1.30	GR - Containment Atmospheric Control	-	13	2	5	89	7	-	20	137	137	-	-	1,086	31	-	-	-	46,696	392	-
2b.1.1.31	GT - Contaiment Purge HVAC	-	83	6	11	160	30	-	54	344	344	-	-	1,948	128	-	-	-	89,958	2,257	-
2b.1.1.32	HA - Gaseous Radwaste	-	248	19	20	228	119	-	131	765	765	-	-	2,782	512	-	-	-	155,375	7,029	-
2b.1.1.33	HB - Liquid Radwaste	539	588	64	56	455	490	-	622	2,815	2,815	-	-	5,544	2,279	-	-	-	399,463	30,741	-
2b.1.1.34	HC - Solid Radwaste	-	329	41	36	228	372	-	219	1,225	1,225	-	-	2,781	1,598	-	-	-	245,197	9,570	-
2b.1.1.35	HD - Decontamination	-	70	5	6	81	31	-	39	232	232	-	-	983	132	-	-	-	50,841	2,049	-
2b.1.1.36	HE - Boron Recycle	272	342	32	28	213	252	-	324	1,463	1,463	-	-	2,600	1,154	-	-	-	195,348	16,649	-
2b.1.1.37	JE - Emergency Fuel Oil	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,260	-
2b.1.1.38	KA - Compressed Air and Instrument	-	152	-	-	-	-	-	23	175	-	-	175	-	-	-	-	-	-	6,089	-
2b.1.1.39	KB - Breathing Air	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	1,075	-
2b.1.1.40	KC - Fire Protection	-	187	-	-	-	-	-	28	215	-	-	215	-	-	-	-	-	-	7,516	-
2b.1.1.41	KC - Fire Protection RCA	-	241	9	28	488	-	-	139	904	904	-	-	5,944	-	-	-	-	241,384	6,383	-
2b.1.1.42	KD - Domestic Water	-	41	-	-	-	-	-	6	47	-	-	47	-	-	-	-	-	-	1,708	-
2b.1.1.43	KE - Fuel Hndlg & Strg Reactor Vssl Serv	-	13	3	5	54	28	-	19	123	123	-	-	661	118	-	-	-	36,924	374	-
2b.1.1.44	KJ - Standby Diesel Engine	-	187	-	-	-	-	-	28	215	-	-	215	-	-	-	-	-	-	6,749	-
2b.1.1.45	LA - Sanitary Drains	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	290	-
2b.1.1.46	LA - Sanitary Drains RCA	-	18	0	1	22	-	-	8	51	51	-	-	272	-	-	-	-	11,053	422	-
2b.1.1.47	LB - Roof Drains	-	32	-	-	-	-	-	5	37	-	-	37	-	-	-	-	-	-	1,276	-
2b.1.1.48	LB - Roof Drains RCA	-	101	3	10	175	-	-	53	343	343	-	-	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	48	81	4	5	41	38	-	61	278	278	-	-	504	159	-	-	-	33,900	3,488	-
2b.1.1.51	LF - Floor & Equipment Drains	-	1,007	99	81	307	1,025	-	576	3,094	3,094	-	-	3,739	4,320	-	-	-	516,638	29,273	-
2b.1.1.52	RM - Process Sampling & Analysis	-	91	7	6	54	43	-	43	243	243	-	-	661	180	-	-	-	42,123	2,771	-
2b.1.1.53	Radwaste Bldg Non-System Specific	-	126	9	9	58	89	-	65	355	355	-	-	705	372	-	-	-	60,301	3,650	-
2b.1.1.54	Radwaste Bldg Non-System Specific RCA	-	805	19	59	1,041	-	-	368	2,291	2,291	-	-	12,684	-	-	-	-	515,103	21,919	-
2b.1.1.55	Reactor Bldg Non-System Specific	-	64	3	3	22	33	-	28	154	154	-	-	269	139	-	-	-	22,768	1,758	-
2b.1.1.56	Reactor Bldg Non-System Specific RCA	-	414	7	22	391	-	-	166	1,001	1,001	-	-	4,768	-	-	-	-	193,612	10,425	-
2b.1.1.57	SJ - Nuclear Sampling	-	52	5	4	35	33	-	27	155	155	-	-	423	138	-	-	-	28,947	1,618	-
2b.1.1.58	ST - Sewage Treatment	-	61	-	-	-	-	-	9	70	-	-	70	-	-	-	-	-	-	2,316	-
2b.1.1.59	SZ - Service Air	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	1,892	-
2b.1.1.60	VA - I&C Shop HVAC	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	155	-
2b.1.1.61	VB - I&C Shop Computer Room HVAC	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	106	-
2b.1.1.62	VC - Health Physics Computer Room HVAC	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	208	-
2b.1.1.63	VJ - Shop Bldg Machine Shop Area Vent	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	57	-
2b.1.1.64	VL - Shop Building HVAC	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	101	-
2b.1.1.65	VS - Admin Bldg HVAC	-	7	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	262	-
2b.1.1.66	VT - Tech Support Building HVAC	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	87	-
2b.1.1.67	VW - Waste Water Treatment Ventilation	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	52	-
2b.1.1.68	WD - Domestic Water	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	870	-
2b.1.1.69	WM - Makeup Demineralizer	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	3,929	-
2b.1.1.70	WS - Plant Services Water	-	83	-	-	-	-	-	12	95	-	-	95	-	-	-	-	-	-	3,297	-
2b.1.1.71	WS - Plant Services Water RCA	-	26	3	9	151	-	-	31	219	219	-	-	1,838	-	-	-	-	74,625	782	-
2b.1.1.72	WT - Waste Water Treatment	-	20	-	-	-	-	-	3	23	-	-	23	-	-	-	-	-	-	769	-
2b.1.1.73	WZ - Radioactive Liquid Waste	-	32	4	3	10	46	-	22	118	118	-	-	120	193	-	-	-	21,326	877	-
2b.1.1.74	Yard Non-System Specific	-	17	-	-	-	-	-	3	19	-	-	19	-	-	-	-	-	-	603	-
2b.1.1	Totals	1,498	9,711	549	677	7,441	4,136	-	5,231	29,242	26,342	-	2,900	90,709	18,019	-	-	-	5,155,525	326,662	-
2b.1.2	Scaffolding in support of decommissioning	-	1,149	35	9	137	24	-	319	1,673	1,673	-	-	1,508	100	-	-	-	76,320	46,205	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2011 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	820	762	33	159	489	1,189	-	999	4,452	4,452	-	-	5,955	10,038	-	-	-	971,093	44,323	-
2b.1.3.2	Auxiliary	424	275	14	72	169	224	-	374	1,552	1,552	-	-	2,058	3,820	-	-	-	412,073	19,424	-
2b.1.3.3	Communication Corridor - Contaminated	9	5	0	1	1	5	-	8	29	29	-	-	17	83	-	-	-	7,854	395	-
2b.1.3.4	Hot Machine Shop	12	10	0	2	-	6	-	10	39	39	-	-	-	103	-	-	-	8,892	597	-
2b.1.3.5	RWST Foundation Decon	-	6	0	3	-	10	-	5	25	25	-	-	-	183	-	-	-	15,840	108	-
2b.1.3.6	Radwaste	226	134	7	37	69	118	-	192	783	783	-	-	844	2,021	-	-	-	208,610	9,997	-
2b.1.3.7	Radwaste Drum Storage	25	14	1	4	5	13	-	21	83	83	-	-	66	226	-	-	-	22,242	1,092	-
2b.1.3.8	Radwaste Storage Building	65	30	1	10	-	33	-	50	189	189	-	-	-	594	-	-	-	51,480	2,632	-
2b.1.3	Totals	1,581	1,235	57	289	733	1,599	-	1,658	7,153	7,153	-	-	8,941	17,068	-	-	-	1,698,084	78,567	-
2b.1	Subtotal Period 2b Activity Costs	3,079	12,095	641	975	8,312	5,758	-	7,208	38,068	35,168	-	2,900	101,157	35,187	-	-	-	6,929,929	451,434	-
Period 2b Collateral Costs																					
2b.3.1	Process decommissioning water waste	190	-	79	288	-	474	-	265	1,296	1,296	-	-	-	1,257	-	-	-	75,412	245	-
2b.3.2	Process decommissioning chemical flush waste	3	-	90	430	-	993	-	323	1,839	1,839	-	-	-	1,481	-	-	-	157,863	277	-
2b.3.3	Small tool allowance	-	236	-	-	-	-	-	35	271	271	-	-	-	-	-	-	-	-	-	-
2b.3.4	Decommissioning Equipment Disposition	-	-	140	43	545	95	-	126	949	949	-	-	6,000	397	-	-	-	303,726	88	-
2b.3.5	Spent Fuel Capital and Transfer	-	-	-	-	-	-	13,233	1,985	15,218	-	15,218	-	-	-	-	-	-	-	-	-
2b.3.6	On-site survey and release of 44.30 tons clean metallic waste	-	-	-	-	-	-	59	6	65	65	-	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	193	236	308	762	545	1,562	13,292	2,740	19,639	4,421	15,218	-	6,000	3,135	-	-	-	537,001	610	-
Period 2b Period-Dependent Costs																					
2b.4.1	Decon supplies	1,267	-	-	-	-	-	-	317	1,583	1,583	-	-	-	-	-	-	-	-	-	-
2b.4.2	Insurance	-	-	-	-	-	-	1,422	142	1,564	1,564	-	-	-	-	-	-	-	-	-	-
2b.4.3	Property taxes	-	-	-	-	-	-	3,791	379	4,171	4,171	-	-	-	-	-	-	-	-	-	-
2b.4.4	Health physics supplies	-	3,123	-	-	-	-	-	781	3,904	3,904	-	-	-	-	-	-	-	-	-	-
2b.4.5	Heavy equipment rental	-	4,768	-	-	-	-	-	715	5,483	5,483	-	-	-	-	-	-	-	-	-	-
2b.4.6	Disposal of DAW generated	-	-	142	33	-	319	-	99	593	593	-	-	-	6,514	-	-	-	130,274	212	-
2b.4.7	Plant energy budget	-	-	-	-	-	-	1,907	286	2,193	2,193	-	-	-	-	-	-	-	-	-	-
2b.4.8	NRC Fees	-	-	-	-	-	-	1,731	173	1,905	1,905	-	-	-	-	-	-	-	-	-	-
2b.4.9	Emergency Planning Fees	-	-	-	-	-	-	1,501	150	1,651	-	1,651	-	-	-	-	-	-	-	-	-
2b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,842	276	2,118	-	2,118	-	-	-	-	-	-	-	-	-
2b.4.11	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	468	70	538	538	-	-	-	-	-	-	-	-	-	-
2b.4.12	Corporate Allocations	-	-	-	-	-	-	543	81	624	624	-	-	-	-	-	-	-	-	-	-
2b.4.13	Security Staff Cost	-	-	-	-	-	-	14,877	2,232	17,109	17,109	-	-	-	-	-	-	-	-	-	318,419
2b.4.14	DOC Staff Cost	-	-	-	-	-	-	27,685	4,153	31,838	31,838	-	-	-	-	-	-	-	-	-	367,503
2b.4.15	Utility Staff Cost	-	-	-	-	-	-	42,829	6,424	49,253	49,253	-	-	-	-	-	-	-	-	-	682,146
2b.4	Subtotal Period 2b Period-Dependent Costs	1,267	7,891	142	33	-	319	98,596	16,279	124,527	120,758	3,769	-	-	6,514	-	-	-	130,274	212	1,368,067
2b.0	TOTAL PERIOD 2b COST	4,539	20,222	1,091	1,770	8,857	7,639	111,889	26,227	182,233	160,347	18,987	2,900	107,157	44,836	-	-	-	7,597,204	452,257	1,368,067
PERIOD 2d - Decontamination Following Wet Fuel Storage																					
Period 2d Direct Decommissioning Activities																					
2d.1.1	Remove spent fuel racks	477	46	281	69	-	1,120	-	569	2,562	2,562	-	-	-	4,688	-	-	-	398,471	1,722	-
Disposal of Plant Systems																					
2d.1.2.1	EC - Fuel Pool Cooling & Cleanup	-	273	22	24	213	195	-	155	882	882	-	-	2,600	817	-	-	-	174,965	8,031	-
2d.1.2.2	Fuel Bldg Non-System Specific	-	34	2	2	14	22	-	16	90	90	-	-	170	90	-	-	-	14,594	953	-
2d.1.2.3	Fuel Bldg Non-System Specific RCA	-	221	5	15	263	-	-	97	601	601	-	-	3,200	-	-	-	-	129,974	5,859	-
2d.1.2.4	Fuel Building Fire Protection	-	106	4	14	241	-	-	65	431	431	-	-	2,941	-	-	-	-	119,444	2,802	-
2d.1.2.5	GG - Fuel Building HVAC	-	179	8	19	306	28	-	101	641	641	-	-	3,729	116	-	-	-	161,302	4,671	-
2d.1.2	Totals	-	812	41	74	1,037	244	-	435	2,644	2,644	-	-	12,641	1,023	-	-	-	600,279	22,317	-
Decontamination of Site Buildings																					
2d.1.3.1	Fuel Building	539	560	9	28	222	73	-	466	1,897	1,897	-	-	2,705	1,041	-	-	-	199,583	31,559	-
2d.1.3	Totals	539	560	9	28	222	73	-	466	1,897	1,897	-	-	2,705	1,041	-	-	-	199,583	31,559	-
2d.1.4	Scaffolding in support of decommissioning	-	230	7	2	27	5	-	64	335	335	-	-	302	20	-	-	-	15,264	9,241	-
2d.1	Subtotal Period 2d Activity Costs	1,017	1,648	338	173	1,286	1,441	-	1,534	7,438	7,438	-	-	15,647	6,773	-	-	-	1,213,597	64,839	-
Period 2d Additional Costs																					
2d.2.1	Final Survey Program Management	-	-	-	-	-	-	1,238	371	1,609	1,609	-	-	-	-	-	-	-	-	-	12,480
2d.2.2	ISFSI License Termination	-	19	5	18	-	83	1,182	206	1,513	-	1,513	-	-	1,454	-	-	-	122,079	1,833	2,560
2d.2	Subtotal Period 2d Additional Costs	-	19	5	18	-	83	2,420	577	3,122	1,609	1,513	-	-	1,454	-	-	-	122,079	1,833	15,040

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
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Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 2d Collateral Costs																					
2d.3.1	Process decommissioning water waste	86	-	36	131	-	215	-	120	588	588	-	-	-	571	-	-	-	34,257	111	-
2d.3.3	Small tool allowance	-	44	-	-	-	-	-	7	51	51	-	-	-	-	-	-	-	-	-	-
2d.3.4	Decommissioning Equipment Disposition	-	-	140	43	545	95	-	126	949	949	-	-	6,000	397	-	-	-	303,726	88	-
2d.3.5	Spent Fuel Capital and Transfer	-	-	-	-	-	-	669	100	770	-	770	-	-	-	-	-	-	-	-	-
2d.3	Subtotal Period 2d Collateral Costs	86	44	176	174	545	310	669	353	2,358	1,588	770	-	6,000	968	-	-	-	337,983	199	-
Period 2d Period-Dependent Costs																					
2d.4.1	Decon supplies	180	-	-	-	-	-	-	45	225	225	-	-	-	-	-	-	-	-	-	-
2d.4.2	Insurance	-	-	-	-	-	-	397	40	437	437	-	-	-	-	-	-	-	-	-	-
2d.4.3	Property taxes	-	-	-	-	-	-	258	26	284	284	-	-	-	-	-	-	-	-	-	-
2d.4.4	Health physics supplies	-	580	-	-	-	-	-	145	725	725	-	-	-	-	-	-	-	-	-	-
2d.4.5	Heavy equipment rental	-	1,331	-	-	-	-	-	200	1,531	1,531	-	-	-	-	-	-	-	-	-	-
2d.4.6	Disposal of DAW generated	-	-	45	10	-	101	-	31	188	188	-	-	-	2,065	-	-	-	41,306	67	-
2d.4.7	Plant energy budget	-	-	-	-	-	-	284	43	327	327	-	-	-	-	-	-	-	-	-	-
2d.4.8	NRC Fees	-	-	-	-	-	-	483	48	532	532	-	-	-	-	-	-	-	-	-	-
2d.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	261	39	300	300	-	-	-	-	-	-	-	-	-	-
2d.4.10	Corporate Allocations	-	-	-	-	-	-	106	16	122	122	-	-	-	-	-	-	-	-	-	-
2d.4.11	Security Staff Cost	-	-	-	-	-	-	1,402	210	1,612	1,612	-	-	-	-	-	-	-	-	-	21,086
2d.4.12	DOC Staff Cost	-	-	-	-	-	-	5,348	802	6,150	6,150	-	-	-	-	-	-	-	-	-	70,286
2d.4.13	Utility Staff Cost	-	-	-	-	-	-	8,651	1,298	9,949	9,949	-	-	-	-	-	-	-	-	-	132,840
2d.4	Subtotal Period 2d Period-Dependent Costs	180	1,912	45	10	-	101	17,191	2,943	22,381	22,381	-	-	-	2,065	-	-	-	41,306	67	224,211
2d.0	TOTAL PERIOD 2d COST	1,282	3,623	563	376	1,832	1,935	20,280	5,406	35,299	33,016	2,283	-	21,647	11,260	-	-	-	1,714,965	66,939	239,251
PERIOD 2f - License Termination																					
Period 2f Direct Decommissioning Activities																					
2f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	154	46	200	200	-	-	-	-	-	-	-	-	-	-
2f.1.2	Terminate license									a											
2f.1	Subtotal Period 2f Activity Costs	-	-	-	-	-	-	154	46	200	200	-	-	-	-	-	-	-	-	-	-
Period 2f Additional Costs																					
2f.2.1	Final Site Survey	-	-	-	-	-	-	5,858	1,757	7,616	7,616	-	-	-	-	-	-	-	-	151,725	6,240
2f.2	Subtotal Period 2f Additional Costs	-	-	-	-	-	-	5,858	1,757	7,616	7,616	-	-	-	-	-	-	-	-	151,725	6,240
Period 2f Collateral Costs																					
2f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,214	182	1,396	1,396	-	-	-	-	-	-	-	-	-	-
2f.3	Subtotal Period 2f Collateral Costs	-	-	-	-	-	-	1,214	182	1,396	1,396	-	-	-	-	-	-	-	-	-	-
Period 2f Period-Dependent Costs																					
2f.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2f.4.2	Property taxes	-	-	-	-	-	-	296	30	326	326	-	-	-	-	-	-	-	-	-	-
2f.4.3	Health physics supplies	-	700	-	-	-	-	-	175	874	874	-	-	-	-	-	-	-	-	-	-
2f.4.4	Disposal of DAW generated	-	-	8	2	-	18	-	5	33	33	-	-	-	360	-	-	-	7,203	12	-
2f.4.5	Plant energy budget	-	-	-	-	-	-	163	24	187	187	-	-	-	-	-	-	-	-	-	-
2f.4.6	NRC Fees	-	-	-	-	-	-	594	59	654	654	-	-	-	-	-	-	-	-	-	-
2f.4.7	Corporate Allocations	-	-	-	-	-	-	61	9	70	70	-	-	-	-	-	-	-	-	-	-
2f.4.8	Security Staff Cost	-	-	-	-	-	-	1,607	241	1,848	1,848	-	-	-	-	-	-	-	-	-	24,171
2f.4.9	DOC Staff Cost	-	-	-	-	-	-	4,616	692	5,308	5,308	-	-	-	-	-	-	-	-	-	58,817
2f.4.10	Utility Staff Cost	-	-	-	-	-	-	5,375	806	6,182	6,182	-	-	-	-	-	-	-	-	-	76,543
2f.4	Subtotal Period 2f Period-Dependent Costs	-	700	8	2	-	18	12,713	2,043	15,483	15,483	-	-	-	360	-	-	-	7,203	12	159,531
2f.0	TOTAL PERIOD 2f COST	-	700	8	2	-	18	19,938	4,028	24,693	24,693	-	-	-	360	-	-	-	7,203	151,737	165,771
PERIOD 2 TOTALS		7,323	53,986	18,937	8,509	20,026	44,929	227,461	75,194	456,366	418,187	32,499	5,679	246,744	121,119	903	459	2,142	20,452,750	1,058,768	2,712,328
PERIOD 3b - Site Restoration																					
Period 3b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
3b.1.1.1	Reactor	-	3,973	-	-	-	-	-	596	4,569	-	-	4,569	-	-	-	-	-	-	60,067	-
3b.1.1.2	Access Vaults	-	14	-	-	-	-	-	2	17	-	-	17	-	-	-	-	-	-	251	-
3b.1.1.3	Administration	-	179	-	-	-	-	-	27	206	-	-	206	-	-	-	-	-	-	4,467	-
3b.1.1.4	Auxiliary	-	3,150	-	-	-	-	-	472	3,622	-	-	3,622	-	-	-	-	-	-	49,968	-
3b.1.1.5	Auxiliary Boiler	-	25	-	-	-	-	-	4	28	-	-	28	-	-	-	-	-	-	619	-
3b.1.1.6	Chemical Addition Structure	-	35	-	-	-	-	-	5	40	-	-	40	-	-	-	-	-	-	735	-

Table C
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			
Demolition of Remaining Site Buildings (continued)																					
3b.1.1.7	Circ Water Pump Enclosure	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	164	-
3b.1.1.8	Circ Water Travel Screen Enclosure	-	4	-	-	-	-	-	1	4	-	-	4	-	-	-	-	-	-	160	-
3b.1.1.9	Circulating Water Discharge Structure	-	136	-	-	-	-	-	20	156	-	-	156	-	-	-	-	-	-	2,373	-
3b.1.1.10	Circulating Water Intake & Screenhouse	-	128	-	-	-	-	-	19	147	-	-	147	-	-	-	-	-	-	2,059	-
3b.1.1.11	Communication Corridor - Clean	-	986	-	-	-	-	-	148	1,134	-	-	1,134	-	-	-	-	-	-	17,215	-
3b.1.1.12	Communication Corridor - Contaminated	-	44	-	-	-	-	-	7	51	-	-	51	-	-	-	-	-	-	674	-
3b.1.1.13	Covered Walkways	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	242	-
3b.1.1.14	Diesel Generator	-	383	-	-	-	-	-	57	440	-	-	440	-	-	-	-	-	-	5,492	-
3b.1.1.15	E.S.W.S. Pumphouse	-	212	-	-	-	-	-	32	243	-	-	243	-	-	-	-	-	-	3,019	-
3b.1.1.16	ESWS Valve House	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	243	-
3b.1.1.17	GOB - Administration Building	-	244	-	-	-	-	-	37	281	-	-	281	-	-	-	-	-	-	5,819	-
3b.1.1.18	Hot Machine Shop	-	15	-	-	-	-	-	2	17	-	-	17	-	-	-	-	-	-	417	-
3b.1.1.19	M.M.O. Building	-	227	-	-	-	-	-	34	261	-	-	261	-	-	-	-	-	-	3,483	-
3b.1.1.20	Material Center West	-	91	-	-	-	-	-	14	104	-	-	104	-	-	-	-	-	-	2,512	-
3b.1.1.21	Misc Structures and Additions	-	66	-	-	-	-	-	10	76	-	-	76	-	-	-	-	-	-	1,523	-
3b.1.1.22	Miscellaneous Site Foundations	-	328	-	-	-	-	-	49	378	-	-	378	-	-	-	-	-	-	7,074	-
3b.1.1.23	Miscellaneous Site Structures	-	1,296	-	-	-	-	-	194	1,490	-	-	1,490	-	-	-	-	-	-	20,147	-
3b.1.1.24	New Covered Walkway	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	160	-
3b.1.1.25	Oil Separator and Waste Tank	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	48	-
3b.1.1.26	Radwaste	-	1,413	-	-	-	-	-	212	1,624	-	-	1,624	-	-	-	-	-	-	21,798	-
3b.1.1.27	Radwaste Drum Storage	-	195	-	-	-	-	-	29	225	-	-	225	-	-	-	-	-	-	3,840	-
3b.1.1.28	Radwaste Storage Building	-	91	-	-	-	-	-	14	104	-	-	104	-	-	-	-	-	-	2,323	-
3b.1.1.29	Security Main Gate North	-	80	-	-	-	-	-	12	92	-	-	92	-	-	-	-	-	-	1,720	-
3b.1.1.30	Security Additions 2010	-	29	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	544	-
3b.1.1.31	Security/Guardhouse	-	41	-	-	-	-	-	6	48	-	-	48	-	-	-	-	-	-	845	-
3b.1.1.32	Site Diesel Generator	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	61	-
3b.1.1.33	Support Complex	-	26	-	-	-	-	-	4	30	-	-	30	-	-	-	-	-	-	697	-
3b.1.1.34	Turbine Building	-	2,529	-	-	-	-	-	379	2,908	-	-	2,908	-	-	-	-	-	-	55,694	-
3b.1.1.35	Turbine Pedestal	-	850	-	-	-	-	-	127	977	-	-	977	-	-	-	-	-	-	10,928	-
3b.1.1.36	Waste Water Treatment	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	407	-
3b.1.1.37	Water Treatment Building North (Z110)	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	911	-
3b.1.1.38	Fuel Building	-	1,608	-	-	-	-	-	241	1,850	-	-	1,850	-	-	-	-	-	-	22,580	-
3b.1.1	Totals	-	18,496	-	-	-	-	-	2,774	21,271	-	-	21,271	-	-	-	-	-	-	311,273	-
Site Closeout Activities																					
3b.1.2	Remove Rubble	-	741	-	-	-	-	-	111	852	-	-	852	-	-	-	-	-	-	4,864	-
3b.1.3	Grade & landscape site	-	101	-	-	-	-	-	15	116	-	-	116	-	-	-	-	-	-	512	-
3b.1.4	Final report to NRC	-	-	-	-	-	-	175	26	201	201	-	-	-	-	-	-	-	-	-	1,560
3b.1	Subtotal Period 3b Activity Costs	-	19,338	-	-	-	-	175	2,927	22,440	201	-	22,239	-	-	-	-	-	-	316,649	1,560
Period 3b Additional Costs																					
3b.2.1	Concrete Crushing	-	852	-	-	-	-	9	129	989	-	-	989	-	-	-	-	-	-	4,312	-
3b.2.2	Circulating Water Intake Cofferdam	-	275	-	-	-	-	-	41	316	-	-	316	-	-	-	-	-	-	2,540	-
3b.2.3	E.S.W.S. Pumphouse Cofferdam	-	367	-	-	-	-	-	55	422	-	-	422	-	-	-	-	-	-	3,386	-
3b.2.4	ISFSI Demolition and Site Restoration	-	290	-	-	-	-	48	51	389	-	389	-	-	-	-	-	-	-	3,990	160
3b.2	Subtotal Period 3b Additional Costs	-	1,784	-	-	-	-	56	276	2,116	-	389	1,727	-	-	-	-	-	-	14,228	160
Period 3b Collateral Costs																					
3b.3.1	Small tool allowance	-	183	-	-	-	-	-	27	210	-	-	210	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	-	183	-	-	-	-	-	27	210	-	-	210	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3b.4.2	Property taxes	-	-	-	-	-	-	264	26	291	-	-	291	-	-	-	-	-	-	-	-
3b.4.3	Heavy equipment rental	-	4,212	-	-	-	-	-	632	4,844	-	-	4,844	-	-	-	-	-	-	-	-
3b.4.4	Plant energy budget	-	-	-	-	-	-	157	24	180	-	-	180	-	-	-	-	-	-	-	-
3b.4.5	Corporate Allocations	-	-	-	-	-	-	48	7	55	55	-	-	-	-	-	-	-	-	-	-
3b.4.6	Security Staff Cost	-	-	-	-	-	-	2,390	359	2,749	-	-	2,749	-	-	-	-	-	-	-	37,234
3b.4.7	DOC Staff Cost	-	-	-	-	-	-	8,465	1,270	9,735	-	-	9,735	-	-	-	-	-	-	-	105,497
3b.4.8	Utility Staff Cost	-	-	-	-	-	-	4,048	607	4,655	-	-	4,655	-	-	-	-	-	-	-	60,506
3b.4	Subtotal Period 3b Period-Dependent Costs	-	4,212	-	-	-	-	15,373	2,925	22,509	55	-	22,454	-	-	-	-	-	-	-	203,237
3b.0	TOTAL PERIOD 3b COST	-	25,517	-	-	-	-	15,604	6,155	47,276	256	389	46,631	-	-	-	-	-	-	330,877	204,957
PERIOD 3 TOTALS		-	25,517	-	-	-	-	15,604	6,155	47,276	256	389	46,631	-	-	-	-	-	-	330,877	204,957
TOTAL COST TO DECOMMISSION		**10,424**	**82,034**	**19,087**	**8,826**	**20,096**	**48,004**	**343,289**	**98,376**	**630,135**	**536,530**	**39,908**	**53,697**	**248,812**	**122,372**	**1,690**	**459**	**2,142**	**20,706,650**	**1,410,762**	**3,971,016**

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			

TOTAL COST TO DECOMMISSION WITH 18.5% CONTINGENCY:	**$630,135**	**thousands of 2011 dollars**
TOTAL NRC LICENSE TERMINATION COST IS 85.15% OR:	**$536,530**	**thousands of 2011 dollars**
SPENT FUEL MANAGEMENT COST IS 6.33% OR:	**$39,908**	**thousands of 2011 dollars**
NON-NUCLEAR DEMOLITION COST IS 8.52% OR:	**$53,697**	**thousands of 2011 dollars**
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	**124,521**	**cubic feet**
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	**2,142**	**cubic feet**
TOTAL SCRAP METAL REMOVED:	**67,807**	**tons**
TOTAL CRAFT LABOR REQUIREMENTS:	**1,410,762**	**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 2011 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	-	-	-	-	-	-	347	104	451	451	-	-	-	-	-	-	-	-	-	-
1a.1.2	Prepare preliminary decommissioning cost	-	-	-	-	-	-	146	22	167	167	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	224	34	258	258	-	-	-	-	-	-	-	-	-	2,000
1a.1.8	Review plant dwgs & specs.	-	-	-	-	-	-	146	22	167	167	-	-	-	-	-	-	-	-	-	1,300
1a.1.9	Perform detailed rad survey									a											
1a.1.10	Estimate by-product inventory	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	End product description	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
1a.1.12	Detailed by-product inventory	-	-	-	-	-	-	168	25	193	193	-	-	-	-	-	-	-	-	-	1,500
1a.1.13	Define major work sequence	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
1a.1.14	Perform SER and EA	-	-	-	-	-	-	347	52	399	399	-	-	-	-	-	-	-	-	-	3,100
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	560	84	644	644	-	-	-	-	-	-	-	-	-	5,000
Activity Specifications																					
1a.1.16.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	551	83	634	634	-	-	-	-	-	-	-	-	-	4,920
1a.1.16.2	Plant systems	-	-	-	-	-	-	467	70	537	537	-	-	-	-	-	-	-	-	-	4,167
1a.1.16.3	Plant structures and buildings	-	-	-	-	-	-	349	52	402	402	-	-	-	-	-	-	-	-	-	3,120
1a.1.16.4	Waste management	-	-	-	-	-	-	224	34	258	258	-	-	-	-	-	-	-	-	-	2,000
1a.1.16.5	Facility and site dormancy	-	-	-	-	-	-	224	34	258	258	-	-	-	-	-	-	-	-	-	2,000
1a.1.16	Total	-	-	-	-	-	-	1,815	272	2,088	2,088	-	-	-	-	-	-	-	-	-	16,207
Detailed Work Procedures																					
1a.1.17.1	Plant systems	-	-	-	-	-	-	133	20	152	152	-	-	-	-	-	-	-	-	-	1,183
1a.1.17.2	Facility closeout & dormancy	-	-	-	-	-	-	134	20	155	155	-	-	-	-	-	-	-	-	-	1,200
1a.1.17	Total	-	-	-	-	-	-	267	40	307	307	-	-	-	-	-	-	-	-	-	2,383
1a.1.18	Procure vacuum drying system	-	-	-	-	-	-	11	2	13	13	-	-	-	-	-	-	-	-	-	100
1a.1.19	Drain/de-energize non-cont. systems									a											
1a.1.20	Drain & dry NSSS									a											
1a.1.21	Drain/de-energize contaminated systems									a											
1a.1.22	Decon/secure contaminated systems									a											
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	4,367	707	5,074	5,074	-	-	-	-	-	-	-	-	-	35,890
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	907	136	1,044	-	1,044	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	907	136	1,044	-	1,044	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	1,786	179	1,965	1,965	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	1,571	157	1,728	1,728	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	472	-	-	-	-	-	118	589	589	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	458	-	-	-	-	-	69	526	526	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	13	5	-	30	-	9	57	57	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	1,053	158	1,211	1,211	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	769	77	846	846	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,133	113	1,246	-	1,246	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	302	45	348	348	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	763	114	878	-	878	-	-	-	-	-	-	-	-	-
1a.4.11	Corporate Allocations	-	-	-	-	-	-	337	51	387	387	-	-	-	-	-	-	-	-	-	-
1a.4.12	Security Staff Cost	-	-	-	-	-	-	7,200	1,080	8,280	8,280	-	-	-	-	-	-	-	-	-	157,471
1a.4.13	Utility Staff Cost	-	-	-	-	-	-	25,243	3,786	29,029	29,029	-	-	-	-	-	-	-	-	-	423,400
1a.4	Subtotal Period 1a Period-Dependent Costs	-	929	13	5	-	30	40,157	5,957	47,090	44,967	2,123	-	-	610	-	-	-	12,190	20	580,871
1a.0	TOTAL PERIOD 1a COST	-	929	13	5	-	30	45,431	6,800	53,207	50,041	3,167	-	-	610	-	-	-	12,190	20	616,761

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 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	808	-	-	-	-	-	-	404	1,213	1,213	-	-	-	-	-	-	-	24,102	-	
1b.1.1.2	Auxiliary	399	-	-	-	-	-	-	200	599	599	-	-	-	-	-	-	-	12,527	-	
1b.1.1.3	Communication Corridor - Contaminated	9	-	-	-	-	-	-	4	13	13	-	-	-	-	-	-	-	276	-	
1b.1.1.4	Fuel Building	532	-	-	-	-	-	-	266	799	799	-	-	-	-	-	-	-	14,371	-	
1b.1.1.5	Hot Machine Shop	11	-	-	-	-	-	-	5	16	16	-	-	-	-	-	-	-	344	-	
1b.1.1.6	Radwaste	212	-	-	-	-	-	-	106	319	319	-	-	-	-	-	-	-	6,671	-	
1b.1.1.7	Radwaste Drum Storage	24	-	-	-	-	-	-	12	36	36	-	-	-	-	-	-	-	750	-	
1b.1.1.8	Radwaste Storage Building	56	-	-	-	-	-	-	28	84	84	-	-	-	-	-	-	-	1,690	-	
1b.1.1	Totals	2,052	-	-	-	-	-	-	1,026	3,078	3,078	-	-	-	-	-	-	-	60,731	-	
1b.1	Subtotal Period 1b Activity Costs	2,052	-	-	-	-	-	-	1,026	3,078	3,078	-	-	-	-	-	-	-	60,731	-	
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	907	-	-	-	-	-	-	136	1,043	1,043	-	-	-	-	-	-	-	-	-	
1b.3.2	Process decommissioning water waste	172	-	68	249	-	410	-	233	1,132	1,132	-	-	-	1,086	-	-	-	65,189	212	
1b.3.4	Small tool allowance	-	34	-	-	-	-	-	5	39	39	-	-	-	-	-	-	-	-	-	
1b.3.5	Spent Fuel Capital and Transfer	-	-	-	-	-	-	1,210	181	1,391	-	1,391	-	-	-	-	-	-	-	-	
1b.3	Subtotal Period 1b Collateral Costs	1,079	34	68	249	-	410	1,210	555	3,605	2,214	1,391	-	-	1,086	-	-	-	65,189	212	-	
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	1,173	-	-	-	-	-	-	293	1,466	1,466	-	-	-	-	-	-	-	-	-	
1b.4.2	Insurance	-	-	-	-	-	-	450	45	495	495	-	-	-	-	-	-	-	-	-	
1b.4.3	Property taxes	-	-	-	-	-	-	396	40	436	436	-	-	-	-	-	-	-	-	-	
1b.4.4	Health physics supplies	-	385	-	-	-	-	-	96	481	481	-	-	-	-	-	-	-	-	-	
1b.4.5	Heavy equipment rental	-	115	-	-	-	-	-	17	133	133	-	-	-	-	-	-	-	-	-	
1b.4.6	Disposal of DAW generated	-	-	16	6	-	37	-	12	71	71	-	-	-	753	-	-	-	15,052	25	
1b.4.7	Plant energy budget	-	-	-	-	-	-	266	40	305	305	-	-	-	-	-	-	-	-	-	
1b.4.8	NRC Fees	-	-	-	-	-	-	194	19	213	213	-	-	-	-	-	-	-	-	-	
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	285	29	314	-	314	-	-	-	-	-	-	-	-	
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	192	29	221	-	221	-	-	-	-	-	-	-	-	
1b.4.11	Corporate Allocations	-	-	-	-	-	-	85	13	98	98	-	-	-	-	-	-	-	-	-	
1b.4.12	Security Staff Cost	-	-	-	-	-	-	1,815	272	2,087	2,087	-	-	-	-	-	-	-	-	-	39,691
1b.4.13	Utility Staff Cost	-	-	-	-	-	-	6,363	954	7,317	7,317	-	-	-	-	-	-	-	-	-	106,720
1b.4	Subtotal Period 1b Period-Dependent Costs	1,173	500	16	6	-	37	10,046	1,859	13,637	13,102	535	-	-	753	-	-	-	15,052	25	146,411
1b.0	TOTAL PERIOD 1b COST	4,304	534	85	255	-	447	11,255	3,440	20,320	18,393	1,927	-	-	1,839	-	-	-	80,241	60,968	146,411
PERIOD 1c - Preparations for SAFSTOR Dormancy																					
Period 1c Direct Decommissioning Activities																					
1c.1.1	Prepare support equipment for storage	-	378	-	-	-	-	-	57	435	435	-	-	-	-	-	-	-	3,000	-	
1c.1.2	Install containment pressure equal. lines	-	25	-	-	-	-	-	4	29	29	-	-	-	-	-	-	-	700	-	
1c.1.3	Interim survey prior to dormancy	-	-	-	-	-	-	733	220	953	953	-	-	-	-	-	-	-	15,678	-	
1c.1.4	Secure building accesses									a											
1c.1.5	Prepare & submit interim report	-	-	-	-	-	-	65	10	75	75	-	-	-	-	-	-	-	-	-	583
1c.1	Subtotal Period 1c Activity Costs	-	404	-	-	-	-	798	290	1,492	1,492	-	-	-	-	-	-	-	19,378	583	
Period 1c Additional Costs																					
1c.2.1	Spent Fuel Isolation	-	-	-	-	-	-	10,280	1,542	11,822	11,822	-	-	-	-	-	-	-	-	-	
1c.2.2	Misc/Hazardous Waste	-	-	63	18	69	-	-	19	170	170	-	-	2,067	-	-	-	-	133,598	716	-
1c.2	Subtotal Period 1c Additional Costs	-	-	63	18	69	-	10,280	1,561	11,992	11,992	-	-	2,067	-	-	-	-	133,598	716	-
Period 1c Collateral Costs																					
1c.3.1	Process decommissioning water waste	187	-	75	271	-	447	-	253	1,232	1,232	-	-	-	1,183	-	-	-	71,001	231	-
1c.3.3	Small tool allowance	-	2	-	-	-	-	-	0	3	3	-	-	-	-	-	-	-	-	-	-
1c.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	1,210	181	1,391	-	1,391	-	-	-	-	-	-	-	-	-
1c.3	Subtotal Period 1c Collateral Costs	187	2	75	271	-	447	1,210	435	2,626	1,235	1,391	-	-	1,183	-	-	-	71,001	231	-
Period 1c Period-Dependent Costs																					
1c.4.1	Insurance	-	-	-	-	-	-	450	45	495	495	-	-	-	-	-	-	-	-	-	-
1c.4.2	Property taxes	-	-	-	-	-	-	396	40	436	436	-	-	-	-	-	-	-	-	-	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 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	-	208	-	-	-	-	-	52	260	260	-	-	-	-	-	-	-	-	-	-
1c.4.4	Heavy equipment rental	-	115	-	-	-	-	-	17	133	133	-	-	-	-	-	-	-	-	-	-
1c.4.5	Disposal of DAW generated	-	-	3	1	-	8	-	2	14	14	-	-	-	154	-	-	-	3,073	5	-
1c.4.6	Plant energy budget	-	-	-	-	-	-	266	40	305	305	-	-	-	-	-	-	-	-	-	-
1c.4.7	NRC Fees	-	-	-	-	-	-	194	19	213	213	-	-	-	-	-	-	-	-	-	-
1c.4.8	Emergency Planning Fees	-	-	-	-	-	-	285	29	314	-	314	-	-	-	-	-	-	-	-	-
1c.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	192	29	221	-	221	-	-	-	-	-	-	-	-	-
1c.4.10	Corporate Allocations	-	-	-	-	-	-	85	13	98	98	-	-	-	-	-	-	-	-	-	-
1c.4.11	Security Staff Cost	-	-	-	-	-	-	1,815	272	2,087	2,087	-	-	-	-	-	-	-	-	-	39,691
1c.4.12	Utility Staff Cost	-	-	-	-	-	-	6,363	954	7,317	7,317	-	-	-	-	-	-	-	-	-	106,720
1c.4	Subtotal Period 1c Period-Dependent Costs	-	323	3	1	-	8	10,046	1,512	11,893	11,358	535	-	-	154	-	-	-	3,073	5	146,411
1c.0	TOTAL PERIOD 1c COST	187	729	141	290	69	454	22,333	3,799	28,003	26,076	1,927	-	2,067	1,337	-	-	-	207,672	20,330	146,995
PERIOD 1 TOTALS		4,491	2,192	239	550	69	931	79,019	14,039	101,531	94,510	7,020	-	2,067	3,786	-	-	-	300,103	81,317	910,168
PERIOD 2a - SAFSTOR Dormancy with Wet Spent Fuel Storage																					
Period 2a Direct Decommissioning Activities																					
2a.1.1	Quarterly Inspection									a											
2a.1.2	Semi-annual environmental survey									a											
2a.1.3	Prepare reports									a											
2a.1.4	Bituminous roof replacement	-	-	-	-	-	-	376	56	433	433	-	-	-	-	-	-	-	-	-	-
2a.1.5	Maintenance supplies	-	-	-	-	-	-	540	135	675	675	-	-	-	-	-	-	-	-	-	-
2a.1	Subtotal Period 2a Activity Costs	-	-	-	-	-	-	916	191	1,107	1,107	-	-	-	-	-	-	-	-	-	-
Period 2a Collateral Costs																					
2a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	21,513	3,227	24,740	-	24,740	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	-	-	-	-	-	-	21,513	3,227	24,740	-	24,740	-	-	-	-	-	-	-	-	-
Period 2a Period-Dependent Costs																					
2a.4.1	Insurance	-	-	-	-	-	-	2,357	236	2,593	2,248	345	-	-	-	-	-	-	-	-	-
2a.4.2	Property taxes	-	-	-	-	-	-	6,283	628	6,912	782	6,130	-	-	-	-	-	-	-	-	-
2a.4.3	Health physics supplies	-	757	-	-	-	-	-	189	946	946	-	-	-	-	-	-	-	-	-	-
2a.4.4	Disposal of DAW generated	-	-	20	7	-	45	-	14	87	87	-	-	-	920	-	-	-	18,406	30	-
2a.4.5	Plant energy budget	-	-	-	-	-	-	843	126	969	485	485	-	-	-	-	-	-	-	-	-
2a.4.6	NRC Fees	-	-	-	-	-	-	881	88	970	970	-	-	-	-	-	-	-	-	-	-
2a.4.7	Emergency Planning Fees	-	-	-	-	-	-	2,487	249	2,736	-	2,736	-	-	-	-	-	-	-	-	-
2a.4.8	Spent Fuel Pool O&M	-	-	-	-	-	-	3,053	458	3,510	-	3,510	-	-	-	-	-	-	-	-	-
2a.4.9	Corporate Allocations	-	-	-	-	-	-	262	39	301	67	235	-	-	-	-	-	-	-	-	-
2a.4.10	Security Staff Cost	-	-	-	-	-	-	21,269	3,190	24,460	8,363	16,097	-	-	-	-	-	-	-	-	444,257
2a.4.11	Utility Staff Cost	-	-	-	-	-	-	20,598	3,090	23,687	4,753	18,934	-	-	-	-	-	-	-	-	329,543
2a.4	Subtotal Period 2a Period-Dependent Costs	-	757	20	7	-	45	58,033	8,308	67,170	18,699	48,471	-	-	920	-	-	-	18,406	30	773,800
2a.0	TOTAL PERIOD 2a COST	-	757	20	7	-	45	80,462	11,726	93,017	19,806	73,211	-	-	920	-	-	-	18,406	30	773,800
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	-	-	-	-	-	-	4,538	681	5,219	5,219	-	-	-	-	-	-	-	-	-	-
2c.1.5	Maintenance supplies	-	-	-	-	-	-	6,508	1,627	8,135	8,135	-	-	-	-	-	-	-	-	-	-
2c.1	Subtotal Period 2c Activity Costs	-	-	-	-	-	-	11,046	2,308	13,354	13,354	-	-	-	-	-	-	-	-	-	-
Period 2c Period-Dependent Costs																					
2c.4.1	Insurance	-	-	-	-	-	-	24,647	2,465	27,112	27,112	-	-	-	-	-	-	-	-	-	-
2c.4.2	Property taxes	-	-	-	-	-	-	8,570	857	9,427	9,427	-	-	-	-	-	-	-	-	-	-
2c.4.3	Health physics supplies	-	4,163	-	-	-	-	-	1,041	5,204	5,204	-	-	-	-	-	-	-	-	-	-
2c.4.4	Disposal of DAW generated	-	-	107	38	-	241	-	77	462	462	-	-	-	4,910	-	-	-	98,209	160	-
2c.4.5	Plant energy budget	-	-	-	-	-	-	5,081	762	5,844	5,844	-	-	-	-	-	-	-	-	-	-
2c.4.6	NRC Fees	-	-	-	-	-	-	9,632	963	10,595	10,595	-	-	-	-	-	-	-	-	-	-
2c.4.7	Corporate Allocations	-	-	-	-	-	-	700	105	806	806	-	-	-	-	-	-	-	-	-	-
2c.4.8	Security Staff Cost	-	-	-	-	-	-	87,700	13,155	100,855	100,855	-	-	-	-	-	-	-	-	-	1,509,257
2c.4.9	Utility Staff Cost	-	-	-	-	-	-	49,848	7,477	57,325	57,325	-	-	-	-	-	-	-	-	-	880,400

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 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			
2c.4	Subtotal Period 2c Period-Dependent Costs	-	4,163	107	38	-	241	186,180	26,902	217,630	217,630	-	-	-	4,910	-	-	-	98,209	160	2,389,657
2c.0	TOTAL PERIOD 2c COST	-	4,163	107	38	-	241	197,226	29,210	230,984	230,984	-	-	-	4,910	-	-	-	98,209	160	2,389,657
PERIOD 2 TOTALS		-	4,920	127	45	-	286	277,688	40,936	324,001	250,790	73,211	-	-	5,831	-	-	-	116,615	190	3,163,457
PERIOD 3a - Reactivate Site Following SAFSTOR Dormancy																					
Period 3a Direct Decommissioning Activities																					
3a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	146	22	167	167	-	-	-	-	-	-	-	-	-	1,300
3a.1.2	Review plant dwgs & specs.	-	-	-	-	-	-	515	77	593	593	-	-	-	-	-	-	-	-	-	4,600
3a.1.3	Perform detailed rad survey									a											
3a.1.4	End product description	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
3a.1.5	Detailed by-product inventory	-	-	-	-	-	-	146	22	167	167	-	-	-	-	-	-	-	-	-	1,300
3a.1.6	Define major work sequence	-	-	-	-	-	-	840	126	966	966	-	-	-	-	-	-	-	-	-	7,500
3a.1.7	Perform SER and EA	-	-	-	-	-	-	347	52	399	399	-	-	-	-	-	-	-	-	-	3,100
3a.1.8	Perform Site-Specific Cost Study	-	-	-	-	-	-	560	84	644	644	-	-	-	-	-	-	-	-	-	5,000
3a.1.9	Prepare/submit License Termination Plan	-	-	-	-	-	-	459	69	528	528	-	-	-	-	-	-	-	-	-	4,096
3a.1.10	Receive NRC approval of termination plan									a											
Activity Specifications																					
3a.1.11.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	826	124	949	854	-	95	-	-	-	-	-	-	-	7,370
3a.1.11.2	Plant systems	-	-	-	-	-	-	467	70	537	483	-	54	-	-	-	-	-	-	-	4,167
3a.1.11.3	Reactor internals	-	-	-	-	-	-	795	119	915	915	-	-	-	-	-	-	-	-	-	7,100
3a.1.11.4	Reactor vessel	-	-	-	-	-	-	728	109	837	837	-	-	-	-	-	-	-	-	-	6,500
3a.1.11.5	Biological shield	-	-	-	-	-	-	56	8	64	64	-	-	-	-	-	-	-	-	-	500
3a.1.11.6	Steam generators	-	-	-	-	-	-	349	52	402	402	-	-	-	-	-	-	-	-	-	3,120
3a.1.11.7	Reinforced concrete	-	-	-	-	-	-	179	27	206	103	-	103	-	-	-	-	-	-	-	1,600
3a.1.11.8	Main Turbine	-	-	-	-	-	-	45	7	52	-	-	52	-	-	-	-	-	-	-	400
3a.1.11.9	Main Condensers	-	-	-	-	-	-	45	7	52	-	-	52	-	-	-	-	-	-	-	400
3a.1.11.10	Plant structures & buildings	-	-	-	-	-	-	349	52	402	201	-	201	-	-	-	-	-	-	-	3,120
3a.1.11.11	Waste management	-	-	-	-	-	-	515	77	593	593	-	-	-	-	-	-	-	-	-	4,600
3a.1.11.12	Facility & site closeout	-	-	-	-	-	-	101	15	116	58	-	58	-	-	-	-	-	-	-	900
3a.1.11	Total	-	-	-	-	-	-	4,455	668	5,124	4,510	-	614	-	-	-	-	-	-	-	39,777
Planning & Site Preparations																					
3a.1.12	Prepare dismantling sequence	-	-	-	-	-	-	269	40	309	309	-	-	-	-	-	-	-	-	-	2,400
3a.1.13	Plant prep. & temp. svces	-	-	-	-	-	-	2,800	420	3,220	3,220	-	-	-	-	-	-	-	-	-	-
3a.1.14	Design water clean-up system	-	-	-	-	-	-	157	24	180	180	-	-	-	-	-	-	-	-	-	1,400
3a.1.15	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,200	330	2,530	2,530	-	-	-	-	-	-	-	-	-	-
3a.1.16	Procure casks/liners & containers	-	-	-	-	-	-	138	21	158	158	-	-	-	-	-	-	-	-	-	1,230
3a.1	Subtotal Period 3a Activity Costs	-	-	-	-	-	-	13,143	1,972	15,115	14,501	-	614	-	-	-	-	-	-	-	72,703
Period 3a Period-Dependent Costs																					
3a.4.1	Insurance	-	-	-	-	-	-	258	26	283	283	-	-	-	-	-	-	-	-	-	-
3a.4.2	Property taxes	-	-	-	-	-	-	90	9	99	99	-	-	-	-	-	-	-	-	-	-
3a.4.3	Health physics supplies	-	208	-	-	-	-	-	52	260	260	-	-	-	-	-	-	-	-	-	-
3a.4.4	Heavy equipment rental	-	231	-	-	-	-	-	35	265	265	-	-	-	-	-	-	-	-	-	-
3a.4.5	Disposal of DAW generated	-	-	6	2	-	13	-	4	24	24	-	-	-	259	-	-	-	5,186	8	-
3a.4.6	Plant energy budget	-	-	-	-	-	-	531	80	611	611	-	-	-	-	-	-	-	-	-	-
3a.4.7	NRC Fees	-	-	-	-	-	-	137	14	151	151	-	-	-	-	-	-	-	-	-	-
3a.4.8	Corporate Allocations	-	-	-	-	-	-	104	16	119	119	-	-	-	-	-	-	-	-	-	-
3a.4.9	Security Staff Cost	-	-	-	-	-	-	1,742	261	2,003	2,003	-	-	-	-	-	-	-	-	-	32,857
3a.4.10	Utility Staff Cost	-	-	-	-	-	-	8,017	1,202	9,219	9,219	-	-	-	-	-	-	-	-	-	130,377
3a.4	Subtotal Period 3a Period-Dependent Costs	-	438	6	2	-	13	10,878	1,698	13,034	13,034	-	-	-	259	-	-	-	5,186	8	163,234
3a.0	TOTAL PERIOD 3a COST	-	438	6	2	-	13	24,021	3,670	28,149	27,536	-	614	-	259	-	-	-	5,186	8	235,937
PERIOD 3b - Decommissioning Preparations																					
Period 3b Direct Decommissioning Activities																					
Detailed Work Procedures																					
3b.1.1.1	Plant systems	-	-	-	-	-	-	530	80	610	549	-	61	-	-	-	-	-	-	-	4,733
3b.1.1.2	Reactor internals	-	-	-	-	-	-	280	42	322	322	-	-	-	-	-	-	-	-	-	2,500
3b.1.1.3	Remaining buildings	-	-	-	-	-	-	151	23	174	43	-	130	-	-	-	-	-	-	-	1,350
3b.1.1.4	CRD cooling assembly	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 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			
Detailed Work Procedures (continued)																					
3b.1.1.5	CRD housings & ICI tubes	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.6	Incore instrumentation	-	-	-	-	-	-	112	17	129	129	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.7	Reactor vessel	-	-	-	-	-	-	407	61	468	468	-	-	-	-	-	-	-	-	-	3,630
3b.1.1.8	Facility closeout	-	-	-	-	-	-	134	20	155	77	-	77	-	-	-	-	-	-	-	1,200
3b.1.1.9	Missile shields	-	-	-	-	-	-	50	8	58	58	-	-	-	-	-	-	-	-	-	450
3b.1.1.10	Biological shield	-	-	-	-	-	-	134	20	155	155	-	-	-	-	-	-	-	-	-	1,200
3b.1.1.11	Steam generators	-	-	-	-	-	-	515	77	593	593	-	-	-	-	-	-	-	-	-	4,600
3b.1.1.12	Reinforced concrete	-	-	-	-	-	-	112	17	129	64	-	64	-	-	-	-	-	-	-	1,000
3b.1.1.13	Main Turbine	-	-	-	-	-	-	175	26	201	-	-	201	-	-	-	-	-	-	-	1,560
3b.1.1.14	Main Condensers	-	-	-	-	-	-	175	26	201	-	-	201	-	-	-	-	-	-	-	1,560
3b.1.1.15	Auxiliary building	-	-	-	-	-	-	306	46	352	316	-	35	-	-	-	-	-	-	-	2,730
3b.1.1.16	Reactor building	-	-	-	-	-	-	306	46	352	316	-	35	-	-	-	-	-	-	-	2,730
3b.1.1	Total	-	-	-	-	-	-	3,612	542	4,153	3,348	-	805	-	-	-	-	-	-	-	32,243
3b.1	Subtotal Period 3b Activity Costs	-	-	-	-	-	-	3,612	542	4,153	3,348	-	805	-	-	-	-	-	-	-	32,243
Period 3b Additional Costs																					
3b.2.1	Site Characterization	-	-	-	-	-	-	2,614	784	3,398	3,398	-	-	-	-	-	-	-	-	19,100	7,852
3b.2	Subtotal Period 3b Additional Costs	-	-	-	-	-	-	2,614	784	3,398	3,398	-	-	-	-	-	-	-	-	19,100	7,852
Period 3b Collateral Costs																					
3b.3.1	Decon equipment	907	-	-	-	-	-	-	136	1,043	1,043	-	-	-	-	-	-	-	-	-	-
3b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,214	182	1,396	1,396	-	-	-	-	-	-	-	-	-	-
3b.3.3	Pipe cutting equipment	-	1,100	-	-	-	-	-	165	1,265	1,265	-	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	907	1,100	-	-	-	-	1,214	483	3,704	3,704	-	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Decon supplies	55	-	-	-	-	-	-	14	69	69	-	-	-	-	-	-	-	-	-	-
3b.4.2	Insurance	-	-	-	-	-	-	589	59	648	648	-	-	-	-	-	-	-	-	-	-
3b.4.3	Property taxes	-	-	-	-	-	-	178	18	195	195	-	-	-	-	-	-	-	-	-	-
3b.4.4	Health physics supplies	-	454	-	-	-	-	-	114	568	568	-	-	-	-	-	-	-	-	-	-
3b.4.5	Heavy equipment rental	-	458	-	-	-	-	-	69	526	526	-	-	-	-	-	-	-	-	-	-
3b.4.6	Disposal of DAW generated	-	-	13	4	-	29	-	9	55	55	-	-	-	582	-	-	-	11,636	19	-
3b.4.7	Plant energy budget	-	-	-	-	-	-	1,053	158	1,211	1,211	-	-	-	-	-	-	-	-	-	-
3b.4.8	NRC Fees	-	-	-	-	-	-	272	27	299	299	-	-	-	-	-	-	-	-	-	-
3b.4.9	Corporate Allocations	-	-	-	-	-	-	206	31	237	237	-	-	-	-	-	-	-	-	-	-
3b.4.10	Security Staff Cost	-	-	-	-	-	-	3,456	518	3,974	3,974	-	-	-	-	-	-	-	-	-	65,179
3b.4.11	DOC Staff Cost	-	-	-	-	-	-	8,934	1,340	10,274	10,274	-	-	-	-	-	-	-	-	-	116,800
3b.4.12	Utility Staff Cost	-	-	-	-	-	-	15,902	2,385	18,288	18,288	-	-	-	-	-	-	-	-	-	258,629
3b.4	Subtotal Period 3b Period-Dependent Costs	55	912	13	4	-	29	30,590	4,742	36,344	36,344	-	-	-	582	-	-	-	11,636	19	440,607
3b.0	TOTAL PERIOD 3b COST	962	2,012	13	4	-	29	38,029	6,551	47,599	46,794	-	805	-	582	-	-	-	11,636	19,119	480,702
PERIOD 3 TOTALS		962	2,450	18	6	-	41	62,050	10,220	75,749	74,330	-	1,419	-	841	-	-	-	16,822	19,127	716,639
PERIOD 4a - Large Component Removal																					
Period 4a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
4a.1.1.1	Reactor Coolant Piping	23	115	25	15	130	197	-	114	620	620	-	-	580	614	-	-	-	134,538	3,957	-
4a.1.1.2	Pressurizer Relief Tank	4	15	7	4	37	51	-	25	143	143	-	-	164	164	-	-	-	36,395	594	-
4a.1.1.3	Reactor Coolant Pumps & Motors	13	54	39	175	-	964	-	291	1,536	1,536	-	-	-	3,386	-	-	-	816,140	2,700	80
4a.1.1.4	Pressurizer	6	36	402	136	-	1,064	-	339	1,983	1,983	-	-	-	3,739	-	-	-	240,915	1,539	1,500
4a.1.1.5	Steam Generators	49	4,795	2,761	2,952	2,549	6,416	-	3,929	23,451	23,451	-	-	40,845	22,546	-	-	-	3,356,336	20,508	4,500
4a.1.1.6	CRDMs/ICIs/Service Structure Removal	20	67	257	32	92	157	-	110	734	734	-	-	1,227	3,012	-	-	-	101,470	2,274	-
4a.1.1.7	Reactor Vessel Internals	44	2,769	7,289	724	-	3,992	204	6,129	21,151	21,151	-	-	-	2,211	376	470	-	325,254	21,567	995
4a.1.1.8	Vessel & Internals GTCC Disposal	-	-	-	-	-	11,924	-	1,789	13,712	13,712	-	-	-	-	-	-	2,142	422,146	-	-
4a.1.1.9	Reactor Vessel	-	5,776	1,424	252	-	2,141	204	5,852	15,648	15,648	-	-	-	9,531	-	-	-	961,949	21,567	995
4a.1.1	Totals	159	13,626	12,203	4,290	2,808	26,906	409	18,577	78,978	78,978	-	-	42,816	45,203	376	470	2,142	6,395,143	74,704	8,069
Removal of Major Equipment																					
4a.1.2	Main Turbine/Generator	-	276	283	35	824	-	-	226	1,645	1,645	-	-	5,099	-	-	-	-	407,936	8,585	-
4a.1.3	Main Condensers	-	779	176	42	737	-	-	329	2,063	2,063	-	-	8,106	-	-	-	-	364,767	24,802	-
Cascading Costs from Clean Building Demolition																					
4a.1.4.1	Reactor	-	700	-	-	-	-	-	105	805	805	-	-	-	-	-	-	-	-	10,579	-
4a.1.4.2	Auxiliary	-	350	-	-	-	-	-	52	402	402	-	-	-	-	-	-	-	-	5,551	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 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			
Cascading Costs from Clean Building Demolition (continued)																					
4a.1.4.3	Fuel Building	-	175	-	-	-	-	-	26	202	202	-	-	-	-	-	-	-	-	2,395	-
4a.1.4.4	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	16	-
4a.1.4.5	Radwaste	-	73	-	-	-	-	-	11	84	84	-	-	-	-	-	-	-	-	1,108	-
4a.1.4	Totals	-	1,299	-	-	-	-	-	195	1,494	1,494	-	-	-	-	-	-	-	-	19,649	-
Disposal of Plant Systems																					
4a.1.5.1	AB - Main Steam	-	144	-	-	-	-	-	22	165	-	-	165	-	-	-	-	-	-	5,833	-
4a.1.5.2	AB - Main Steam RCA	-	53	3	10	177	-	-	42	285	285	-	-	2,156	-	-	-	-	87,550	1,515	-
4a.1.5.3	AC - Main Turbine	-	144	-	-	-	-	-	22	165	-	-	165	-	-	-	-	-	-	5,641	-
4a.1.5.4	AD - Condensate	-	162	-	-	-	-	-	24	187	-	-	187	-	-	-	-	-	-	6,144	-
4a.1.5.5	AE - Feedwater	-	110	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	4,271	-
4a.1.5.6	AF - Feedwater Hter Extrction, Drn & Vnt	-	133	-	-	-	-	-	20	153	-	-	153	-	-	-	-	-	-	5,352	-
4a.1.5.7	AK - Condensate Demineralizer	-	50	-	-	-	-	-	7	57	-	-	57	-	-	-	-	-	-	1,944	-
4a.1.5.8	AL - Auxiliary Feedwater	-	22	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	852	-
4a.1.5.9	AL-Auxiliary Feedwater Surge Tanks	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	87	-
4a.1.5.10	AQ - Condensate & Feedwater Chem Additn	-	12	-	-	-	-	-	2	14	-	-	14	-	-	-	-	-	-	468	-
4a.1.5.11	AX - Acid Feed	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	754	-
4a.1.5.12	Auxiliary Bldg Non-System Specific	-	70	2	4	68	6	-	30	179	179	-	-	824	23	-	-	-	35,461	2,030	-
4a.1.5.13	Auxiliary Bldg Non-System Specific RCA	-	484	12	35	626	-	-	221	1,379	1,379	-	-	7,629	-	-	-	-	309,812	13,471	-
4a.1.5.14	BL - Reactor Makeup Water	-	181	12	16	207	75	-	99	591	591	-	-	2,529	330	-	-	-	129,325	5,223	-
4a.1.5.15	BM - Steam Generator Blowdown	-	369	8	24	423	-	-	160	984	984	-	-	5,160	-	-	-	-	209,560	10,703	-
4a.1.5.16	CA - Steam Seal	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	455	-
4a.1.5.17	CB - Main Turbine Lube Oil	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	1,207	-
4a.1.5.18	CC - Generator Hydrogen & CO2	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	198	-
4a.1.5.19	CD - Generator Seal Oil	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	287	-
4a.1.5.20	CE - Stator Cooling Water	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	241	-
4a.1.5.21	CF - Lube Oil Strg, Xfer & Purification	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	812	-
4a.1.5.22	CG - Condenser Air Removal	-	17	-	-	-	-	-	3	20	-	-	20	-	-	-	-	-	-	657	-
4a.1.5.23	CH - Main Turbine Control Oil	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,219	-
4a.1.5.24	CL - Chlorination	-	15	-	-	-	-	-	2	17	-	-	17	-	-	-	-	-	-	569	-
4a.1.5.25	CO - Carbon Dioxide	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	121	-
4a.1.5.26	CW - Circulating Water	-	196	-	-	-	-	-	29	226	-	-	226	-	-	-	-	-	-	7,858	-
4a.1.5.27	CZ - Caustic Acid	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	111	-
4a.1.5.28	DA - Circulating Water System	-	199	-	-	-	-	-	30	229	-	-	229	-	-	-	-	-	-	7,953	-
4a.1.5.29	DM - Equipment Drains	-	33	-	-	-	-	-	5	38	-	-	38	-	-	-	-	-	-	1,223	-
4a.1.5.30	DM - Equipment Drains RCA	-	100	23	72	1,267	-	-	228	1,690	1,690	-	-	15,445	-	-	-	-	627,223	2,840	-
4a.1.5.31	EG - Component Cooling Water RCA	-	494	21	66	1,162	-	-	310	2,053	2,053	-	-	14,161	-	-	-	-	575,071	13,646	-
4a.1.5.32	EJ - Residual Heat Removal	-	234	26	34	366	209	-	173	1,041	1,041	-	-	4,461	876	-	-	-	255,470	7,008	-
4a.1.5.33	EM - High Pressure Coolant Injection	-	195	3	10	177	-	-	77	462	462	-	-	2,159	-	-	-	-	87,663	5,527	-
4a.1.5.34	EN - Containment Spray	-	150	5	14	248	-	-	77	495	495	-	-	3,026	-	-	-	-	122,874	4,134	-
4a.1.5.35	FB - Auxiliary Steam	-	52	-	-	-	-	-	8	60	-	-	60	-	-	-	-	-	-	2,106	-
4a.1.5.36	FB - Auxiliary Steam RCA	-	58	1	4	67	-	-	25	155	155	-	-	816	-	-	-	-	33,148	1,537	-
4a.1.5.37	FC - Auxiliary Turbines	-	35	-	-	-	-	-	5	40	-	-	40	-	-	-	-	-	-	1,301	-
4a.1.5.38	FE - Auxiliary Steam Chemical Addition	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	105	-
4a.1.5.39	GE - Turbine Bldg HVAC	-	78	-	-	-	-	-	12	89	-	-	89	-	-	-	-	-	-	3,189	-
4a.1.5.40	GF - Miscellaneous Building HVAC	-	23	-	-	-	-	-	4	27	-	-	27	-	-	-	-	-	-	987	-
4a.1.5.41	GS - Containment Hydrogen Control	-	47	1	4	66	-	-	22	140	140	-	-	801	-	-	-	-	32,539	1,395	-
4a.1.5.42	HF - Secondary Liquid Waste	-	606	42	57	692	284	-	339	2,020	2,020	-	-	8,431	1,234	-	-	-	443,537	17,817	-
4a.1.5.43	HY - Hydrogen	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	223	-
4a.1.5.44	KH - Service Gas	-	16	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	644	-
4a.1.5.45	LE - Oily Waste	-	64	-	-	-	-	-	10	73	-	-	73	-	-	-	-	-	-	2,575	-
4a.1.5.46	LE - Oily Waste RCA	-	135	3	8	141	-	-	56	344	344	-	-	1,718	-	-	-	-	69,785	3,518	-
4a.1.5.47	NT - Nitrogen	-	4	-	-	-	-	-	1	4	-	-	4	-	-	-	-	-	-	149	-
4a.1.5.48	OX - Oxygen	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	171	-
4a.1.5.49	SW - Screen Wash	-	18	-	-	-	-	-	3	21	-	-	21	-	-	-	-	-	-	635	-
4a.1.5.50	Turbine Bldg Non-System Specific	-	423	-	-	-	-	-	63	487	-	-	487	-	-	-	-	-	-	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	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	593	-
4a.1.5.54	WL - Cooling Lake Makeup & Blowdown	-	20	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	745	-
4a.1.5	Totals	-	5,333	162	357	5,686	573	-	2,184	14,294	11,817	-	2,477	69,317	2,464	-	-	-	3,019,017	173,868	-
4a.1.6	Scaffolding in support of decommissioning	-	841	28	7	110	19	-	235	1,240	1,240	-	-	1,206	80	-	-	-	61,056	33,925	-
4a.1	Subtotal Period 4a Activity Costs	159	22,154	12,853	4,731	10,164	27,499	409	21,746	99,714	97,237	-	2,477	126,544	47,747	376	470	2,142	10,247,920	335,532	8,069

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 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 Collateral Costs																					
4a.3.1	Process decommissioning water waste	5	-	5	18	-	29	-	13	69	69	-	-	-	77	-	-	-	4,598	15	-
4a.3.3	Small tool allowance	-	206	-	-	-	-	-	31	237	213	-	24	-	-	-	-	-	-	-	-
4a.3.4	On-site survey and release of 113.5 tons clean metallic waste	-	-	-	-	-	-	152	15	167	167	-	-	-	-	-	-	-	-	-	-
4a.3	Subtotal Period 4a Collateral Costs	5	206	5	18	-	29	152	59	473	449	-	24	-	77	-	-	-	4,598	15	-
Period 4a Period-Dependent Costs																					
4a.4.1	Decon supplies	69	-	-	-	-	-	-	17	86	86	-	-	-	-	-	-	-	-	-	-
4a.4.2	Insurance	-	-	-	-	-	-	736	74	810	810	-	-	-	-	-	-	-	-	-	-
4a.4.3	Property taxes	-	-	-	-	-	-	222	22	244	220	-	24	-	-	-	-	-	-	-	-
4a.4.4	Health physics supplies	-	2,046	-	-	-	-	-	512	2,558	2,558	-	-	-	-	-	-	-	-	-	-
4a.4.5	Heavy equipment rental	-	2,488	-	-	-	-	-	373	2,861	2,861	-	-	-	-	-	-	-	-	-	-
4a.4.6	Disposal of DAW generated	-	-	98	35	-	222	-	70	425	425	-	-	-	4,523	-	-	-	90,455	148	-
4a.4.7	Plant energy budget	-	-	-	-	-	-	1,250	188	1,438	1,438	-	-	-	-	-	-	-	-	-	-
4a.4.8	NRC Fees	-	-	-	-	-	-	896	90	986	986	-	-	-	-	-	-	-	-	-	-
4a.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	484	73	557	557	-	-	-	-	-	-	-	-	-	-
4a.4.10	Corporate Allocations	-	-	-	-	-	-	259	39	298	298	-	-	-	-	-	-	-	-	-	-
4a.4.11	Security Staff Cost	-	-	-	-	-	-	4,317	648	4,965	4,965	-	-	-	-	-	-	-	-	-	81,429
4a.4.12	DOC Staff Cost	-	-	-	-	-	-	13,265	1,990	15,255	15,255	-	-	-	-	-	-	-	-	-	179,794
4a.4.13	Utility Staff Cost	-	-	-	-	-	-	20,091	3,014	23,105	23,105	-	-	-	-	-	-	-	-	-	325,714
4a.4	Subtotal Period 4a Period-Dependent Costs	69	4,534	98	35	-	222	41,521	7,108	53,587	53,563	-	24	-	4,523	-	-	-	90,455	148	586,937
4a.0	TOTAL PERIOD 4a COST	233	26,895	12,956	4,783	10,164	27,749	42,081	28,913	153,775	151,250	-	2,525	126,544	52,346	376	470	2,142	10,342,970	335,695	595,007
PERIOD 4b - Site Decontamination																					
Period 4b Direct Decommissioning Activities																					
4b.1.1	Remove spent fuel racks	437	46	281	69	-	1,120	-	548	2,501	2,501	-	-	-	4,688	-	-	-	398,471	1,722	-
Disposal of Plant Systems																					
4b.1.2.1	AN - Demineralized Wtr Storage & xfer	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	1,548	-
4b.1.2.2	AN - Demineralized Wtr Strg & xfer RCA	-	13	0	1	10	-	-	5	29	29	-	-	120	-	-	-	-	4,855	334	-
4b.1.2.3	AP - Condensate Storage & Transfer	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	1,660	-
4b.1.2.4	BB - Reactor Coolant	-	184	23	24	206	200	-	133	770	770	-	-	2,511	927	-	-	-	173,271	5,724	-
4b.1.2.5	BG - Chemical & Volume Control	-	586	58	66	669	463	-	378	2,221	2,221	-	-	8,155	1,954	-	-	-	495,977	16,980	-
4b.1.2.6	BN - Borated Refueling Water Storage	-	201	9	29	513	-	-	133	885	885	-	-	6,255	-	-	-	-	254,024	6,161	-
4b.1.2.7	Control Bldg Non-System Specific	-	125	3	10	175	-	-	59	373	373	-	-	2,139	-	-	-	-	86,849	3,413	-
4b.1.2.8	Control Bldg Non-System Specific Cln	-	894	-	-	-	-	-	134	1,028	-	-	1,028	-	-	-	-	-	-	29,076	-
4b.1.2.9	DO - Diesel Oil	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	48	-
4b.1.2.10	EA - Service Water	-	65	-	-	-	-	-	10	75	-	-	75	-	-	-	-	-	-	2,592	-
4b.1.2.11	EB - Closed Cooling Water	-	31	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	1,267	-
4b.1.2.12	EC - Fuel Pool Cooling & Cleanup	-	249	6	19	338	-	-	116	728	728	-	-	4,115	-	-	-	-	167,129	7,154	-
4b.1.2.13	EF - Essential Service Water	-	73	-	-	-	-	-	11	84	-	-	84	-	-	-	-	-	-	2,951	-
4b.1.2.14	EF - Essential Service Water RCA	-	62	2	7	117	-	-	34	222	222	-	-	1,427	-	-	-	-	57,959	1,734	-
4b.1.2.15	EP - Accumulator Safety Injection	-	101	3	9	161	-	-	51	325	325	-	-	1,958	-	-	-	-	79,502	2,904	-
4b.1.2.16	FA - Auxiliary Steam Generator	-	12	-	-	-	-	-	2	14	-	-	14	-	-	-	-	-	-	521	-
4b.1.2.17	FO - Fuel Oil	-	12	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	486	-
4b.1.2.18	FP - Fire Protection	-	97	-	-	-	-	-	14	111	-	-	111	-	-	-	-	-	-	3,826	-
4b.1.2.19	FP - Fire Protection RCA	-	135	7	21	368	-	-	93	624	624	-	-	4,492	-	-	-	-	182,411	3,541	-
4b.1.2.20	Fuel Bldg Non-System Specific	-	31	1	2	26	2	-	12	74	74	-	-	322	9	-	-	-	13,832	850	-
4b.1.2.21	Fuel Bldg Non-System Specific RCA	-	221	5	15	263	-	-	97	601	601	-	-	3,200	-	-	-	-	129,974	5,859	-
4b.1.2.22	Fuel Building Fire Protection	-	106	4	14	241	-	-	65	431	431	-	-	2,941	-	-	-	-	119,444	2,802	-
4b.1.2.23	GA - Plant Heating	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	1,912	-
4b.1.2.24	GA - Plant Heating RCA	-	80	1	3	61	-	-	30	176	176	-	-	746	-	-	-	-	30,275	2,072	-
4b.1.2.25	GB - Central Chilled Water	-	44	-	-	-	-	-	7	50	-	-	50	-	-	-	-	-	-	1,803	-
4b.1.2.26	GB - Central Chilled Water RCA	-	19	0	1	15	-	-	7	42	42	-	-	187	-	-	-	-	7,591	482	-
4b.1.2.27	GD - Esstl Srvc Wtr Pumphs Bldg HVAC	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	284	-
4b.1.2.28	GG - Fuel Building HVAC	-	164	6	18	324	-	-	93	604	604	-	-	3,945	-	-	-	-	160,195	4,052	-
4b.1.2.29	GH - Radwaste Building HVAC	-	119	4	12	210	-	-	63	408	408	-	-	2,561	-	-	-	-	104,012	3,004	-
4b.1.2.30	GK - Control Building HVAC	-	89	-	-	-	-	-	13	102	-	-	102	-	-	-	-	-	-	3,959	-
4b.1.2.31	GL - Auxiliary Building HVAC	-	297	8	25	441	-	-	145	917	917	-	-	5,381	-	-	-	-	218,514	7,364	-
4b.1.2.32	GM - Diesel Generator Building HVAC	-	15	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	695	-
4b.1.2.33	GN - Containment Cooling	-	321	12	38	677	-	-	189	1,237	1,237	-	-	8,250	-	-	-	-	335,052	8,317	-
4b.1.2.34	GP - Containmnt Integratd Leak Rate Test	-	27	1	3	48	-	-	14	93	93	-	-	580	-	-	-	-	23,570	750	-
4b.1.2.35	GR - Containment Atmospheric Control	-	12	2	5	94	-	-	18	130	130	-	-	1,143	-	-	-	-	46,407	350	-
4b.1.2.36	GT - Containment Purge HVAC	-	76	3	10	179	-	-	48	316	316	-	-	2,185	-	-	-	-	88,746	1,973	-
4b.1.2.37	HA - Gaseous Radwaste	-	228	5	17	303	-	-	106	659	659	-	-	3,699	-	-	-	-	150,219	6,296	-
4b.1.2.38	HB - Liquid Radwaste	-	539	41	50	602	259	-	301	1,792	1,792	-	-	7,343	1,131	-	-	-	390,460	15,365	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 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)																					
4b.1.2.39	HC - Solid Radwaste	-	302	28	32	327	217	-	186	1,091	1,091	-	-	3,986	916	-	-	-	239,034	8,558	-
4b.1.2.40	HD - Decontamination	-	64	2	6	100	-	-	32	203	203	-	-	1,220	-	-	-	-	49,558	1,828	-
4b.1.2.41	HE - Boron Recycle	-	313	20	25	284	142	-	162	946	946	-	-	3,460	614	-	-	-	191,035	8,962	-
4b.1.2.42	JE - Emergency Fuel Oil	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,260	-
4b.1.2.43	KA - Compressed Air and Instrument	-	152	-	-	-	-	-	23	175	-	-	175	-	-	-	-	-	-	6,089	-
4b.1.2.44	KB - Breathing Air	-	27	-	-	-	-	-	4	31	-	-	31	-	-	-	-	-	-	1,075	-
4b.1.2.45	KC - Fire Protection	-	187	-	-	-	-	-	28	215	-	-	215	-	-	-	-	-	-	7,516	-
4b.1.2.46	KC - Fire Protection RCA	-	241	9	28	488	-	-	139	904	904	-	-	5,944	-	-	-	-	241,384	6,383	-
4b.1.2.47	KD - Domestic Water	-	41	-	-	-	-	-	6	47	-	-	47	-	-	-	-	-	-	1,708	-
4b.1.2.48	KE - Fuel Hndlg & Strg Reactor Vssl Serv	-	11	1	4	72	-	-	14	104	104	-	-	882	-	-	-	-	35,813	332	-
4b.1.2.49	KJ - Standby Diesel Engine	-	187	-	-	-	-	-	28	215	-	-	215	-	-	-	-	-	-	6,749	-
4b.1.2.50	LA - Sanitary Drains	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	290	-
4b.1.2.51	LA - Sanitary Drains RCA	-	18	0	1	22	-	-	8	51	51	-	-	272	-	-	-	-	11,053	422	-
4b.1.2.52	LB - Roof Drains	-	32	-	-	-	-	-	5	37	-	-	37	-	-	-	-	-	-	1,276	-
4b.1.2.53	LB - Roof Drains RCA	-	101	3	10	175	-	-	53	343	343	-	-	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	-	74	1	4	65	-	-	29	173	173	-	-	797	-	-	-	-	32,369	2,139	-
4b.1.2.56	LF - Floor & Equipment Drains	-	923	68	71	546	650	-	493	2,751	2,751	-	-	6,660	2,726	-	-	-	501,646	26,134	-
4b.1.2.57	RM - Process Sampling & Analysis	-	82	1	5	81	-	-	33	202	202	-	-	990	-	-	-	-	40,200	2,450	-
4b.1.2.58	Radwaste Bldg Non-System Specific	-	114	3	7	109	9	-	48	290	290	-	-	1,329	38	-	-	-	57,156	3,252	-
4b.1.2.59	Radwaste Bldg Non-System Specific RCA	-	805	19	59	1,041	-	-	368	2,291	2,291	-	-	12,684	-	-	-	-	515,103	21,919	-
4b.1.2.60	Reactor Bldg Non-System Specific	-	58	1	3	41	3	-	22	129	129	-	-	502	14	-	-	-	21,595	1,569	-
4b.1.2.61	Reactor Bldg Non-System Specific RCA	-	414	7	22	391	-	-	166	1,001	1,001	-	-	4,768	-	-	-	-	193,612	10,425	-
4b.1.2.62	SJ - Nuclear Sampling	-	46	1	3	56	-	-	20	126	126	-	-	677	-	-	-	-	27,501	1,430	-
4b.1.2.63	ST - Sewage Treatment	-	61	-	-	-	-	-	9	70	-	-	70	-	-	-	-	-	-	2,316	-
4b.1.2.64	SZ - Service Air	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	1,892	-
4b.1.2.65	VA - I&C Shop HVAC	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	155	-
4b.1.2.66	VB - I&C Shop Computer Room HVAC	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	106	-
4b.1.2.67	VC - Health Physics Computer Room HVAC	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	208	-
4b.1.2.68	VJ - Shop Bldg Machine Shop Area Vent	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	57	-
4b.1.2.69	VL - Shop Building HVAC	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	101	-
4b.1.2.70	VS - Admin Bldg HVAC	-	7	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	262	-
4b.1.2.71	VT - Tech Support Building HVAC	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	87	-
4b.1.2.72	VW - Waste Water Treatment Ventilation	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	52	-
4b.1.2.73	WD - Domestic Water	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	870	-
4b.1.2.74	WM - Makeup Demineralizer	-	100	-	-	-	-	-	15	115	-	-	115	-	-	-	-	-	-	3,929	-
4b.1.2.75	WS - Plant Services Water	-	83	-	-	-	-	-	12	95	-	-	95	-	-	-	-	-	-	3,297	-
4b.1.2.76	WS - Plant Services Water RCA	-	26	3	9	151	-	-	31	219	219	-	-	1,838	-	-	-	-	74,625	782	-
4b.1.2.77	WT - Waste Water Treatment	-	20	-	-	-	-	-	3	23	-	-	23	-	-	-	-	-	-	769	-
4b.1.2.78	WZ - Radioactive Liquid Waste	-	29	3	3	20	30	-	19	104	104	-	-	247	125	-	-	-	20,673	782	-
4b.1.2.79	Yard Non-System Specific	-	17	-	-	-	-	-	3	19	-	-	19	-	-	-	-	-	-	603	-
4b.1.2	Totals	-	10,039	376	688	10,012	1,976	-	4,394	27,485	24,585	-	2,900	122,048	8,454	-	-	-	5,659,482	300,934	-
4b.1.3	Scaffolding in support of decommissioning	-	1,261	42	11	164	29	-	353	1,860	1,860	-	-	1,809	120	-	-	-	91,584	50,887	-
Decontamination of Site Buildings																					
4b.1.4.1	Reactor	741	629	32	148	489	1,151	-	914	4,102	4,102	-	-	5,955	9,353	-	-	-	911,795	38,198	-
4b.1.4.2	Auxiliary	376	162	9	41	169	119	-	291	1,167	1,167	-	-	2,058	1,954	-	-	-	250,301	15,247	-
4b.1.4.3	Communication Corridor - Contaminated	8	2	0	1	1	2	-	6	21	21	-	-	17	42	-	-	-	4,296	306	-
4b.1.4.4	Fuel Building	482	472	8	20	222	46	-	408	1,657	1,657	-	-	2,705	562	-	-	-	158,021	27,454	-
4b.1.4.5	Hot Machine Shop	10	4	0	1	-	3	-	7	26	26	-	-	-	51	-	-	-	4,446	421	-
4b.1.4.6	RWST Foundation Decon	-	6	0	3	-	10	-	5	24	24	-	-	-	183	-	-	-	15,840	95	-
4b.1.4.7	Radwaste	200	57	3	11	69	30	-	135	506	506	-	-	844	473	-	-	-	74,462	7,523	-
4b.1.4.8	Radwaste Drum Storage	23	7	0	2	5	7	-	16	61	61	-	-	66	114	-	-	-	12,564	850	-
4b.1.4.9	Radwaste Storage Building	57	13	1	5	-	17	-	37	130	130	-	-	-	297	-	-	-	25,740	2,011	-
4b.1.4	Totals	1,898	1,354	53	232	955	1,385	-	1,817	7,695	7,695	-	-	11,646	13,029	-	-	-	1,457,465	92,105	-
4b.1	Subtotal Period 4b Activity Costs	2,335	12,700	753	1,000	11,132	4,509	-	7,113	39,541	36,641	-	2,900	135,503	26,291	-	-	-	7,607,001	445,648	-
Period 4b Additional Costs																					
4b.2.1	Final Survey Program Management	-	-	-	-	-	-	1,238	371	1,609	1,609	-	-	-	-	-	-	-	-	-	12,480
4b.2.2	ISFSI License Termination	-	19	5	18	-	83	1,182	206	1,513	-	1,513	-	-	1,454	-	-	-	122,079	1,833	2,560
4b.2	Subtotal Period 4b Additional Costs	-	19	5	18	-	83	2,420	577	3,122	1,609	1,513	-	-	1,454	-	-	-	122,079	1,833	15,040
Period 4b Collateral Costs																					
4b.3.1	Process decommissioning water waste	12	-	13	47	-	77	-	34	182	182	-	-	-	204	-	-	-	12,246	40	-
4b.3.3	Small tool allowance	-	239	-	-	-	-	-	36	275	275	-	-	-	-	-	-	-	-	-	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 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 Collateral Costs (continued)																					
4b.3.4	Decommissioning Equipment Disposition	-	-	140	43	545	95	-	126	949	949	-	-	6,000	397	-	-	-	303,726	88	-
4b.3.5	On-site survey and release of 44.30 tons clean metallic waste	-	-	-	-	-	-	59	6	65	65	-	-	-	-	-	-	-	-	-	-
4b.3	Subtotal Period 4b Collateral Costs	12	239	153	90	545	172	59	201	1,472	1,472	-	-	6,000	601	-	-	-	315,972	128	-
Period 4b Period-Dependent Costs																					
4b.4.1	Decon supplies	1,313	-	-	-	-	-	-	328	1,641	1,641	-	-	-	-	-	-	-	-	-	-
4b.4.2	Insurance	-	-	-	-	-	-	1,632	163	1,795	1,795	-	-	-	-	-	-	-	-	-	-
4b.4.3	Property taxes	-	-	-	-	-	-	492	49	541	541	-	-	-	-	-	-	-	-	-	-
4b.4.4	Health physics supplies	-	3,224	-	-	-	-	-	806	4,030	4,030	-	-	-	-	-	-	-	-	-	-
4b.4.5	Heavy equipment rental	-	5,472	-	-	-	-	-	821	6,292	6,292	-	-	-	-	-	-	-	-	-	-
4b.4.6	Disposal of DAW generated	-	-	145	51	-	326	-	104	626	626	-	-	-	6,655	-	-	-	133,096	217	-
4b.4.7	Plant energy budget	-	-	-	-	-	-	2,188	328	2,516	2,516	-	-	-	-	-	-	-	-	-	-
4b.4.8	NRC Fees	-	-	-	-	-	-	1,987	199	2,186	2,186	-	-	-	-	-	-	-	-	-	-
4b.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	1,074	161	1,235	1,235	-	-	-	-	-	-	-	-	-	-
4b.4.10	Corporate Allocations	-	-	-	-	-	-	542	81	624	624	-	-	-	-	-	-	-	-	-	-
4b.4.11	Security Staff Cost	-	-	-	-	-	-	9,571	1,436	11,007	11,007	-	-	-	-	-	-	-	-	-	180,536
4b.4.12	DOC Staff Cost	-	-	-	-	-	-	28,680	4,302	32,982	32,982	-	-	-	-	-	-	-	-	-	387,069
4b.4.13	Utility Staff Cost	-	-	-	-	-	-	42,298	6,345	48,643	48,643	-	-	-	-	-	-	-	-	-	681,703
4b.4	Subtotal Period 4b Period-Dependent Costs	1,313	8,696	145	51	-	326	88,465	15,123	114,118	114,118	-	-	-	6,655	-	-	-	133,096	217	1,249,307
4b.0	TOTAL PERIOD 4b COST	3,660	21,653	1,054	1,160	11,677	5,089	90,944	23,014	158,252	153,840	1,513	2,900	141,503	35,001	-	-	-	8,178,148	447,826	1,264,347
PERIOD 4f - License Termination																					
Period 4f Direct Decommissioning Activities																					
4f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	154	46	200	200	-	-	-	-	-	-	-	-	-	-
4f.1.2	Terminate license									a											
4f.1	Subtotal Period 4f Activity Costs	-	-	-	-	-	-	154	46	200	200	-	-	-	-	-	-	-	-	-	-
Period 4f Additional Costs																					
4f.2.1	Final Site survey	-	-	-	-	-	-	5,858	1,757	7,616	7,616	-	-	-	-	-	-	-	-	151,725	6,240
4f.2	Subtotal Period 4f Additional Costs	-	-	-	-	-	-	5,858	1,757	7,616	7,616	-	-	-	-	-	-	-	-	151,725	6,240
Period 4f Collateral Costs																					
4f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,214	182	1,396	1,396	-	-	-	-	-	-	-	-	-	-
4f.3	Subtotal Period 4f Collateral Costs	-	-	-	-	-	-	1,214	182	1,396	1,396	-	-	-	-	-	-	-	-	-	-
Period 4f Period-Dependent Costs																					
4f.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4f.4.2	Property taxes	-	-	-	-	-	-	137	14	151	151	-	-	-	-	-	-	-	-	-	-
4f.4.3	Health physics supplies	-	700	-	-	-	-	-	175	874	874	-	-	-	-	-	-	-	-	-	-
4f.4.4	Disposal of DAW generated	-	-	8	3	-	18	-	6	34	34	-	-	-	360	-	-	-	7,203	12	-
4f.4.5	Plant energy budget	-	-	-	-	-	-	163	24	187	187	-	-	-	-	-	-	-	-	-	-
4f.4.6	NRC Fees	-	-	-	-	-	-	594	59	654	654	-	-	-	-	-	-	-	-	-	-
4f.4.7	Corporate Allocations	-	-	-	-	-	-	61	9	70	70	-	-	-	-	-	-	-	-	-	-
4f.4.8	Security Staff Cost	-	-	-	-	-	-	1,241	186	1,428	1,428	-	-	-	-	-	-	-	-	-	19,337
4f.4.9	DOC Staff Cost	-	-	-	-	-	-	4,616	692	5,308	5,308	-	-	-	-	-	-	-	-	-	58,817
4f.4.10	Utility Staff Cost	-	-	-	-	-	-	5,375	806	6,182	6,182	-	-	-	-	-	-	-	-	-	76,543
4f.4	Subtotal Period 4f Period-Dependent Costs	-	700	8	3	-	18	12,188	1,972	14,888	14,888	-	-	-	360	-	-	-	7,203	12	154,697
4f.0	TOTAL PERIOD 4f COST	-	700	8	3	-	18	19,414	3,958	24,099	24,099	-	-	-	360	-	-	-	7,203	151,737	160,937
PERIOD 4 TOTALS		3,893	49,248	14,018	5,946	21,842	32,856	152,439	55,884	336,126	329,188	1,513	5,425	268,047	87,707	376	470	2,142	18,528,320	935,258	2,020,291
PERIOD 5b - Site Restoration																					
Period 5b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
5b.1.1.1	Reactor	-	3,973	-	-	-	-	-	596	4,569	-	-	4,569	-	-	-	-	-	-	60,067	-
5b.1.1.2	Access Vaults	-	14	-	-	-	-	-	2	17	-	-	17	-	-	-	-	-	-	251	-
5b.1.1.3	Administration	-	179	-	-	-	-	-	27	206	-	-	206	-	-	-	-	-	-	4,467	-
5b.1.1.4	Auxiliary	-	3,150	-	-	-	-	-	472	3,622	-	-	3,622	-	-	-	-	-	-	49,968	-
5b.1.1.5	Auxiliary Boiler	-	25	-	-	-	-	-	4	28	-	-	28	-	-	-	-	-	-	619	-
5b.1.1.6	Chemical Addition Structure	-	35	-	-	-	-	-	5	40	-	-	40	-	-	-	-	-	-	735	-
5b.1.1.7	Circ Water Pump Enclosure	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	164	-
5b.1.1.8	Circ Water Travel Screen Enclosure	-	4	-	-	-	-	-	1	4	-	-	4	-	-	-	-	-	-	160	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 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.1.1.9	Circulating Water Discharge Structure	-	136	-	-	-	-	-	20	156	-	-	156	-	-	-	-	-	-	2,373	-
5b.1.1.10	Circulating Water Intake & Screenhouse	-	128	-	-	-	-	-	19	147	-	-	147	-	-	-	-	-	-	2,059	-
5b.1.1.11	Communication Corridor - Clean	-	986	-	-	-	-	-	148	1,134	-	-	1,134	-	-	-	-	-	-	17,215	-
5b.1.1.12	Communication Corridor - Contaminated	-	44	-	-	-	-	-	7	51	-	-	51	-	-	-	-	-	-	674	-
5b.1.1.13	Covered Walkways	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	242	-
5b.1.1.14	Diesel Generator	-	383	-	-	-	-	-	57	440	-	-	440	-	-	-	-	-	-	5,492	-
5b.1.1.15	E.S.W.S. Pumphouse	-	212	-	-	-	-	-	32	243	-	-	243	-	-	-	-	-	-	3,019	-
5b.1.1.16	ESWS Valve House	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	243	-
5b.1.1.17	Fuel Building	-	1,608	-	-	-	-	-	241	1,850	-	-	1,850	-	-	-	-	-	-	22,580	-
5b.1.1.18	GOB - Administration Building	-	244	-	-	-	-	-	37	281	-	-	281	-	-	-	-	-	-	5,819	-
5b.1.1.19	Hot Machine Shop	-	15	-	-	-	-	-	2	17	-	-	17	-	-	-	-	-	-	417	-
5b.1.1.20	M.M.O. Building	-	227	-	-	-	-	-	34	261	-	-	261	-	-	-	-	-	-	3,483	-
5b.1.1.21	Material Center West	-	91	-	-	-	-	-	14	104	-	-	104	-	-	-	-	-	-	2,512	-
5b.1.1.22	Misc Structures and Additions	-	66	-	-	-	-	-	10	76	-	-	76	-	-	-	-	-	-	1,523	-
5b.1.1.23	Miscellaneous Site Foundations	-	328	-	-	-	-	-	49	378	-	-	378	-	-	-	-	-	-	7,074	-
5b.1.1.24	Miscellaneous Site Structures	-	1,296	-	-	-	-	-	194	1,490	-	-	1,490	-	-	-	-	-	-	20,147	-
5b.1.1.25	New Covered Walkway	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	160	-
5b.1.1.26	Oil Separator and Waste Tank	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	48	-
5b.1.1.27	Radwaste	-	1,413	-	-	-	-	-	212	1,624	-	-	1,624	-	-	-	-	-	-	21,798	-
5b.1.1.28	Radwaste Drum Storage	-	195	-	-	-	-	-	29	225	-	-	225	-	-	-	-	-	-	3,840	-
5b.1.1.29	Radwaste Storage Building	-	91	-	-	-	-	-	14	104	-	-	104	-	-	-	-	-	-	2,323	-
5b.1.1.30	Security Main Gate North	-	80	-	-	-	-	-	12	92	-	-	92	-	-	-	-	-	-	1,720	-
5b.1.1.31	Security Additions 2010	-	25	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	489	-
5b.1.1.32	Security/Guardhouse	-	41	-	-	-	-	-	6	48	-	-	48	-	-	-	-	-	-	845	-
5b.1.1.33	Site Diesel Generator	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	61	-
5b.1.1.34	Support Complex	-	26	-	-	-	-	-	4	30	-	-	30	-	-	-	-	-	-	697	-
5b.1.1.35	Turbine Building	-	2,529	-	-	-	-	-	379	2,908	-	-	2,908	-	-	-	-	-	-	55,694	-
5b.1.1.36	Turbine Pedestal	-	850	-	-	-	-	-	127	977	-	-	977	-	-	-	-	-	-	10,928	-
5b.1.1.37	Waste Water Treatment	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	407	-
5b.1.1.38	Water Treatment Building North (Z110)	-	48	-	-	-	-	-	7	55	-	-	55	-	-	-	-	-	-	911	-
5b.1.1	Totals	-	18,492	-	-	-	-	-	2,774	21,266	-	-	21,266	-	-	-	-	-	-	311,219	-
Site Closeout Activities																					
5b.1.2	Remove Rubble	-	741	-	-	-	-	-	111	852	-	-	852	-	-	-	-	-	-	4,864	-
5b.1.3	Grade & landscape site	-	101	-	-	-	-	-	15	116	-	-	116	-	-	-	-	-	-	512	-
5b.1.4	Final report to NRC	-	-	-	-	-	-	175	26	201	201	-	-	-	-	-	-	-	-	-	1,560
5b.1	Subtotal Period 5b Activity Costs	-	19,334	-	-	-	-	175	2,926	22,435	201	-	22,234	-	-	-	-	-	-	316,595	1,560
Period 5b Additional Costs																					
5b.2.1	Concrete Crushing	-	852	-	-	-	-	9	129	989	-	-	989	-	-	-	-	-	-	4,312	-
5b.2.2	Circulating Water Intake Cofferdam	-	275	-	-	-	-	-	41	316	-	-	316	-	-	-	-	-	-	2,540	-
5b.2.3	E.S.W.S. Pumphouse Cofferdam	-	367	-	-	-	-	-	55	422	-	-	422	-	-	-	-	-	-	3,386	-
5b.2.4	ISFSI Demolition and Site Restoration	-	290	-	-	-	-	48	51	389	-	389	-	-	-	-	-	-	-	3,990	160
5b.2	Subtotal Period 5b Additional Costs	-	1,784	-	-	-	-	56	276	2,116	-	389	1,727	-	-	-	-	-	-	14,228	160
Period 5b Collateral Costs																					
5b.3.1	Small tool allowance	-	183	-	-	-	-	-	27	210	-	-	210	-	-	-	-	-	-	-	-
5b.3	Subtotal Period 5b Collateral Costs	-	183	-	-	-	-	-	27	210	-	-	210	-	-	-	-	-	-	-	-
Period 5b Period-Dependent Costs																					
5b.4.1	Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5b.4.2	Property taxes	-	-	-	-	-	-	264	26	291	-	-	291	-	-	-	-	-	-	-	-
5b.4.3	Heavy equipment rental	-	4,212	-	-	-	-	-	632	4,844	-	-	4,844	-	-	-	-	-	-	-	-
5b.4.4	Plant energy budget	-	-	-	-	-	-	157	24	180	-	-	180	-	-	-	-	-	-	-	-
5b.4.5	Corporate Allocations	-	-	-	-	-	-	48	7	55	55	-	-	-	-	-	-	-	-	-	-
5b.4.6	Security Staff Cost	-	-	-	-	-	-	2,390	359	2,749	-	-	2,749	-	-	-	-	-	-	-	37,234
5b.4.7	DOC Staff Cost	-	-	-	-	-	-	8,465	1,270	9,735	-	-	9,735	-	-	-	-	-	-	-	105,497
5b.4.8	Utility Staff Cost	-	-	-	-	-	-	4,048	607	4,655	-	-	4,655	-	-	-	-	-	-	-	60,506
5b.4	Subtotal Period 5b Period-Dependent Costs	-	4,212	-	-	-	-	15,373	2,925	22,509	55	-	22,454	-	-	-	-	-	-	-	203,237
5b.0	TOTAL PERIOD 5b COST	-	25,512	-	-	-	-	15,604	6,154	47,271	256	389	46,626	-	-	-	-	-	-	330,823	204,957
PERIOD 5 TOTALS		-	25,512	-	-	-	-	15,604	6,154	47,271	256	389	46,626	-	-	-	-	-	-	330,823	204,957
TOTAL COST TO DECOMMISSION		**9,346**	**84,323**	**14,402**	**6,547**	**21,911**	**34,114**	**586,800**	**127,234**	**884,677**	**749,075**	**82,133**	**53,470**	**270,114**	**98,165**	**376**	**470**	**2,142**	**18,961,860**	**1,366,716**	**7,015,511**

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(thousands of 2011 dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			

TOTAL COST TO DECOMMISSION WITH 16.8% CONTINGENCY:	**$884,677**	**thousands of 2011 dollars**
TOTAL NRC LICENSE TERMINATION COST IS 84.67% OR:	**$749,075**	**thousands of 2011 dollars**
SPENT FUEL MANAGEMENT COST IS 9.28% OR:	**$82,133**	**thousands of 2011 dollars**
NON-NUCLEAR DEMOLITION COST IS 6.04% OR:	**$53,470**	**thousands of 2011 dollars**
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	**99,010**	**cubic feet**
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	**2,142**	**cubic feet**
TOTAL SCRAP METAL REMOVED:	**67,879**	**tons**
TOTAL CRAFT LABOR REQUIREMENTS:	**1,366,716**	**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

Since the issuance of the last Decommissioning Cost Analysis for Wolf Creek in August 2008, 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, 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

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

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 July 29, 2011, the Blue Ribbon Commission issued its "Draft 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] proceed promptly to develop one or more consolidated interim storage facilities" [4]
- "[T]he United States must proceed promptly to develop one or more permanent deep geological facilities for the safe disposal of spent fuel and high-level nuclear waste."[5]

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, the disposal cost is 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. However, 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.[6] The post-shutdown costs incurred to satisfy this requirement are described below.

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3 Ibid.
4 "Blue Ribbon Commission on America's Nuclear Future, Draft Report to the Secretary of Energy," http://www.brc.gov/, p. 36, July 2011
5 Ibid., p.30
6 U.S. Code of Federal Regulations, Title 10, Part 50, "Domestic Licensing of Production and

Base Analyses

The estimates described in the main report (and detailed in Appendix C and D) are based in general upon 1) a 2020 start date for DOE initiating transfer of commercial spent fuel to a federal facility, and 2) a 2028 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.[7]

The assumed 2020 DOE start date is nominally based on the last position stated by the DOE. On July 15, 2008, the then-Director of the DOE's Office of Civilian Radioactive Waste Management testified before Congress that DOE "could be ready to begin accepting spent nuclear fuel by 2020."[8] While his statement was based on continued program funding, WCNOC believes that one or more monitored retrievable storage facilities could be put into place following a Blue Ribbon Commission recommendation for the same, within a reasonable time.

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:

Utilization Facilities," Subpart 54 (bb), "Conditions of Licenses"

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

8 Statement of Edward F. Sproat, III, Director Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Before the Subcommittee on Energy and Air Quality Committee on Energy and Commerce U.S. House of Representatives, July 15, 2008

9 Draft Report of the Blue Ribbon Commission, p. 47: "[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

- The spent fuel pool would be at capacity following the final core off-load.
- 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.
- 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 444 assemblies would be placed in dry storage during plant operations (i.e., maintain full core off-load capability) in 37-assembly capacity multi-purpose canisters.
- 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,

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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

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

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
- Pickup of spent fuel beyond the last published date would be based upon the plant average of the previous five 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 (2075)

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

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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

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

	Base Case	Alternative
Spent fuel pool inventory at shutdown (assemblies)	1,765	1,765
ISFSI inventory at shutdown (assemblies)	444	444
Spent fuel transferred to the DOE during decommissioning (assemblies)	2,209	336
Spent fuel transferred to the ISFSI for interim storage within five and one-half years after shutdown (assemblies)	0	1,432
Number of additional dry-storage modules need to support decommissioning (including GTCC)	0	43
Transfer of Spent Fuel to DOE Complete (year)	2050	2075

In essence, spent fuel is on site for additional 25 years after plant decommissioning, 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 $240,000 (from the wet pool to the ISFSI). A unit cost of $120,000 (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.

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 2011 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 (2075). 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, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	43,038	4,022	982	30	6,085	54,157
2046	64,057	28,541	1,803	12,143	20,305	126,849
2047	62,114	37,514	1,151	26,886	10,094	137,760
2048	53,508	20,823	979	13,427	7,277	96,014
2049	49,980	14,295	909	8,176	6,162	79,522
2050	45,519	12,292	777	7,676	5,457	71,721
2051	33,191	5,382	331	2,409	3,155	44,469
2052	24,011	11,111	138	4	2,020	37,284
2053	15,916	7,670	89	0	1,883	25,558
2054	4,761	212	36	0	1,854	6,863
2055	4,761	212	36	0	1,854	6,863
2056	4,774	212	36	0	1,859	6,882
2057	4,761	212	36	0	1,854	6,863
2058	4,761	212	36	0	1,854	6,863
2059	4,761	212	36	0	1,854	6,863
2060	4,774	212	36	0	1,859	6,882
2061	4,761	212	36	0	1,854	6,863
2062	4,761	212	36	0	1,854	6,863
2063	4,761	212	36	0	1,854	6,863
2064	4,774	212	36	0	1,859	6,882
2065	4,761	212	36	0	1,854	6,863
2066	4,761	212	36	0	1,854	6,863
2067	4,761	212	36	0	1,854	6,863
2068	4,774	212	36	0	1,859	6,882
2069	4,761	212	36	0	1,854	6,863
2070	4,761	212	36	0	1,854	6,863
2071	4,761	212	36	0	1,854	6,863
2072	4,774	212	36	0	1,859	6,882
2073	4,761	212	36	0	1,854	6,863
2074	4,761	212	36	0	1,854	6,863

TABLE E (continued)
DECON ALTERNATIVE WITH LONG-TERM SPENT FUEL MANAGEMENT
SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2011 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2075	4,751	995	36	1	15,573	21,356
2076	1,600	479	30	103	1,824	4,036
Total	497,730	147,577	7,989	70,856	118,801	842,953