BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of	)	
Evergy Metro, Inc. d/b/a Evergy Missouri	)	
Metro for Approval of the Accrual and Funding	)	Case No. EO-2021-_____
of Wolf Creek Generating Station	)	
Decommissioning Costs at Current Levels	)	

APPLICATION OF EVERGY MISSOURI METRO FOR APPROVAL OF THE ACCRUAL AND FUNDING OF WOLF CREEK GENERATING STATION DECOMMISSIONING COSTS AT CURRENT LEVELS

Pursuant to 20 CSR 4240-3.185(3), Evergy Metro, Inc. d/b/a Evergy Missouri Metro ("Evergy Missouri Metro" or the "Company")[1] hereby submits its application to the Missouri Public Service Commission ("Commission") for approval of the accrual and funding of Wolf Creek Generating Station ("Wolf Creek") decommissioning costs at current levels. In support thereof, Evergy Missouri Metro states as follows:

1. Evergy Missouri Metro is a Missouri corporation with its principal office and place of business at 1200 Main Street, Kansas City, Missouri 64105. It is engaged in the generation, transmission, distribution and sale of electricity in western Missouri and eastern Kansas, operating primarily in the Kansas City metropolitan area. Evergy Missouri Metro is an "electrical corporation" and a "public utility" subject to the jurisdiction, supervision, and control of the Commission under Chapters 386 and 393.

2. Evergy Missouri Metro's certificate of good standing was filed in Case No. EN-2020-0063 and is incorporated by reference pursuant to 20 CSR 4240-2.060(1)(G).

[1] Effective October 7, 2019, Evergy Metro Inc. d/b/a Evergy Missouri Metro adopted the service territory and tariffs of Kansas City Power & Light Company ("KCP&L").

3. Evergy Missouri Metro has filed with the Commission certified copies of its Articles of Incorporation and all amendments thereto. These documents are incorporated herein by reference.

4. Communications concerning this submission should be addressed to:

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5. Data requests concerning this Application should be addressed to Regulatory.Affairs@evergy.com.

6. 20 CSR 4240-3.185(3) requires Evergy Missouri Metro to file by September 1, 1990, and every three years thereafter, a cost study detailing Evergy Missouri Metro's latest cost estimate for decommissioning Wolf Creek. The Wolf Creek Generating Station Decommissioning Cost Estimate Update for August 31, 2020 ("2020 Study") is filed herewith as **Schedule A**.

7. The Missouri jurisdictional share of the current annual decommissioning trust fund accrual is $1,281,264 and was first authorized by the Commission in Case No. ER-2006-0314. Evergy Missouri Metro has accrued at this rate since January 1, 2007. The Commission

order in Case No. EO-2018-0062 approved the continuation of the annual decommissioning expense accruals and trust fund payment at the current level of $1,281,264. The current level of $1,281,264 was also included in the cost of service in Evergy Missouri Metro's general rate case in Case No. ER-2018-0145.

8. The 2020 Study shows the decommissioning cost estimate to be $1,073,642,000 in 2020 dollars. 20 CSR 4240-3.185(3) also requires Evergy Missouri Metro to provide funding levels necessary to defray these decommissioning costs. **Schedule B** ("2020 Funding Analysis") along with supporting workpapers is filed herewith. The 2020 Funding Analysis demonstrates that the current annual trust fund contribution of $1,281,264 is sufficient to defray the estimated decommissioning cost within 0.40% of the Missouri jurisdictional share of future estimated total decommissioning costs. The 2020 Funding Analysis is based on the actual nuclear decommissioning trust fund balance as of June 30, 2020, the decommissioning cost estimate from the 2020 Study, a Missouri jurisdictional allocation based on average monthly peak demand over the life of the plant with the 2019 allocation used for the remaining years after 2019, capital market assumptions dated July 1, 2020 from Evergy Missouri Metro's pension consultants, Willis Towers Watson, as agreed to in the Stipulation and Agreement approved in Case No. EO-2012-0068, initial asset allocations based on the Wolf Creek Nuclear Decommissioning Trust Investment Guidelines authorized in Case No. EO-2009-439, and a decommissioning cost escalation rate based on inflation assumptions also from Willis Towers Watson dated July 1, 2020 in order to provide consistency with the capital market assumptions. The weighted decommissioning cost escalation of 3.48% is based on a 3.90% wage inflation rate assumption for the labor portion of the decommissioning cost estimate and a 3.00% price inflation rate for the non-labor portion of the decommissioning cost estimate. Evergy Missouri Metro believes

that it is reasonable and prudent to continue the annual accruals at the current level of $1,281,264. Evergy Missouri Metro therefore requests that the Commission approve the continuation of the annual accrual at the current level.

9. Because Evergy Missouri Metro is not requesting a change in the current level of $1,281,264 already included in Evergy Missouri Metro's retail rates approved in Case No. ER-2018-0145, no new tariff(s) are being filed with this application.

WHEREFORE, Evergy Missouri Metro requests an order from the Commission: (i) finding that the 2020 Study and the 2020 Funding Analysis satisfy the requirements of 20 CSR 4240-3.185(3); and (ii) approving the continuation of the annual decommissioning expense accrual and trust fund contribution at the current level of $1,281,264.

Respectfully submitted,

/s/ Roger W. Steiner

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CERTIFICATE OF SERVICE

The undersigned certifies that true and correct copies of the foregoing have been e-mailed or mailed, via first class United States Mail, postage pre-paid, to the service list of record this 1st day of September 2020.

General Counsel's Office
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/s/ Roger W. Steiner
Roger W. Steiner
Counsel for Evergy Missouri Metro

VERIFICATION

STATE OF MISSOURI)
) ss.
COUNTY OF JACKSON)

James P. Gilligan, being first duly sworn, on his oath and in his capacity as Assistant Treasurer for Evergy Missouri Metro, states that he is authorized to execute on behalf of Evergy Missouri Metro this *Application for Approval of the Accrual and Funding of Wolf Creek Generating Station Decommissioning Costs at Current Levels*, and has knowledge of the matters stated in this Application, and that said matters are true and correct to the best of his knowledge, information and belief.

James P. Gilligan

Subscribed and sworn to before me this 1st day of September 2020.

Notary Pubic

My Commission expires: 4/26/2021

ANTHONY R WESTENKIRCHNER
Notary Public, Notary Seal
State of Missouri
Platte County
Commission # 17279952
My Commission Expires April 26, 2021

DECOMMISSIONING COST ANALYSIS

for the

WOLF CREEK GENERATING STATION

prepared for

Wolf Creek Nuclear Operating Corporation

prepared by

TLG Services, Inc.
Bridgewater, Connecticut

August 2020

APPROVALS

Project Manager	Francis W. Seymore	8/31/2020
	Francis W. Seymore	Date
Project Engineer	Benjamin J. Stochmal	8/31/2020
	Benjamin J. Stochmal	Date
Technical Manager	Lori A. Glander	8/31/2020
	Lori A. Glander.	Date

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No.	Date	Item Revised	Reason for Revision
0	8-31-2020		Original Issue

EXECUTIVE SUMMARY

This report presents estimates of the cost to decommission the Wolf Creek Generating Station (Wolf Creek) for the selected decommissioning alternatives following the scheduled and permanent cessation of plant operations. The estimates are designed to provide the Wolf Creek Nuclear Operating Corporation (WCNOC), the plant's operator, and its owners: Evergy Kansas South, Inc. and Evergy Metro, Inc., wholly owned subsidiaries of Evergy, Inc. and Kansas Electric Power Cooperative, Inc., with sufficient information to assess their financial obligations, as they pertain to the eventual decommissioning of the nuclear station.

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

As discussed in the 2017 estimate, 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 is ready for decommissioning. While there is still much uncertainty in this area, the probabilities that the 2017 base case estimate occurs has become unlikely, The alternative scenario in the 2017 estimate, where the spent fuel remains on site for an extended period following decommissioning of the power block, has become the most likely scenario. This 2020 estimate has therefore swapped the 2017 base and alternate cases, with the base case of extended ISFSI operations following decommissioning becoming the base case of the 2020 estimate.

For continuity and comparison of the 2017 estimate, the five years wet storage with complete transfer to DOE (the 2017 base case) is presented in Appendix F, updated to 2020 dollars. There still is much uncertainty in this area. Because the assumptions used in Appendix F analysis are speculative at this point, the hypothetical cost effects shown here have not been included in the overall updated cost estimate in this report.

While the analysis is not a detailed engineering evaluation, it represents the estimates prepared in advance of the detailed engineering required to carry out the

1 "Decommissioning Cost Analysis for the Wolf Creek Generating Station," Document D03-1741-001, Rev. 0, TLG Services, Inc., August 2017

decommissioning of the nuclear plant. It may also not reflect the actual plan to decommission Wolf Creek; the plan may differ from the assumptions made in this analysis based on facts that exist at the time of decommissioning.

The 2017 plant inventory, the basis for the decontamination and dismantling requirements and cost, and the decommissioning waste streams, was reviewed for this analysis. There were no substantive changes made to the plant inventory (that would impact decommissioning). The current analysis does include, however, the costs to decommission the Main Access Facility.

The costs to decommission Wolf Creek for the scenarios evaluated are tabulated at the end of this section. Costs are reported in 2020 dollars and include monies anticipated to be spent for radiological remediation and operating license termination, spent fuel management, and site restoration activities.

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

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

The ISFSI, consisting of transportable storage canisters to house the spent fuel assemblies, and horizontal storage modules, will remain operational until the DOE is able to complete the transfer of the fuel to a federal facility (e.g., a monitored retrievable storage facility).[2] DOE officials have stated that DOE does not have an obligation to accept already-canistered fuel without an amendment to DOE's contracts with plant licensees to remove the fuel (the "Standard Contract"), but DOE has not explained what any such amendment would involve. For purposes of this analysis, it is assumed that DOE will accept already-canistered fuel. If this assumption is incorrect, it is assumed

2 Projected expenditures for spent fuel management identified in the cost analyses do not consider the outcome of the litigation with the DOE with regard to the delays incurred by the owner in the timely removal of spent fuel from the site.

the DOE will have liability for costs incurred to transfer the fuel to DOE-supplied containers.

Alternatives and Regulations

The ultimate objective of the decommissioning process is to reduce the inventory of contaminated and activated material such that the license can be terminated. The Nuclear Regulatory Commission (NRC) provided general decommissioning requirements in a rule adopted on June 27, 1988.[3] In this rule, the NRC set forth technical and financial criteria for decommissioning licensed nuclear facilities. The regulations addressed planning needs, timing, funding methods, and environmental review requirements for decommissioning. The rule also defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB.

> DECON is defined as "the alternative in which the equipment, structures, and portions of a facility and site containing radioactive contaminants are removed or decontaminated to a level that permits the property to be released for unrestricted use shortly after cessation of operations."[4]
>
> 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."[5] Decommissioning is required 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."[6] As with the SAFSTOR alternative, decommissioning is currently required to be completed within 60 years, although longer time periods will also be considered when necessary to protect public health and safety.

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3 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

4 Ibid. Page FR24022, Column 3

5 Ibid.

6 Ibid. Page FR24023, Column 2

> 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 (e.g., on engineered barriers).
>
> In a draft regulatory basis document published in March 2017 in support of rulemaking that would amend NRC regulations concerning nuclear plant decommissioning, the NRC staff proposed removing any discussion of the ENTOMB option from existing guidance documents since the method is not deemed practically feasible.

In 1996, the NRC published revisions to its general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process.[7] The amendments allow for greater public participation and better define the transition process from operations to decommissioning. Regulatory Guide 1.184, issued in July 2000, (as revised in October 2013), further described the methods and procedures that are acceptable to the NRC staff for implementing the requirements of the 1996 revised rule that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and sequence in the amended regulations. The format and content of the estimates is also consistent with the recommendations of Regulatory Guide 1.202, issued February 2005.[8]

In 2011, the NRC issued regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy site.[9] The regulations require licensees to report additional details in their decommissioning cost estimate, including a decommissioning estimate for the ISFSI. This estimate is provided in Appendix E.

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7 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

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

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

Decommissioning Scenarios

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

1. The first scenario assumes that the plant would be promptly decommissioned (DECON alternative) upon the expiration of the current operating license, i.e., in 2045. All remaining spent fuel in the plant's spent fuel storage pool is transferred to the DOE or to the onsite ISFSI within the first four years. The equipment, structures, and portions of the plant containing radioactive contaminants are removed or decontaminated to a level that permits the facility to be released for unrestricted use. Site structures are then demolished. Spent fuel storage operations continue at the site until the transfer of the fuel from the ISFSI to the DOE is complete, assumed to be in the year 2078.

2. In the second scenario, the nuclear plant is placed into safe-storage (SAFSTOR alternative) at the end of its current operating license. All remaining spent fuel in the plant's spent fuel storage pool is transferred to the DOE or to the onsite ISFSI and the plant reconfigured for long-term storage. Spent fuel storage operations continue at the site until the transfer of the fuel from the ISFSI to the DOE is complete, assumed to be in the year 2078. Decommissioning operations commence in 2098, with the decontamination and dismantling of Wolf Creek completed in 2105, sixty years after the cessation of operations. Site structures are then demolished.

Methodology

The methodology used to develop the estimates follows the basic approach originally presented in the cost estimating guidelines[10] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference describes a unit cost factor method for estimating decommissioning activity costs. The unit cost factors used in this analysis incorporate site-specific costs and the latest available information about worker productivity in decommissioning.

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

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

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

Contingency

Consistent with cost estimating practice, contingencies are applied to the decontamination and dismantling costs developed as "specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur."[11] The cost elements in the estimates are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the plant.

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 Management

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is generally 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 Disposal Act" in 1980 and its Amendments of 1985, [12] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

With the exception of Texas, no new compact facilities have been successfully sited, licensed, and constructed. The Texas Compact disposal facility is now operational and

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

12 "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, January 15, 1986

waste is being accepted from generators within the Compact by the operator, Waste Control Specialists (WCS), located in Andrews, Texas. The facility is also able to accept limited quantities of non-Compact waste.

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

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

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

The DOE issued its final Environmental Impact Statement for the disposal of GTCC on January 2016.[14] The study evaluated the potential environmental impacts associated with constructing and operating a new facility or using an existing facility, disposal methods, and locations. DOE is awaiting Congressional action on the report and its recommendations. At this time, the federal government has not identified a specific cost for disposing of GTCC or a schedule for acceptance.

For purposes of this analysis only, the GTCC radioactive waste is assumed to be packaged and disposed of in a similar manner as high-level waste and at a cost equivalent to that envisioned for the spent fuel. The GTCC is packaged in canisters compatible with the spent fuel dry storage system and either stored on site or shipped directly to a federal facility as it is generated (depending upon the timing of the

13 Waste is classified in accordance with U.S. Code of Federal Regulations, Title 10, Part 61.55
14 "Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (DOE/EIS-0375)," January 2016

decommissioning and whether the spent fuel has been removed from the site prior to the start of decommissioning).

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 reflect the savings from waste recovery/volume reduction.

High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"[15] (NWPA) in 1982, assigning the federal government's long-standing responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. The DOE was to begin accepting spent fuel by January 31, 1998; however, to date no progress in the removal of spent fuel from commercial generating sites has been made.

Today, the country is at an impasse on high-level waste disposal, despite DOE's submittal of its License Application for a geologic repository to the NRC in 2008. The Obama administration eliminated the budget for the repository program while promising to "conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle … and make recommendations for a new plan."[16] Towards that goal, the Obama administration appointed a Blue Ribbon Commission on America's Nuclear Future (Blue Ribbon Commission) to make recommendations for a new plan for nuclear waste disposal. The Blue Ribbon Commission's charter included a requirement that it consider "[o]ptions for safe storage of used nuclear fuel while final disposition pathways are selected and deployed."[17]

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

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

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

17 Ibid.

- "[T]he United States [should] establish a program that leads to the timely development of one or more consolidated storage facilities"[18]
- "[T]he United States should undertake an integrated nuclear waste management program that leads to the timely development of one or more permanent deep geological facilities for the safe disposal of spent fuel and high-level nuclear waste."[19]

In January 2013, the DOE issued the "Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste," in response to the recommendations made by the Blue Ribbon Commission and as "a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel..."[20] This document states:

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

- Sites, designs and licenses, constructs and begins operations of a pilot interim storage facility by 2021 with an initial focus on accepting used nuclear fuel from shut-down reactor sites;
- Advances toward the siting and licensing of a larger interim storage facility to be available by 2025 that will have sufficient capacity to provide flexibility in the waste management system and allows for acceptance of enough used nuclear fuel to reduce expected government liabilities; and
- Makes demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository by 2048."[21]

The NRC's review of DOE's license application to construct a geologic repository at Yucca Mountain was suspended in 2011, when the Obama administration significantly reduced the budget for completing that work. However, the US Court of Appeals for the District of Columbia Circuit issued a writ of mandamus (in August 2013)[22] ordering NRC to comply with federal law and resume its review of DOE's Yucca Mountain repository license application to the extent allowed by previously

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

19 Ibid., p.27

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

21 Ibid., p.2

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

appropriated funding for the review. That review was completed with the publication of a five-volume safety evaluation report. A supplement to DOE's environmental impact statement and adjudicatory hearing on the contentions filed by interested parties must be completed before a licensing decision can be made. Although the DOE proposed it would start fuel acceptance in 2025, no progress has been made in the repository program since DOE's 2013 strategy was issued except for the completion of the Yucca Mountain safety evaluation report.

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

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

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

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program had originally 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.[23] However, the Blue Ribbon Commission, in its final report, noted that: "[A]ccepting spent fuel according to the OFF [Oldest Fuel First] priority ranking instead of giving priority to shutdown

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

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."

WCNOC's current spent fuel management plan for the Wolf Creek spent fuel is based in general upon: a 2031 start date for DOE initiating transfer of commercial spent fuel from the currently operating units to a licensed facility, and expectations for spent fuel receipt by the DOE for the Wolf Creek fuel.

Assuming the DOE starts accepting fuel from the currently operating plants in 2031, and from Wolf Creek in 2038, and a maximum rate of transfer of 3,000 metric tons of uranium (MTU)/year,[25] transfer of spent fuel from the ISFSI is anticipated to continue through the year 2078, if the plant ceases operating in 2045.

The NRC requires that licensees establish a program to manage and provide funding for the caretaking of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE.[24] Interim storage of the fuel, until the DOE has completed the transfer, will be in the fuel building's storage pool as well as at an on-site ISFSI.

The new ISFSI, operated under a Part 50 General License (in accordance with 10 CFR 72, Subpart K[25]), has been constructed to also support decommissioning operations. Spent fuel stored in the existing storage pool will be transferred to the DOE first, followed by transfer of the fuel in dry storage canisters at the ISFSI With the storage pool emptied, the fuel building can be either decontaminated and dismantled or prepared for long-term storage.

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

Sensitivity of Spent Fuel Management Assumptions

The estimates described in this analysis were developed with the assumption that the DOE would accept spent fuel from generators in the order in which it was generated or oldest fuel first, and that the ISFSI is used for interim storage, similar to what has occurred at recently decommissioned reactor sites. To support the decommissioning

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

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

program, the ISFSI would be used for the interim storage of the fuel so that decommissioning could proceed on the power block structures.

It should also be noted that the additional costs for purchase and operation of the ISFSI, 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.

If DOE is able to give priority to removing spent fuel from shutdown sites. the spent fuel could 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).

Appendix F evaluates such a scenario (i.e., where spent fuel is accepted from shutdown reactors first). The resulting costs for short-term fuel pool spent fuel management (summarized in Table F) are illustrative only and based upon current regulations and associated constraints that may change as a result of actions taken on the Blue Ribbon Commission's recommendations. However, the analysis described in Appendix F may prove useful as an alternate planning basis should changes occur in the policies involving the national solution for the disposition of spent fuel and high-level waste.

Site Restoration

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

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

Summary

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

Decommissioning is accomplished within the 60-year period required by current NRC regulations. In the interim, the spent fuel remains in storage at the site until such time that the transfer to a DOE facility is complete. Once emptied, the storage facility can also be decommissioned.

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 for the DECON and SAFSTOR alternatives are assigned to one of three subcategories: NRC License Termination (radiological remediation), 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 §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 License Termination cost subcategory also includes costs to decommission the ISFSI (as required by 10 CFR §72.30). Section 3.4.1 provides the basis for the ISFSI decommissioning cost.

The "Spent Fuel Management" subcategory is used to accumulate costs associated with the containerization and transfer of spent fuel from the wet storage pool to the DOE, as well as the eventual transfer of the spent fuel in storage at the ISFSI to the DOE. Costs are included for the operation of the storage pool and the management of the ISFSI until such time that the transfer is complete. It does not include any spent fuel management expenses incurred prior to the cessation of plant operations, nor does it include any costs related to the final disposal of the spent fuel.

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

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

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

As noted within this document, the estimates were developed and costs are presented in 2020 dollars. As such, the estimates do not reflect the escalation of costs (due to inflationary and market forces) over the remaining operating life of the plant or during the decommissioning period.

DECON COST SUMMARY
DECOMMISSIONING COST ELEMENTS
(thousands of 2020 dollars)

Cost Element	Total
Decontamination	16,487
Removal	124,532
Packaging	25,873
Transportation	13,667
Waste Disposal	97,223
Off-site Waste Processing	32,565
Program Management [1]	273,921
Site Security	236,859
Corporate Allocations	3,225
Spent Fuel Pool Isolation	14,576
Spent Fuel Management - Direct Costs [2]	109,651
Insurance and Regulatory Fees	37,634
Energy	11,388
Characterization and Licensing Surveys	21,278
Property Taxes	47,192
Miscellaneous Equipment	7,317
Total [3]	1,073,642

Cost Element	Total
License Termination	670,864
Spent Fuel Management	343,044
Site Restoration	59,734
Total [3]	1,073,642

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

SAFSTOR COST SUMMARY
DECOMMISSIONING COST ELEMENTS
(thousands of 2020 dollars)

Cost Element	Total
Decontamination	14,677
Removal	134,086
Packaging	18,393
Transportation	11,008
Waste Disposal	72,363
Off-site Waste Processing	36,405
Program Management [1]	425,082
Site Security	359,495
Corporate Allocations	5,887
Spent Fuel Pool Isolation	14,576
Spent Fuel Management - Direct Costs [2]	101,003
Insurance and Regulatory Fees	63,652
Energy	28,610
Characterization and Licensing Surveys	25,477
Property Taxes	75,009
Miscellaneous Equipment	25,264
Total [3]	1,410,987

Cost Element	Total
License Termination	1,050,876
Spent Fuel Management	298,581
Site Restoration	61,530
Total [3]	1,410,987

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

1. INTRODUCTION

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

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

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

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

1.1 OBJECTIVES OF STUDY

The objectives of this study are 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.

* References provided in Section 7 of the document

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

1.2 SITE DESCRIPTION

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

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

A power conversion system converts heat produced in the reactor to electrical energy. This system converts the thermal energy of the steam into mechanical shaft power and then into electrical energy. The turbine-generator is a tandem-compound, six-flow, four element, 1800-rpm unit. The unit consists of one high pressure and three low-pressure turbine elements driving a directly coupled generator. (The four turbine elements were replaced in 2010 with very similar equipment.) The turbine is operated in a closed feedwater cycle that condenses the steam; the feedwater is returned to the steam generators. Heat rejected in the main condensers is removed by the circulating water system.

The circulating water system supplies cooling water to the main condenser, condensing the steam exhausted from the turbine. A large cooling lake provides the heat sink required for removal of waste heat in the power plant's thermal cycle.

1.3 REGULATORY GUIDANCE

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

The rule defined three decommissioning alternatives as being acceptable to the NRC: DECON, SAFSTOR, and ENTOMB. The DECON alternative assumes that any contaminated or activated portion of the plant's systems, structures and facilities are removed or decontaminated to levels that permit the site to be released for unrestricted use shortly after the cessation of plant operations, while the SAFSTOR and ENTOMB alternatives defer the process.

The rule also placed limits on the time allowed to complete the decommissioning process. For all alternatives, 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. At the conclusion of a 60-year dormancy period (or longer 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 did re-evaluate the 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. The staff also found that additional rulemaking would be needed before this option could be treated as a generic alternative.

The NRC had considered rulemaking to alter the 60-year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments.[5] However, the NRC's staff has subsequently recommended that rulemaking be deferred, based upon several factors (e.g., no licensee has committed to pursuing the entombment option, the unresolved issues associated with the disposition of greater-than-Class C material (GTCC), and the NRC's current priorities), at least until after the additional research studies are complete. The Commission concurred with the staff's recommendation.

In a draft regulatory basis document published in March 2017 in support of rulemaking that would amend NRC regulations concerning nuclear plant decommissioning, the NRC staff proposes removing any discussion of the ENTOMB option from existing guidance documents since the method is not deemed practically feasible.

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

Under the revised regulations, licensees will submit written certification to the NRC within 30 days after the decision to cease operations. Certification will also be required once the fuel is permanently removed from the reactor vessel. Submittal of these notices, along with related changes to Technical Specifications, entitle the licensee to a fee reduction and eliminate the obligation to follow certain requirements needed only during operation of the reactor. Prior to or within 2 years following permanent cessation of operations, the licensee is required to submit a Post-Shutdown Decommissioning Activities Report (PSDAR) to the NRC, and a copy to the affected State(s) (10 CFR 50.82(a)(4)(i)). The PSDAR describes the planned decommissioning activities, the associated sequence and schedule, and an estimate of expected costs. Prior to completing decommissioning, the licensee is required to submit an application to the NRC to terminate the license, which includes a license termination plan (LTP).

In 2011, the NRC issued regulations to improve decommissioning planning and thereby reduce the likelihood that any current operating facility will become a legacy site.[7] The regulations require licensees to report additional details in their decommissioning cost estimate including a decommissioning estimate for the ISFSI. This estimate is provided in Appendix E.

1.3.1 High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act" (NWPA) in 1982,[8] 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. It was to begin accepting spent fuel by January 31, 1998; however, to date no progress in the removal of spent fuel from commercial generating sites has been made.

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

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

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

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

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

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

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

Holtec International submitted a license application to the NRC on March 30, 2017 for a consolidated interim spent fuel storage facility in southeast New Mexico called HI-STORE CIS (Consolidated Interim Storage) under

the provisions of 10 CFR Part 72. The application is currently under NRC review.

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

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

Completion of the decommissioning process is dependent upon the DOE's ability to remove spent fuel from the site in a timely manner. DOE's repository program had originally 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.[13] However, the Blue Ribbon Commission, in its final report, noted that: "[A]ccepting spent fuel according to the OFF [Oldest Fuel First] 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."

WCNOC's current spent fuel management plan for the Wolf Creek spent fuel is based in general upon: 1) a 2031 start date for DOE initiating transfer of commercial spent fuel to a federal facility, and 2) a 2038 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.[14] Transfer of spent fuel from the ISFSI is anticipated to continue through the year 2078, if the plant ceases operating in 2045.

The NRC requires that licensees establish a program to manage and provide funding for the caretaking of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE.[15] Interim storage of the fuel, until the DOE has completed the transfer, will be in the fuel building's storage pool as well as at an on-site ISFSI.

The new ISFSI, operated under a Part 50 General License (in accordance with 10 CFR 72, Subpart K[16]), has been constructed to also support decommissioning operations. Spent fuel stored in the existing storage pool will be transferred to the DOE first, followed by transfer of the fuel in dry storage canisters at the ISFSI. With the storage pool emptied, the fuel building can be either decontaminated and dismantled or prepared for long-term storage.

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

1.3.2 Low-Level Radioactive Waste Management

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[17] and its Amendments of 1985,[18] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

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

Disposition of the various waste streams produced by the decommissioning process considered all options and services currently

available to WCNOC. The majority of the low-level radioactive waste designated for controlled disposal (Class A[19]) can be sent to Energy*Solutions*' facility in Clive, Utah. Therefore, disposal costs for Class A waste were based upon WCNOC's "Long Term Waste Disposal Agreement" with Energy*Solutions*. This facility is not licensed to receive the higher activity portion (Classes B and C) of the decommissioning waste stream.

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

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

The DOE issued its final Environmental Impact Statement for the disposal of GTCC on January 2016.[20] The study evaluated the potential environmental impacts associated with constructing and operating a new facility or using an existing facility, disposal methods, and locations. DOE is awaiting Congressional action on the report and its recommendations. At this time, the federal government has not identified a specific cost for disposing of GTCC or a schedule for acceptance.

For purposes of this analysis only, the GTCC radioactive waste is assumed to be packaged and disposed of in a similar manner as high-level waste and at a cost equivalent to that envisioned for the spent fuel. The GTCC is packaged in canisters compatible with the spent fuel dry storage system and either stored on site or shipped directly to a federal facility as it is generated (depending upon the timing of the decommissioning and whether the spent fuel has been removed from the site prior to the start of decommissioning).

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 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,"[21] 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).[22] An additional and separate limit of 4 millirem per year, as defined in 40 CFR §141.16, is applied to drinking water.[23]

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)[24] 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 based upon the NRC-approved decommissioning alternatives DECON and SAFSTOR. Although the alternatives differ with respect to technique, process, cost, and schedule, they attain the same result: the ultimate release of the site for unrestricted use.

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

1. The first scenario assumes that the plant would be promptly decommissioned (DECON alternative) upon the expiration of the current operating license, i.e., in 2045. All remaining spent fuel in the plant's spent fuel storage pool is transferred to the DOE or to the onsite ISFSI within the first four years. The equipment, structures, and portions of the plant containing radioactive contaminants are removed or decontaminated to a level that permits the facility to be released for unrestricted use. Site structures are then demolished. Spent fuel storage operations continue at the site until the transfer of the fuel from the ISFSI to the DOE is complete, assumed to be in the year 2078.

2. In the second scenario, the nuclear plant is placed into safe-storage (SAFSTOR alternative) at the end of its current operating license. All remaining spent fuel in the plant's spent fuel storage pool is transferred to the DOE or to the onsite ISFSI and the plant reconfigured for long-term storage. Spent fuel storage operations continue at the site until the transfer of the fuel from the ISFSI to the DOE is complete, assumed to be in the year 2078. Decommissioning operations commence in 2098, with the decontamination and dismantling of Wolf Creek completed in 2105, sixty years after the cessation of operations. Site structures are then demolished.

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

2.1.1 Period 1 - Preparations

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

Engineering and Planning

The PSDAR, required prior to or within two years of permanent cessation of operations, provides a description of the licensee's planned decommissioning activities, a timetable, and the associated financial requirements of the intended decommissioning program. Upon receipt of the PSDAR, the NRC will make the document available to the public for comment in a local hearing to be held in the vicinity of the reactor site. Ninety days following submittal and NRC receipt of the PSDAR, the licensee may begin to perform major decommissioning activities under a

modified 10 CFR §50.59 procedure, i.e., without specific NRC approval. Major activities are defined as any activity that results in permanent removal of major radioactive components, permanently modifies the structure of the containment, or results in dismantling components (for shipment) containing GTCC, as defined by 10 CFR §61. Major components are further defined as comprising the reactor vessel and internals, large bore reactor coolant system piping, and other large components that are radioactive. The NRC includes the following additional criteria for use of the §50.59 process in decommissioning. The proposed activity must not:

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

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

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

Site Preparations

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

- Characterization of the site and surrounding environs. This includes radiation surveys of work areas, major components (including the

reactor vessel and its internals), internal piping, and primary shield cores.

- Isolation of the spent fuel storage pool and reactor systems, such that decommissioning operations can commence on the balance of the plant. Decommissioning operations are scheduled around the reactor areas to optimize the overall project schedule. The fuel is transferred to the DOE as allocations permit. Consequently, it is assumed that the fuel pool remains operational for approximately four years following the cessation operations.
- 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 release of the site from the 10 CFR §50 operating license, exclusive of the ISFSI. Significant decommissioning activities in this phase include:

- Construction of temporary facilities and/or modification of existing facilities to support dismantling activities. For example, this will 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 will include the upgrading of roads (on- and off-site) to facilitate hauling and transport. Modifications will be required to the containment structure to facilitate access of large/heavy equipment. Modifications will also be required to the refueling area of the reactor building to support the segmentation of the reactor vessel internals and component extraction.
- Procurement and installation of all required Dry Shielded Canisters (DSCs) and horizontal storage modules (HSMs) in the ISFSI for the storage of Wolf Creek spent fuel that-cannot be transferred directly to the DOE.

- Transfer of the spent fuel from the spent fuel pool to the DOE and/or ISFSI. The spent fuel pool at Wolf Creek is kept open for approximately four years after the cessation of plant operations. In the prompt decommissioning scenario, once the majority of the decontamination and dismantling activities have been completed (over the first five years), the site organization is configured and streamlined to support the remaining spent fuel transfer activities. With the pool emptied, management resources are remobilized to support the final site survey (exclusive of the ISFSI) and building demolition.
- 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 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 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.
- Removal of the contaminated equipment and material from the auxiliary and fuel buildings 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)."[25] This document incorporates the statistical approaches to survey design and data interpretation used by the EPA. It also identifies commercially available instrumentation and procedures for conducting radiological surveys. Use of this guidance ensures that the surveys are conducted in a manner that provides a high degree of confidence that applicable NRC criteria are satisfied. Once the survey is complete, the results are provided to the NRC in a format that can be verified. The NRC then reviews and evaluates the information, performs an independent confirmation of radiological site conditions, and makes a determination on the requested change to the operating license (that would release the property, exclusive of the ISFSI, for unrestricted use).

The NRC will amend 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 property (exclusive of the ISFSI) is suitable for release.

2.1.3 Period 3 - Site Restoration

Following completion of decommissioning operations, site restoration activities can begin. Efficient removal of the contaminated materials and verification that residual radionuclide concentrations are below the NRC limits will result in substantial damage to many of the structures. Although performed in a controlled, safe manner, blasting, coring, drilling, scarification (surface removal), and the other decontamination

activities will substantially degrade power block structures including the reactor, auxiliary, fuel, and radwaste buildings. Under certain circumstances, verifying that subsurface radionuclide concentrations meet NRC site release requirements will require removal of grade slabs and lower floors, potentially weakening footings and structural supports. This removal activity will be necessary for those facilities and plant areas where historical records, when available, indicate the potential for radionuclides having been present in the soil, where system failures have been recorded, or where it is required to confirm that subsurface process and drain lines were not breached over the operating life of the plant.

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

This cost study presumes that site structures and other 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.

2.1.4 ISFSI Operations and Decommissioning

Transfer of spent fuel to a DOE repository or interim facility is assumed to be exclusively from the ISFSI once the fuel pool has been emptied and the fuel building released for decommissioning. The ISFSI will continue to operate, for example, under a general license (10 CFR Part 50), following the amendment of the operating license to release the adjacent (power block) property.

Assuming the DOE starts accepting fuel from Wolf Creek in 2038, transfer of spent fuel from the ISFSI is anticipated to be completed by the year 2078.

At the conclusion of the spent fuel transfer process, the ISFSI will be decommissioned. The Commission will terminate the Part 50 license if it determines that the remediation of the ISFSI has been performed in accordance with an ISFSI license termination plan and that the final radiation survey and associated documentation demonstrate that the facility is suitable for release. Once the requirements are satisfied, the NRC can terminate the license for the ISFSI.

The design of the new ISFSI is based upon a transportable storage canister to house the spent fuel assemblies, and a horizontal storage module for pad storage. It is assumed that once the canisters containing the spent fuel assemblies have been removed, any required decontamination is performed on the storage modules (some minor neutron activation is assumed), and the license for the facility terminated, the modules can be dismantled using conventional techniques for the demolition of reinforced concrete. The concrete storage pad is then removed and the area regraded.

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 (the spent fuel pool will be operational for four years after shutdown). 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.
- Transferring the spent fuel from the storage pool to the DOE or to a newly constructed ISFSI, following the 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 including 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.

Consistent with the DECON scenario, the spent fuel storage pool is emptied within approximately four years from the cessation of operations. The pool is drained and decontaminated and prepared for long-term storage. The transfer of the spent fuel from the ISFSI to a DOE facility begins in 2050 and continues throughout the dormancy period until completed in 2078. Once emptied, the ISFSI is placed in storage and decommissioned along with the power block structures in Period 4.

An environmental surveillance program is carried out during the dormancy period to ensure that releases of radioactive material to the environment are prevented 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 are maintained throughout the dormancy period. Fire and radiation alarms are also monitored and maintained.

After a period of storage (such that license termination is accomplished within 60 years of final shutdown), it is required that the licensee submit an application to terminate the license, along with a 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 and the assembly of activity specifications and detailed work 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 dismantling process due to the operation of the spent fuel pool in the DECON option.

Radioactive decay over the length of the dormancy period will have some effect upon the quantities of radioactive wastes generated from system and structure removal operations. However, 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. 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 substantially 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 begin. Dismantling, as a continuation of the decommissioning process is a cost-effective option, as described in Section 2.1.3. The basis for the dismantling cost 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 ESTIMATES

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

3.1 BASIS OF ESTIMATES

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

3.2 METHODOLOGY

The methodology used to develop the estimates follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"[26] and the DOE "Decommissioning Handbook."[27] These documents present a unit factor method for estimating decommissioning activity costs, which simplifies the estimating calculations. Unit factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/inch) are developed using local labor rates. The activity-dependent costs are estimated with the item quantities (cubic yards and tons), developed from plant drawings and inventory documents. Removal rates and material costs for the conventional disposition of components and structures rely upon information available in the industry publication, "Building Construction Cost Data," published by RSMeans. [28]

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

Regulatory Guide 1.184[29] Revision 1, issued in October 2013, describes the methods and procedures that are acceptable to the NRC staff for implementing the requirements that relate to the initial activities and the major phases of the decommissioning process. The costs and schedules presented in this analysis follow the general guidance and sequence in the regulations. The format and content of the estimates is also consistent with the recommendations of Regulatory Guide 1.202,[30] issued February 2005.

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

Work Difficulty Factors

The estimates follow 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.

Work difficulty adjustment factors (WDFs) account for the inefficiencies in working in a power plant environment. The factors are assigned to each unique set of unit cost 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 labor-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. In the DECON alternative, dismantling of the fuel building systems and decontamination of the spent fuel pool is also dependent upon the timetable for the transfer of the spent fuel assemblies from the pool to the DOE and/or ISFSI.

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, spent fuel management and site restoration.

3.3.1 Contingency

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.

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"[31] 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 a contingency percentage 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 plant.

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

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

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

- Reactor Vessel Component Disposal 50%
- GTCC Disposal 15%

• Staffing	15%
• Spent Fuel Management	15%
• Non-Radioactive Component Removal	15%
• Heavy Equipment and Tooling	15%
• Supplies	25%
• Engineering	15%
• Energy	15%
• Insurance and Fees	10%
• Characterization and Termination Surveys	30%
• Operations and Maintenance Expense	15%
• Construction	15%
• Property Taxes	10%
• ISFSI Decommissioning	25%

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

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

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

3.4 SITE-SPECIFIC CONSIDERATIONS

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

3.4.1 Spent Fuel Management

The cost to dispose the spent fuel generated from plant operations is not reflected within the estimates to decommission Wolf Creek. Ultimate disposition of the spent fuel is within the province of the DOE's Waste Management System, as defined by the Nuclear Waste Policy Act. As such, until recently, the disposal cost was being financed by a 1 mill/kWhr surcharge on nuclear generated energy delivered to customers, the fee

being paid into the DOE's waste fund during operations. The D.C. Circuit ruling on November 19, 2013, ordered the DOE to submit a proposal to Congress to suspend the Nuclear Waste Fund fee "until such time as either the Secretary chooses to comply with the Act as it is currently written, or until Congress enacts an alternative waste management plan." The fee was reduced to 0.0 mill/kWh as of May 16, 2014. The fee is expected to be reinstated in the future.

The NRC does, however, require licensees to 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. This requirement is prepared for through inclusion of certain high-level waste cost elements within the estimates, as described below.

Completion of the decommissioning process is highly dependent upon the DOE's ability to remove spent fuel from the site. For planning purposes only, this estimate assumes that the currently shutdown sites will receive priority. WCNOC's current spent fuel management plan for the Wolf Creek spent fuel is based in general upon: 1) a 2031 start date for DOE initiating transfer of commercial spent fuel from the currently operating units to a licensed facility, and 2) expectations for spent fuel receipt by the DOE for the Wolf Creek fuel.

Assuming the DOE starts accepting fuel from the currently operating plants in 2031, and from Wolf Creek in 2038, and a maximum rate of transfer of 3,000 metric tons of uranium (MTU)/year,[32] transfer of spent fuel from the ISFSI is anticipated to continue through the year 2078, if the plant ceases operating in 2045.

ISFSI

The new ISFSI is designed to accommodate all fuel assemblies expected to be discharged by the Wolf Creek reactor. For purposes of this analysis only, the ISFSI would be sized to accommodate 2,439 Wolf Creek assemblies.

The ISFSI will be expected to operate throughout decommissioning, and beyond the conclusion of the remediation phase in the DECON decommissioning scenario, until such time that the transfer of spent fuel to the DOE can be completed. The scenario is similar for the SAFSTOR alternative; however, based upon the expected completion date for fuel transfer, the ISFSI will be emptied prior to the commencement of decommissioning operations.

Operation and maintenance costs for the spent fuel pool and the ISFSI are included within the estimates and address the cost for staffing the facility, as well as other costs (e.g., security, insurance, and licensing fees). The estimates also include the costs to transfer the transportable storage canisters to the DOE. Costs are also provided for the final disposition of the facilities once the transfer is complete.

Storage Canister Design

A horizontal dry storage system is used as a cost basis. The system consists of a transportable storage canister with a horizontal concrete storage module. A dry-storage canister capacity of 37 pressurized water reactor assemblies was assumed.

Canister Loading and Transfer

For fuel transferred directly from the pool to the DOE, the DOE was assumed to provide Transport, Aging and Disposal (TAD) canisters with a 21 assembly capacity for pressurized water reactor fuel. The TADs are assumed to be provided at no additional cost to the owner.

The estimates include the cost for the materials and labor to load, seal and transfer each spent fuel canister from the pool into either a DOE transport cask for off-site shipment or an on-site transporter for relocation to the ISFSI.

Operations and Maintenance

The estimates also include the cost of operating and maintaining the spent fuel pool and the ISFSI, respectively. Pool operations are expected to continue for approximately four years after the cessation of operations. ISFSI operating costs are based upon the previously stated assumptions on fuel transfer expectations.

ISFSI Decommissioning

In accordance with 10 CFR §72.30, licensees must have a proposed decommissioning plan for the ISFSI site and facilities that includes a cost estimate to implement. The plan should contain sufficient information on the proposed practices and procedures for the decontamination of the ISFSI and for the disposal of residual radioactive materials after all spent fuel, high-level radioactive waste, and reactor-related GTCC waste have been removed.

The Wolf Creek ISFSI storage modules are assumed to have some level of neutron-induced activation as a result of the long-term storage of the Wolf Creek fuel, i.e., to levels exceeding free-release limits. As an allowance for module remediation, six horizontal modules are assumed to have some level of neutron-induced activation (i.e., to levels exceeding free-release limits), equivalent to the number of modules required to accommodate the final core off load. The ISFSI pad is not expected to be contaminated and will be demolished accordingly, after a confirmation survey.

The cost estimate for decommissioning the ISFSI reflects: 1) the cost of an independent contractor performing the decommissioning activities; 2) an adequate contingency factor; and 3) the cost of meeting the criteria for unrestricted use. The cost summary for decommissioning the ISFSI is presented in Appendix E.

GTCC

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

It is assumed that the DOE would not accept this waste prior to completing the transfer of spent fuel. Therefore, until such time the DOE is ready to accept GTCC waste, it is reasonable to assume that this material would remain in storage at the Wolf Creek site (for the DECON alternative). In the SAFSTOR scenario, the GTCC material is shipped directly to a DOE facility as it is generated since the fuel has been removed from the site prior to the start of delayed dismantling.

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

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

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

It is not known whether this option will be available when the Wolf Creek plant 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 that 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. Disposal of the decontamination solution effluent is included within the estimate as a "process liquid waste" charge. In the SAFSTOR scenario, radionuclide decay is expected to provide the same benefit and, therefore, a chemical decontamination is not included.

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

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

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

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

Disposal costs are based upon the displaced volume and weight of the units. Each component is then loaded onto a rail car for transport to the disposal facility.

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.[33] The contaminated material will be packaged in Industrial Packages (IP-1, IP-2, or IP-3, as defined in subpart 10 CFR §173.411) for transport unless demonstrated to qualify as their own shipping containers. The reactor vessel and internal components are expected to be transported in accordance with 10 CFR Part 71, in Type B containers. 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.

Truck transport costs were developed from published tariffs from Tri-State Motor Transit.[34] based upon the mileage to the Energy*Solutions* facility in Clive, Utah and the Waste Control Specialist facility in Andrews County, Texas. Transportation costs for off-site waste processing are based upon the mileage to Oak Ridge, Tennessee. The disposal cost for the GTCC material is assumed to be inclusive of the transportation cost.

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, D, E, and F, 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 lowest level and 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) are based upon preliminary and indicative information on the cost for such from WCS.

Material exceeding Class C limits (limited to material closest to the reactor core and comprising less than 1% of the total waste volume) is generally not suitable for shallow-land disposal. This material is packaged in the same multi-purpose canisters used for spent fuel storage/transport.

3.4.7 Site Conditions Following Decommissioning

The NRC will amend or terminate the site license if 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. Building codes and environmental regulations will dictate the next step in the decommissioning process, as well as owner's own future plans for the site.

The major structures that may require decontamination or radiological remediation are the reactor, auxiliary, communication corridor, radwaste, and fuel buildings.

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

Concrete rubble generated from demolition activities is processed and made available as clean fill for the power block foundations; excess rubble is removed from the site and disposed of as construction debris. Soil is brought in to cap the power block excavations and to permit seeding for erosion control.

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

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

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

3.5 ASSUMPTIONS

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

3.5.1 Estimating Basis

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

The estimates rely upon the physical plant inventory that was the basis for the 2017 analysis (updated to reflect any material changes to the plant over the past three years).

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

3.5.2 Labor Costs

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

Personnel costs are based upon average salary information provided by WCNOC. Overhead costs are included for site and corporate support, reduced commensurate with the staffing of the project.

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

Security, while reduced from operating levels, is maintained throughout the decommissioning for access control, material control, and to safeguard the spent fuel (in accordance with the requirements of 10 CFR Part 37, Part 72, and Part 73).

Security levels are assumed to be maintained at “operating levels” for approximately 18 months after operations ceases. Additional reductions in force size are assumed when the pool is empty and with the completion of the decommissioning and site restoration activities.

A profile of the staffing levels for decommissioning, including contractors and craft, is provided in Figures 3.1 and 3.2 for the DECON and SAFSTOR scenarios, respectively. Utility staffing levels will gradually

decrease after completing the removal of physical systems. Staffing levels and management support will vary based upon the amount and type of decommissioning work. Craft manpower levels decrease after systems removal and structures decontamination and drop substantially during the license termination survey period. However, craft levels increase again during the site restoration period due to the work associated with structures demolition.

3.5.3 Design Conditions

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

The curie contents of the vessel and internals at final shutdown are derived from those listed in NUREG/CR-3474.[35] 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 NUREG/CR-0130[36] and NUREG/CR-0672,[37] and benchmarked to the long-lived values from NUREG/CR-3474.

Neutron activation of the containment building structure is assumed to be confined to the biological shield.

3.5.4 General

Transition Activities

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

- Drain and collect fuel oils, lubricating oils, and transformer oils for recycle and/or sale.
- Drain and collect acids, caustics, and other chemical stores for recycle and/or sale.

- Process operating waste inventories (i.e., the estimates do not address the disposition of any legacy wastes; the disposal of operating wastes during this initial period is not considered a decommissioning expense)..

Scrap and Salvage

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

It is assumed, for purposes of this analysis, that any value received from the sale of scrap generated in the dismantling process would be more than offset by the on-site processing costs. The dismantling techniques assumed in the decommissioning estimates do not include the additional cost for size reduction and preparation to meet "furnace ready" conditions. For example, the recovery of copper from electrical cabling may require the removal and disposition of any contaminated insulation, an added expense. With a volatile market, the potential profit margin in scrap recovery is highly speculative, regardless of the ability to free release this material. This assumption is an implicit recognition of scrap value in the disposal of clean metallic waste at no additional cost to the project.

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

Energy

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

Insurance

Costs for continuing coverage (nuclear liability and property insurance) following cessation of plant operations and during decommissioning are included and based upon current operating premiums. Reductions in premiums, throughout the decommissioning process, are based upon the guidance provided in SECY-00-0145, "Integrated Rulemaking Plan for Nuclear Power Plant Decommissioning."[38] The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

Emergency Planning

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

Severance Program

No severance program is included for the personnel in the decommissioning organization.

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 costs by year of expenditure as well as cost contributor (e.g., labor, materials, and waste disposal).

The tables in Appendices C and D provide additional detail. The cost elements in these tables are 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 plant'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 containerization and transfer of spent fuel from the wet storage pool to the DOE, as well as the eventual transfer of the spent fuel in storage at the ISFSI to the DOE. Costs are included for the operation of the storage pool and the management of the ISFSI until such time that the transfer is complete. It does not include any spent fuel management expenses incurred prior to the cessation of plant operations, nor does it include any costs related to the final disposal of the spent fuel. These costs are identified in Tables 3.1b and 3.2b.

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

It should be noted that the costs assigned to these subcategories are allocations. Delegation of cost elements is for the purposes of comparison (e.g., with NRC financial guidelines) or to permit specific financial treatment (e.g., Asset Retirement Obligation determinations). In reality, there can be considerable interaction between the activities in the three subcategories. For example, an

owner may decide to remove non-contaminated structures early in the project to improve access to highly contaminated facilities or plant components. In these instances, the non-contaminated removal costs could be reassigned from Site Restoration to an NRC License Termination support activity. However, in general, the allocations represent a reasonable accounting of those costs that can be expected to be incurred for the specific subcomponents of the total estimated program cost, if executed as described.

As discussed in Section 3.4.1, it is assumed that the DOE will not accept the GTCC waste prior to completing the transfer of spent fuel. Therefore, the cost of GTCC disposal is shown in the final year of ISFSI operation (for the DECON alternative). While designated for disposal at a federal facility 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 2020 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
TOTAL ANNUAL EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	61,722	2,188	1,919	35	10,644	76,509
2046	84,987	22,874	3,523	16,229	28,077	155,689
2047	84,155	38,904	2,248	40,496	14,625	180,428
2048	86,834	40,771	1,981	38,053	13,695	181,333
2049	54,643	13,176	1,038	13,882	7,557	90,297
2050	32,810	6,270	388	22	4,897	44,386
2051	24,418	13,174	237	0	6,283	44,112
2052	8,674	2,372	30	0	3,595	14,670
2053	6,290	531	0	0	3,197	10,018
2054	6,290	531	0	0	3,197	10,018
2055	6,356	728	0	0	3,197	10,281
2056	6,307	531	0	0	3,206	10,044
2057	6,290	531	0	0	3,197	10,018
2058	6,356	728	0	0	3,197	10,281
2059	6,290	531	0	0	3,197	10,018
2060	6,307	531	0	0	3,206	10,044
2061	6,356	728	0	0	3,197	10,281
2062	6,290	531	0	0	3,197	10,018
2063	6,290	531	0	0	3,197	10,018
2064	6,373	729	0	0	3,206	10,307
2065	6,290	531	0	0	3,197	10,018
2066	6,290	531	0	0	3,197	10,018
2067	6,356	728	0	0	3,197	10,281
2068	6,307	531	0	0	3,206	10,044
2069	6,356	728	0	0	3,197	10,281
2070	6,159	136	0	0	3,197	9,492
2071	6,159	136	0	0	3,197	9,492
2072	6,176	137	0	0	3,206	9,518
2073	6,159	136	0	0	3,197	9,492
2074	6,159	136	0	0	3,197	9,492

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2075	6,159	136	0	0	3,197	9,492
2076	6,176	137	0	0	3,206	9,518
2077	6,159	136	0	0	3,197	9,492
2078	6,159	1,568	0	0	19,813	27,541
2079	1,401	761	25	4,450	4,052	10,689
Total	602,502	153,361	11,388	113,167	193,224	1,073,642

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	61,115	1,885	1,919	35	8,491	73,446
2046	81,962	19,165	3,523	16,229	25,616	146,494
2047	78,651	30,286	2,248	40,496	12,601	164,283
2048	79,491	24,673	1,981	38,053	11,667	155,864
2049	48,030	9,064	1,038	13,882	6,322	78,337
2050	20,058	1,299	302	22	2,236	23,917
2051	145	0	0	0	785	929
2052	18	0	0	0	99	117
2053-77	0	0	0	0	0	0
2078	234	1,429	0	0	16,691	18,355
2079	890	231	17	4,450	3,532	9,120
Total	370,596	88,032	11,029	113,167	88,040	670,864

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	101	302	0	0	2,153	2,556
2046	1,219	3,658	0	0	2,461	7,339
2047	2,817	8,452	0	0	2,023	13,292
2048	5,319	15,957	0	0	2,029	23,304
2049	6,324	4,089	0	0	1,236	11,648
2050	6,234	356	86	0	1,524	8,200
2051	6,249	411	237	0	2,358	9,255
2052	6,384	763	30	0	3,100	10,277
2053	6,290	531	0	0	3,197	10,018
2054	6,290	531	0	0	3,197	10,018
2055	6,356	728	0	0	3,197	10,281
2056	6,307	531	0	0	3,206	10,044
2057	6,290	531	0	0	3,197	10,018
2058	6,356	728	0	0	3,197	10,281
2059	6,290	531	0	0	3,197	10,018
2060	6,307	531	0	0	3,206	10,044
2061	6,356	728	0	0	3,197	10,281
2062	6,290	531	0	0	3,197	10,018
2063	6,290	531	0	0	3,197	10,018
2064	6,373	729	0	0	3,206	10,307
2065	6,290	531	0	0	3,197	10,018
2066	6,290	531	0	0	3,197	10,018
2067	6,356	728	0	0	3,197	10,281
2068	6,307	531	0	0	3,206	10,044
2069	6,356	728	0	0	3,197	10,281
2070	6,159	136	0	0	3,197	9,492
2071	6,159	136	0	0	3,197	9,492
2072	6,176	137	0	0	3,206	9,518
2073	6,159	136	0	0	3,197	9,492
2074	6,159	136	0	0	3,197	9,492

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2075	6,159	136	0	0	3,197	9,492
2076	6,176	137	0	0	3,206	9,518
2077	6,159	136	0	0	3,197	9,492
2078	5,925	139	0	0	3,122	9,186
2079	0	0	0	0	0	0
Total	197,270	45,431	352	0	99,991	343,044

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	506	0	0	0	0	506
2046	1,805	51	0	0	0	1,856
2047	2,686	166	0	0	0	2,853
2048	2,024	141	0	0	0	2,165
2049	289	23	0	0	0	312
2050	6,518	4,616	0	0	1,136	12,270
2051	18,025	12,763	0	0	3,141	33,928
2052	2,272	1,608	0	0	396	4,276
2053-78	0	0	0	0	0	0
2079	511	530	8	0	520	1,569
Total	34,636	19,898	8	0	5,192	59,734

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	52,364	1,718	1,919	35	10,426	66,462
2046	55,837	11,673	1,786	1,435	25,918	96,649
2047	31,639	12,955	473	17	7,478	52,561
2048	31,726	12,990	475	17	7,498	52,705
2049	13,524	2,748	281	10	3,982	20,544
2050	9,433	763	237	8	3,167	13,607
2051	9,433	763	237	8	3,167	13,607
2052	9,524	961	237	8	3,175	13,905
2053	9,433	763	237	8	3,167	13,607
2054	9,433	763	237	8	3,167	13,607
2055	9,498	960	237	8	3,167	13,870
2056	9,458	764	237	8	3,175	13,642
2057	9,433	763	237	8	3,167	13,607
2058	9,498	960	237	8	3,167	13,870
2059	9,433	763	237	8	3,167	13,607
2060	9,458	764	237	8	3,175	13,642
2061	9,498	960	237	8	3,167	13,870
2062	9,433	763	237	8	3,167	13,607
2063	9,433	763	237	8	3,167	13,607
2064	9,524	961	237	8	3,175	13,905
2065	9,433	763	237	8	3,167	13,607
2066	9,433	763	237	8	3,167	13,607
2067	9,498	960	237	8	3,167	13,870
2068	9,458	764	237	8	3,175	13,642
2069	9,498	960	237	8	3,167	13,870
2070	9,433	763	237	8	3,167	13,607
2071	9,433	763	237	8	3,167	13,607
2072	9,524	961	237	8	3,175	13,905
2073	9,433	763	237	8	3,167	13,607
2074	9,433	763	237	8	3,167	13,607

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2075	9,498	960	237	8	3,167	13,870
2076	9,458	764	237	8	3,175	13,642
2077	9,433	763	237	8	3,167	13,607
2078	9,367	566	237	8	3,167	13,344
2079	4,217	359	237	7	1,787	6,606
2080	4,228	360	237	7	1,791	6,625
2081	4,217	359	237	7	1,787	6,606
2082	4,217	359	237	7	1,787	6,606
2083	4,217	359	237	7	1,787	6,606
2084	4,228	360	237	7	1,791	6,625
2085	4,217	359	237	7	1,787	6,606
2086	4,217	359	237	7	1,787	6,606
2087	4,217	359	237	7	1,787	6,606
2088	4,228	360	237	7	1,791	6,625
2089	4,217	359	237	7	1,787	6,606
2090	4,217	359	237	7	1,787	6,606
2091	4,217	359	237	7	1,787	6,606
2092	4,228	360	237	7	1,791	6,625
2093	4,217	359	237	7	1,787	6,606
2094	4,217	359	237	7	1,787	6,606
2095	4,217	359	237	7	1,787	6,606
2096	4,228	360	237	7	1,791	6,625
2097	4,217	359	237	7	1,787	6,606
2098	9,653	902	517	20	1,858	12,950
2099	46,241	4,798	2,366	96	2,361	55,862
2100	55,908	23,352	2,292	25,763	14,706	122,022
2101	56,031	26,727	2,122	33,521	17,908	136,309
2102	47,919	8,986	1,775	12,748	6,848	78,275
2103	47,919	8,986	1,775	12,748	6,848	78,275
2104	38,982	4,954	1,020	5,363	4,374	54,693

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2105	21,175	10,952	281	6	4,126	36,542
2106	12,562	8,818	160	0	3,037	24,577
Total	875,901	171,103	28,610	92,147	243,227	1,410,987

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	52,263	1,416	1,919	35	8,272	63,906
2046	52,338	6,795	1,786	1,435	23,457	85,811
2047	21,393	530	473	17	5,455	27,867
2048	21,451	531	475	17	5,470	27,943
2049	6,630	399	281	10	2,746	10,066
2050	3,189	368	237	8	2,115	5,917
2051	3,189	368	237	8	2,115	5,917
2052	3,198	370	237	8	2,120	5,933
2053	3,189	368	237	8	2,115	5,917
2054	3,189	368	237	8	2,115	5,917
2055	3,189	368	237	8	2,115	5,917
2056	3,198	370	237	8	2,120	5,933
2057	3,189	368	237	8	2,115	5,917
2058	3,189	368	237	8	2,115	5,917
2059	3,189	368	237	8	2,115	5,917
2060	3,198	370	237	8	2,120	5,933
2061	3,189	368	237	8	2,115	5,917
2062	3,189	368	237	8	2,115	5,917
2063	3,189	368	237	8	2,115	5,917
2064	3,198	370	237	8	2,120	5,933
2065	3,189	368	237	8	2,115	5,917
2066	3,189	368	237	8	2,115	5,917
2067	3,189	368	237	8	2,115	5,917
2068	3,198	370	237	8	2,120	5,933
2069	3,189	368	237	8	2,115	5,917
2070	3,189	368	237	8	2,115	5,917
2071	3,189	368	237	8	2,115	5,917
2072	3,198	370	237	8	2,120	5,933
2073	3,189	368	237	8	2,115	5,917
2074	3,189	368	237	8	2,115	5,917

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2075	3,189	368	237	8	2,115	5,917
2076	3,198	370	237	8	2,120	5,933
2077	3,189	368	237	8	2,115	5,917
2078	3,189	368	237	8	2,115	5,917
2079	4,217	359	237	7	1,787	6,606
2080	4,228	360	237	7	1,791	6,625
2081	4,217	359	237	7	1,787	6,606
2082	4,217	359	237	7	1,787	6,606
2083	4,217	359	237	7	1,787	6,606
2084	4,228	360	237	7	1,791	6,625
2085	4,217	359	237	7	1,787	6,606
2086	4,217	359	237	7	1,787	6,606
2087	4,217	359	237	7	1,787	6,606
2088	4,228	360	237	7	1,791	6,625
2089	4,217	359	237	7	1,787	6,606
2090	4,217	359	237	7	1,787	6,606
2091	4,217	359	237	7	1,787	6,606
2092	4,228	360	237	7	1,791	6,625
2093	4,217	359	237	7	1,787	6,606
2094	4,217	359	237	7	1,787	6,606
2095	4,217	359	237	7	1,787	6,606
2096	4,228	360	237	7	1,791	6,625
2097	4,217	359	237	7	1,787	6,606
2098	9,567	902	517	20	1,858	12,863
2099	45,445	4,798	2,366	96	2,361	55,066
2100	54,080	23,269	2,292	25,763	14,706	120,111
2101	54,317	26,611	2,122	33,521	17,908	134,479
2102	46,712	8,915	1,775	12,748	6,848	76,997
2103	46,712	8,915	1,775	12,748	6,848	76,997
2104	38,476	4,924	1,020	5,363	4,374	54,157

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2105	6,238	385	89	6	487	7,206
2106	98	0	0	0	0	98
Total	628,432	105,917	28,258	92,147	196,122	1,050,876

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	101	302	0	0	2,153	2,556
2046	3,499	4,877	0	0	2,461	10,838
2047	10,246	12,425	0	0	2,023	24,694
2048	10,274	12,459	0	0	2,029	24,762
2049	6,894	2,349	0	0	1,236	10,478
2050	6,244	394	0	0	1,052	7,690
2051	6,244	394	0	0	1,052	7,690
2052	6,326	592	0	0	1,055	7,973
2053	6,244	394	0	0	1,052	7,690
2054	6,244	394	0	0	1,052	7,690
2055	6,309	592	0	0	1,052	7,953
2056	6,260	394	0	0	1,055	7,710
2057	6,244	394	0	0	1,052	7,690
2058	6,309	592	0	0	1,052	7,953
2059	6,244	394	0	0	1,052	7,690
2060	6,260	394	0	0	1,055	7,710
2061	6,309	592	0	0	1,052	7,953
2062	6,244	394	0	0	1,052	7,690
2063	6,244	394	0	0	1,052	7,690
2064	6,326	592	0	0	1,055	7,973
2065	6,244	394	0	0	1,052	7,690
2066	6,244	394	0	0	1,052	7,690
2067	6,309	592	0	0	1,052	7,953
2068	6,260	394	0	0	1,055	7,710
2069	6,309	592	0	0	1,052	7,953
2070	6,244	394	0	0	1,052	7,690
2071	6,244	394	0	0	1,052	7,690
2072	6,326	592	0	0	1,055	7,973
2073	6,244	394	0	0	1,052	7,690
2074	6,244	394	0	0	1,052	7,690

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2075	6,309	592	0	0	1,052	7,953
2076	6,260	394	0	0	1,055	7,710
2077	6,244	394	0	0	1,052	7,690
2078	6,178	197	0	0	1,052	7,427
2079-2106	0	0	0	0	0	0
Total	212,722	45,431	0	0	40,428	298,581

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

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045-97	0	0	0	0	0	0
2098	86	0	0	0	0	86
2099	796	0	0	0	0	796
2100	1,828	83	0	0	0	1,911
2101	1,714	116	0	0	0	1,830
2102	1,207	71	0	0	0	1,278
2103	1,207	71	0	0	0	1,278
2104	506	30	0	0	0	536
2105	14,937	10,567	192	0	3,639	29,336
2106	12,464	8,818	160	0	3,037	24,480
Total	34,746	19,755	352	0	6,676	61,530

FIGURE 3.1
DECOMMISSIONING PERSONNEL LEVELS
DECON

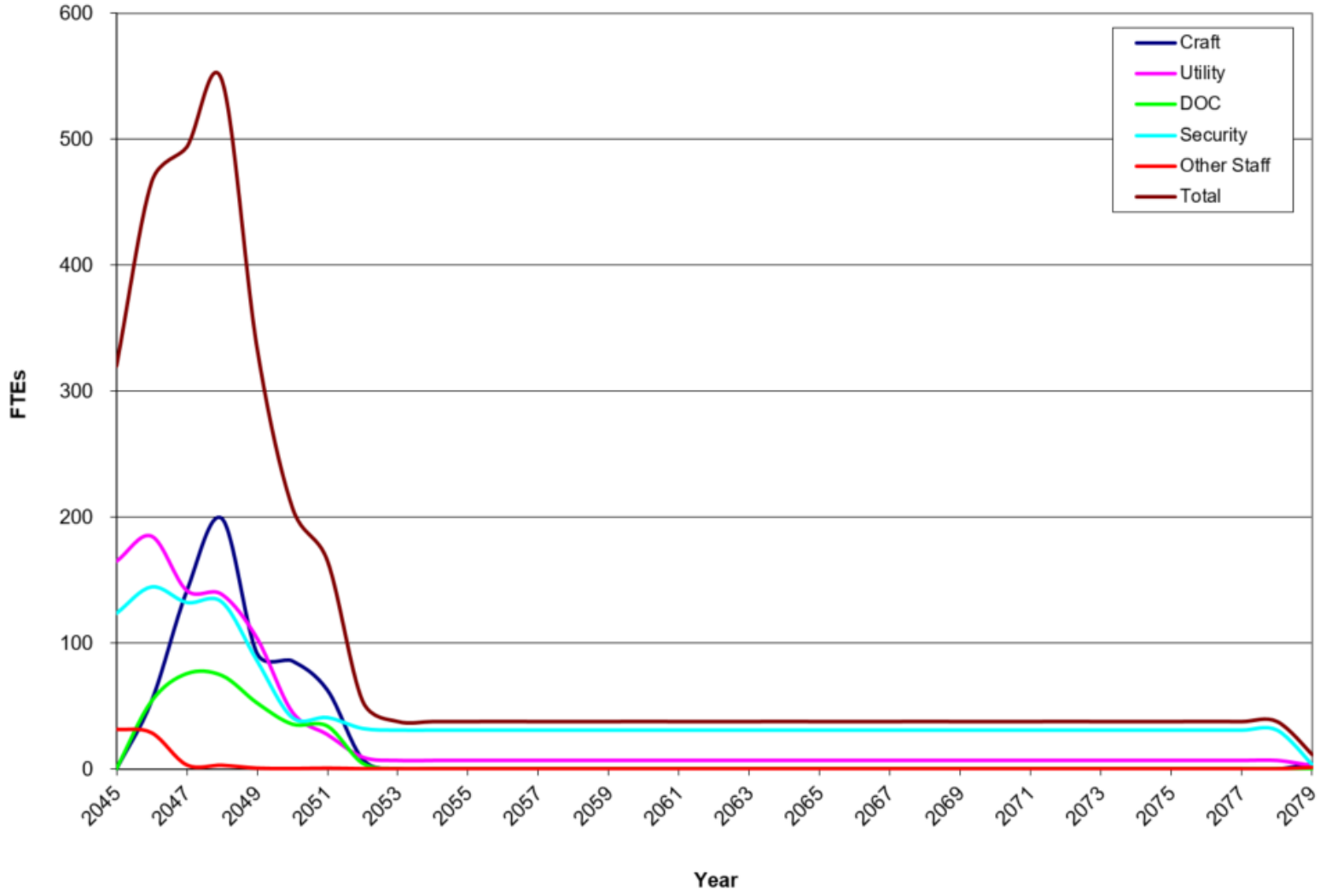
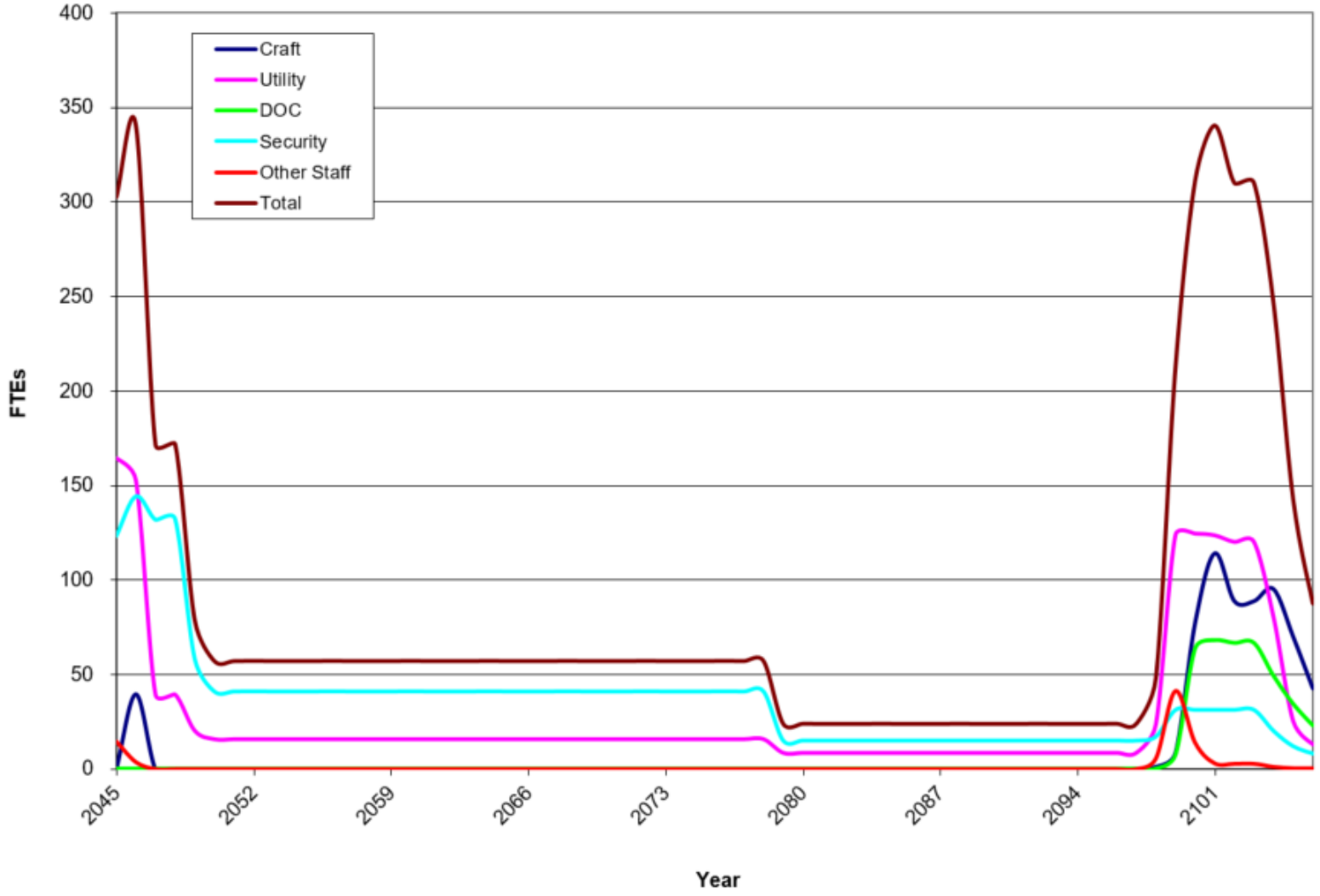


FIGURE 3.2
DECOMMISSIONING PERSONNEL LEVELS
SAFSTOR



4. SCHEDULE ESTIMATE

The schedules for the decommissioning scenarios considered in this analysis 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 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 is based on the fuel being removed from the spent fuel pool within approximately four years. The key activities listed in the schedule do not reflect a one-to-one correspondence with those activities in the cost tables, but reflect dividing some activities for clarity and combining others for convenience. The schedule was prepared using the "Microsoft Project Professional" computer software. [39]

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:

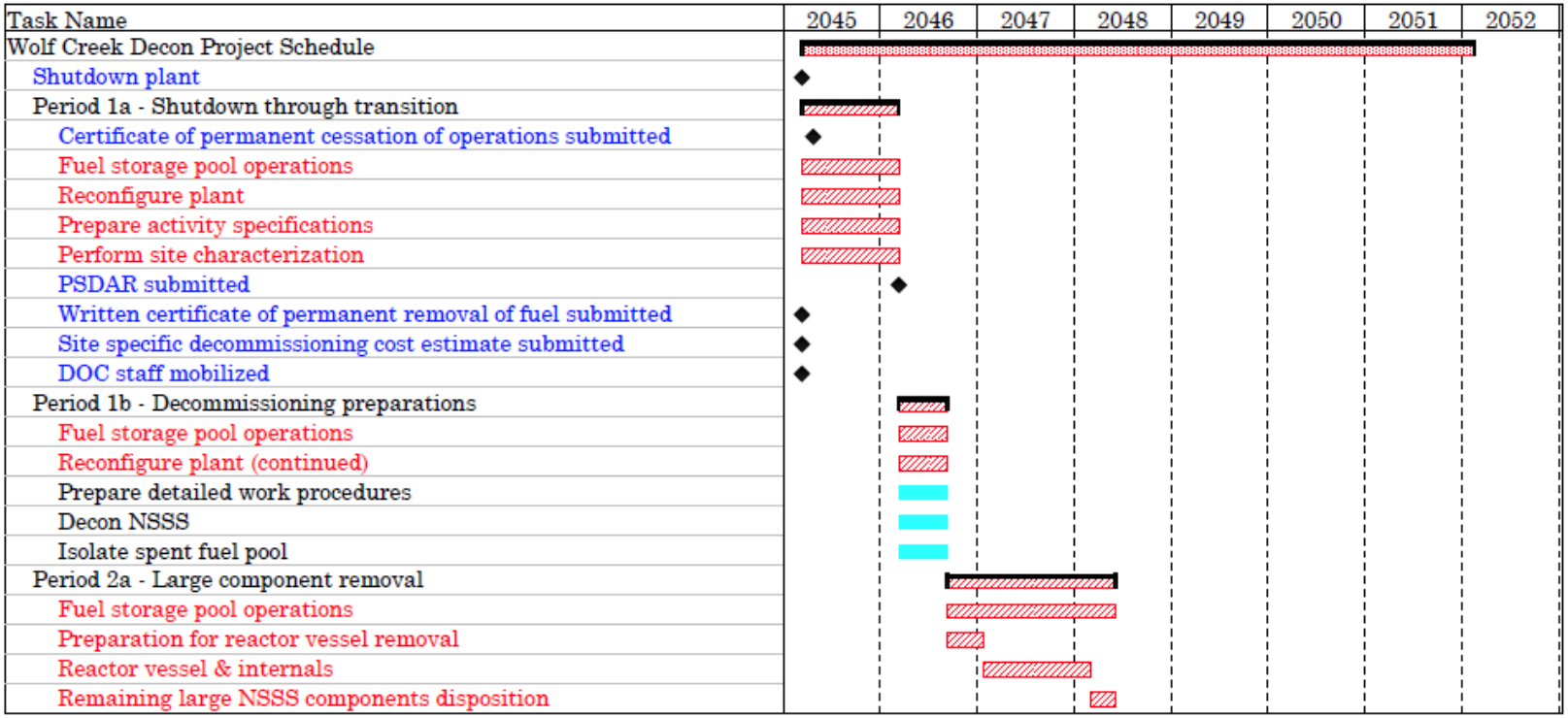
- The fuel building is isolated until such time that all spent fuel has been discharged from the spent fuel pool to the DOE and/or ISFSI. Decontamination and dismantling of the storage pool is initiated once the transfer of spent fuel is complete (DECON option).
- All work (except vessel and internals removal) is performed during an 8-hour workday, 5 days per week, with no overtime.
- 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.

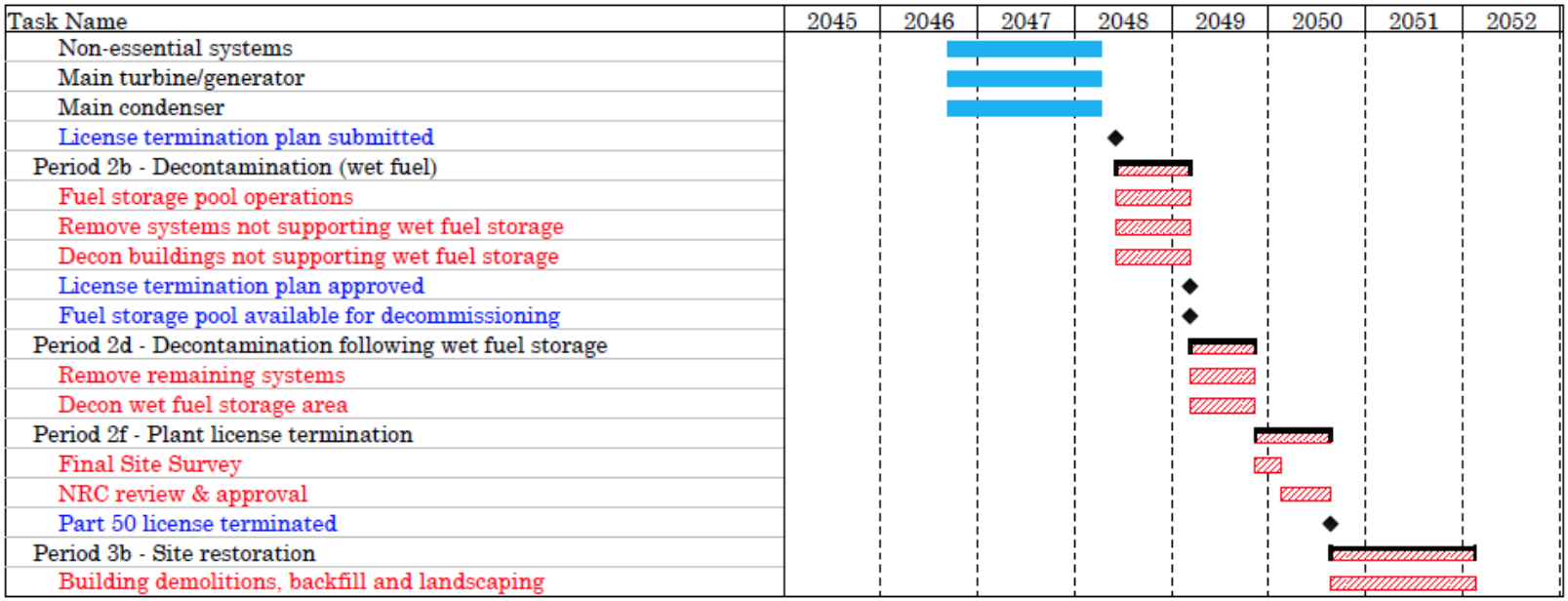
Project timelines are provided in Figures 4.2 and 4.3, with milestone dates based on the 2045 shutdown date. The fuel pool is emptied approximately four years after shutdown, while ISFSI operations continue until the DOE can complete the transfer of assemblies. Deferred decommissioning in the SAFSTOR scenario 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



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

FIGURE 4.1
ACTIVITY SCHEDULE
(continued)



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

FIGURE 4.2
DECOMMISSIONING TIMELINE
DECON
(not to scale)

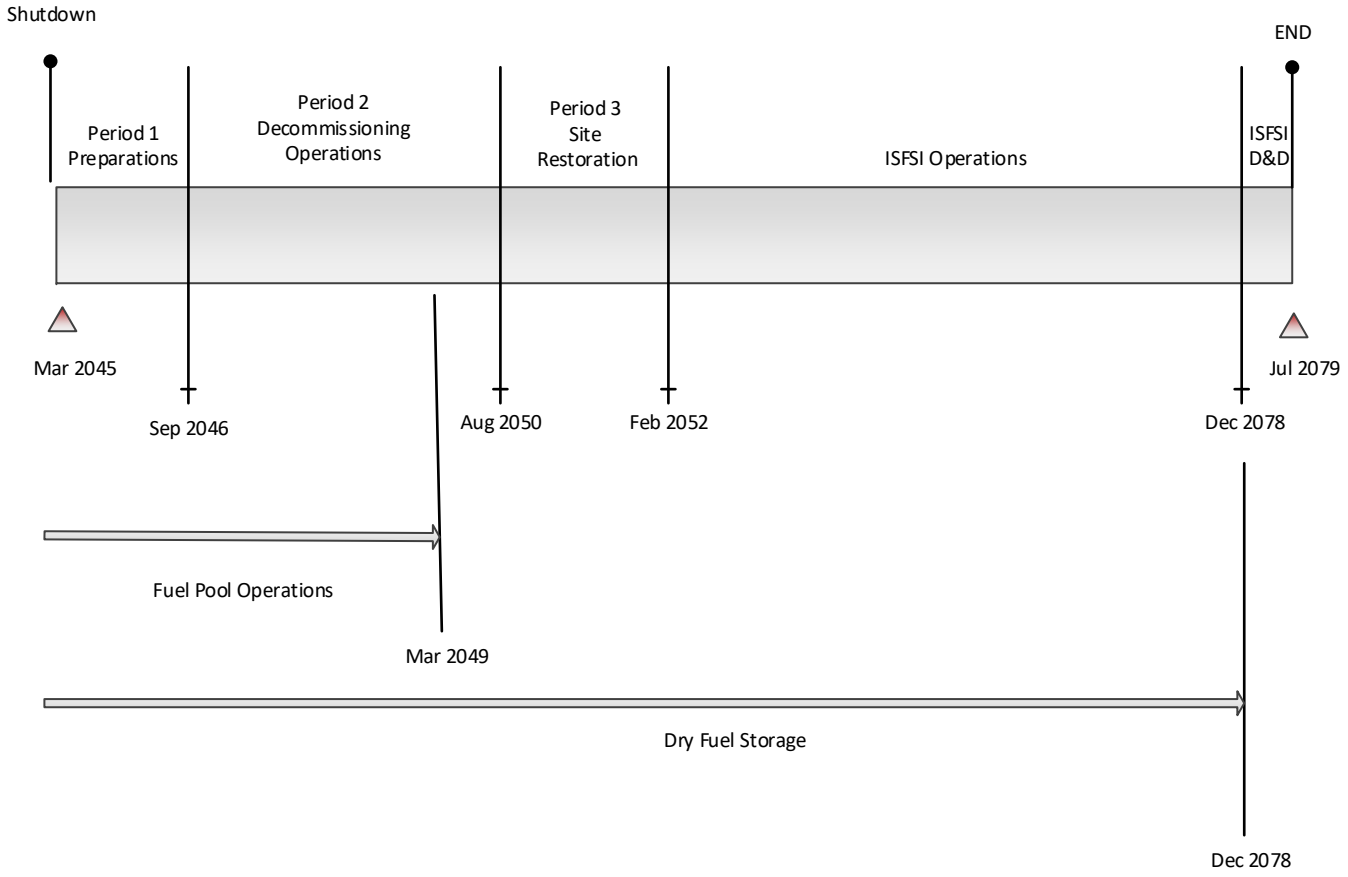
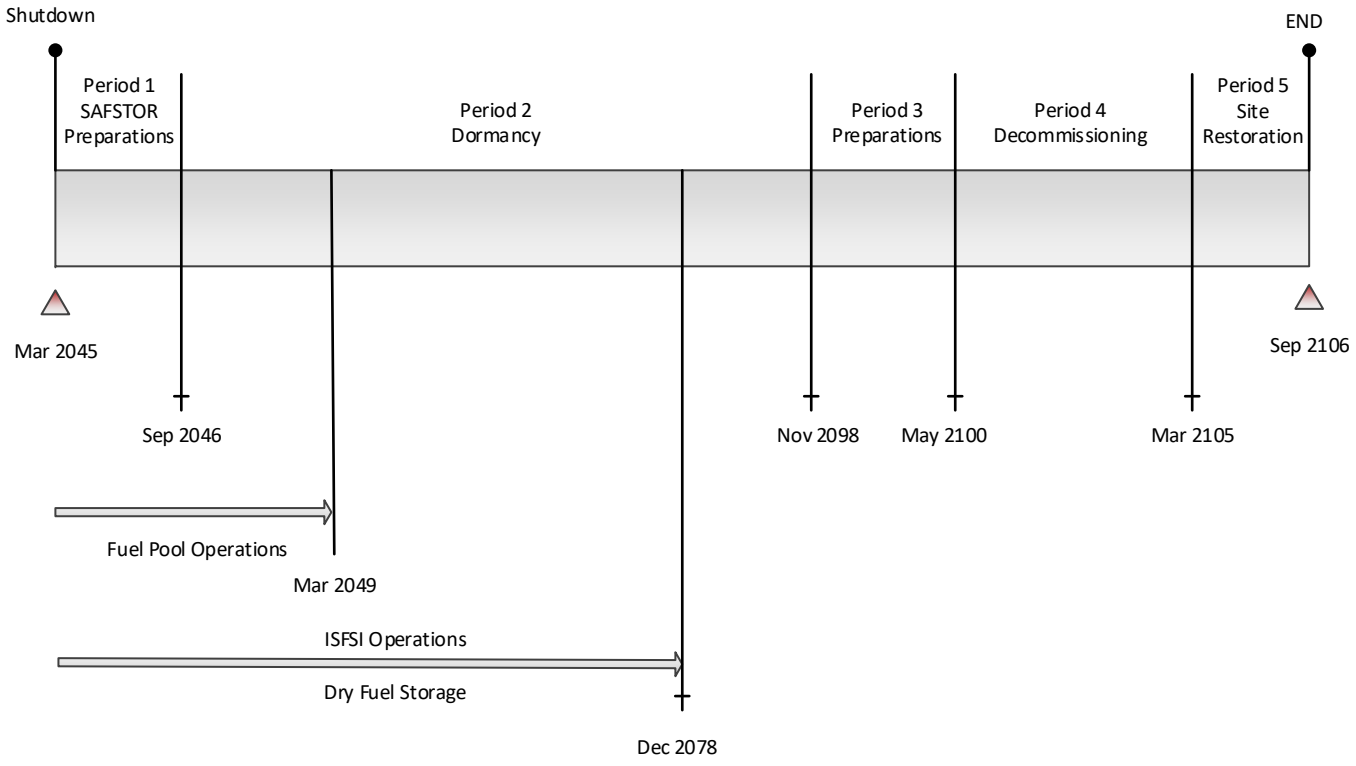


FIGURE 4.3
DECOMMISSIONING TIMELINE
SAFSTOR



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

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

The destinations for the various waste streams from decommissioning are identified in Figures 5.1 and 5.2. The volumes are shown on a line-item basis in Appendices C and D and summarized in Tables 5.1 and 5.2. 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 casks.

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

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

Disposal costs for Class A waste were based upon information provided by Wolf Creek. 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 preliminary and indicative rates for WCS's Andrews County disposal facility.

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

FIGURE 5.1
RADIOACTIVE WASTE DISPOSITION

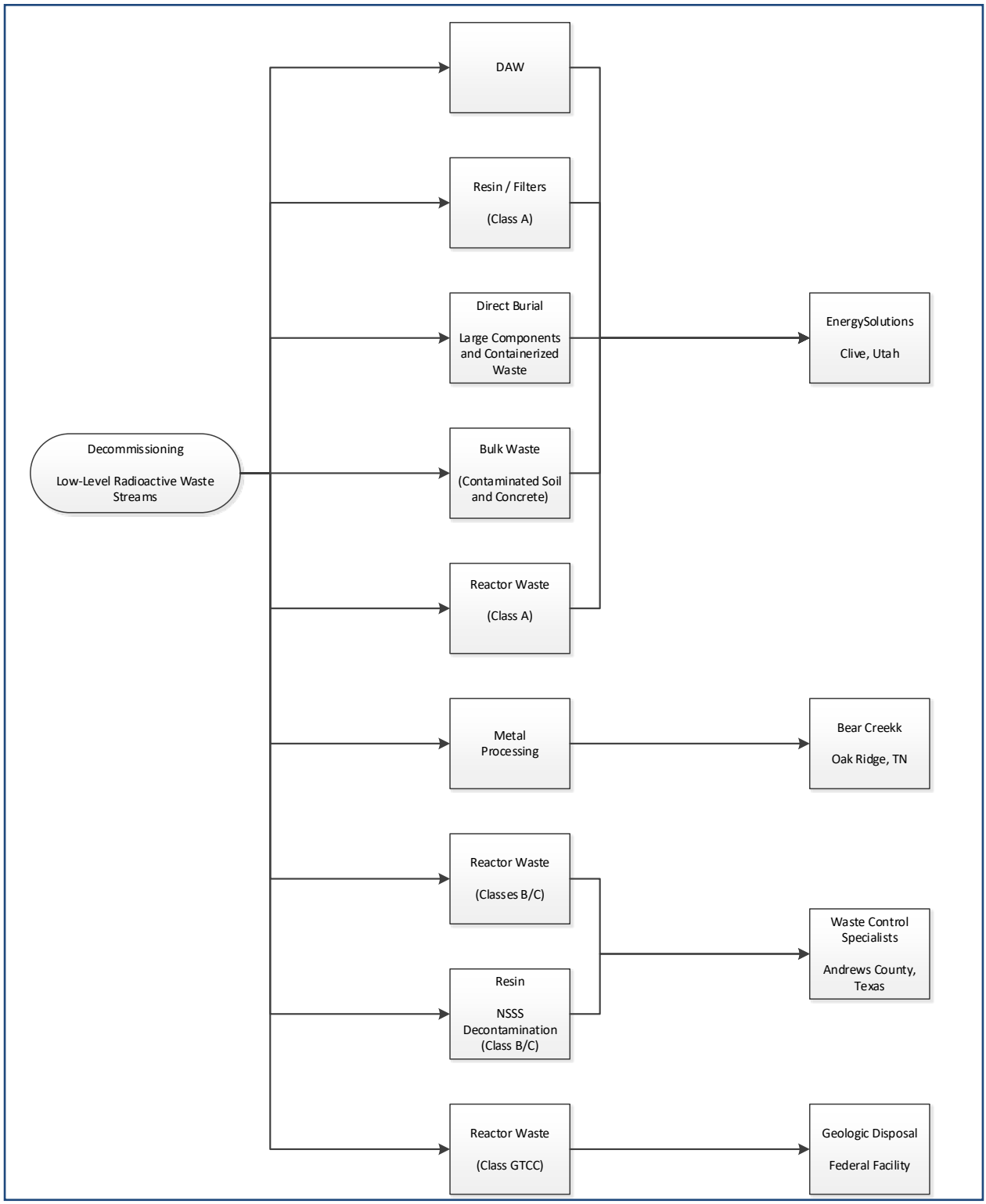


FIGURE 5.2
DECOMMISSIONING WASTE DESTINATIONS
RADIOLOGICAL

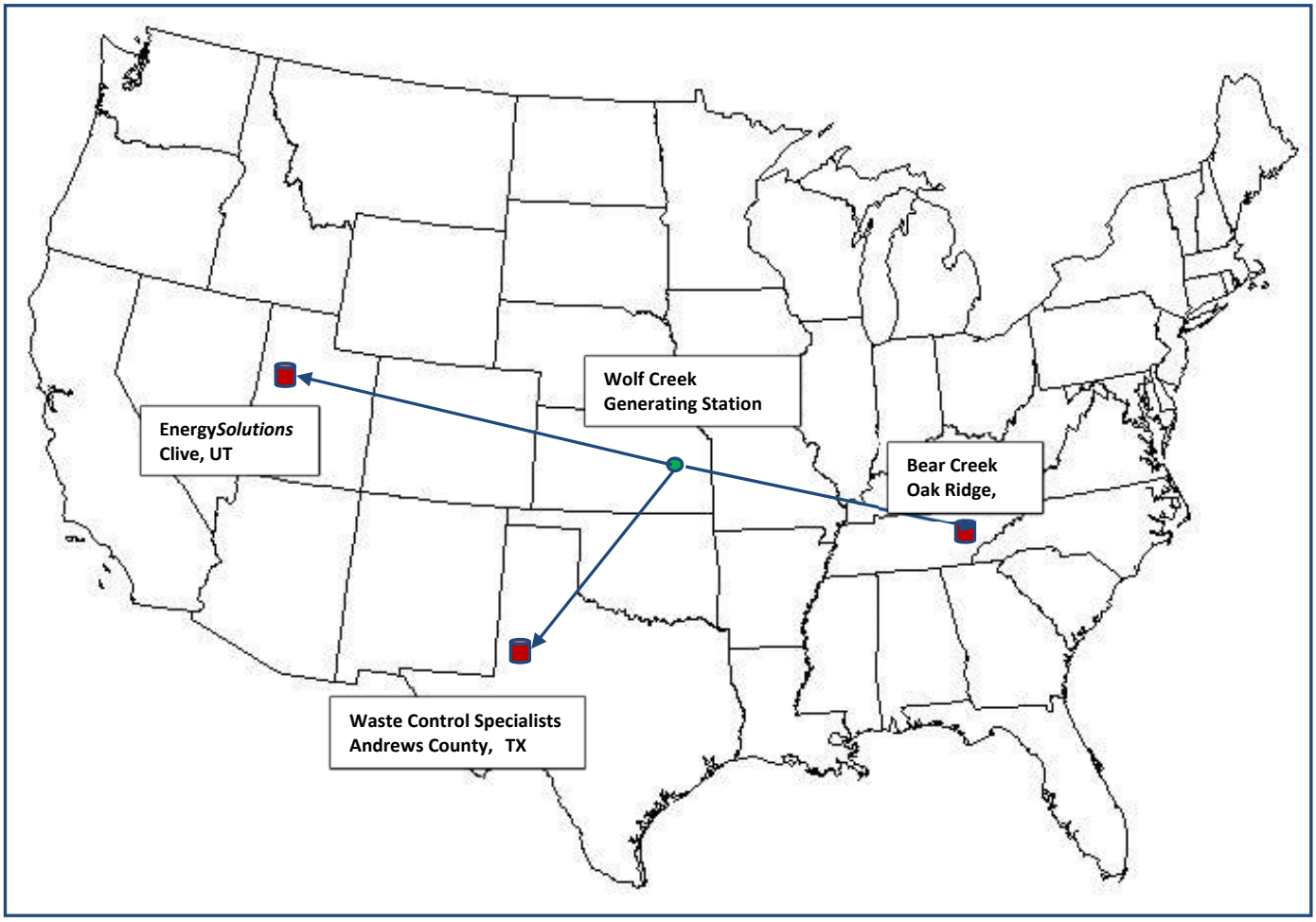


TABLE 5.1
DECON ALTERNATIVE
DECOMMISSIONING WASTE SUMMARY

Waste	Cost Basis	Class [1]	Waste Volume (cubic feet)	Mass (pounds)
Low-Level Radioactive Waste (near-surface disposal)	Energy*Solutions*	A	171,255	12,539,267
	WCS	B	1,750	191,469
	WCS	C	393	47,411
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,217	433,180
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	264,421	9,941,940
Totals [2]			440,035	23,153,268

[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	171,861	12,538,829
	WCS	B	1,750	191,469
	WCS	C	393	47,411
Greater than Class C (geologic repository)	Spent Fuel Equivalent	GTCC	2,217	433,180
Processed/Conditioned (off-site recycling center)	Recycling Vendors	A	264,421	9,941,940
Totals [2]			440,641	23,152,830

[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 2017. While not an engineering study, the estimates provide the owner with sufficient information to assess their financial obligations, as they pertain to the eventual decommissioning of the nuclear station.

The estimates described in this report are based on numerous fundamental assumptions, including regulatory requirements, project contingencies, low-level radioactive waste disposal practices, high-level radioactive waste management options, and site restoration requirements. The decommissioning scenarios assume continued operation of the plant's spent fuel pool for a minimum of approximately four years following the cessation of operations for continued cooling of the assemblies.

The cost projected to promptly decommission (DECON) Wolf Creek is estimated to be $1,074 million. The majority of this cost (approximately 62.5%) is associated with the physical decontamination and dismantling of the nuclear plant so that the operating license can be terminated. Another 32.0% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 5.5% 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 $1,411 million. The majority of this cost (approximately 74.5%) is associated with placing the plant in storage, ongoing caretaking of the plant during dormancy, and the eventual physical decontamination and dismantling of the nuclear plant so that the operating license can be terminated. Another 21.1% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 4.4% is for the demolition of the designated structures and limited restoration of the site.

The primary cost contributors, identified in Tables 6.1 and 6.2, are either labor-related or associated with the management and disposition of the radioactive waste. Program management and security are the largest single contributors 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, and the long-term care of the spent fuel (for the DECON alternative).

As described in this report, the spent fuel pool will remain operational for a minimum of four years following the cessation of operations. Over this period, the spent fuel will be packaged into transportable canisters for loading into a DOE-provided transport cask, or will be transferred to dry fuel storage canisters and placed on the onsite ISFSI.

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 the Energy*Solutions*' and WCS facilities. Highly activated components, requiring additional isolation from the environment (GTCC), are packaged for geologic disposal. The cost of geologic disposal is based upon a cost equivalent for spent fuel.

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

Removal costs reflect the labor-intensive nature of the decommissioning process, as well as the management controls required to ensure a safe and successful program. Decontamination and packaging costs also have a large labor component that is based upon prevailing union wages. Non-radiological demolition is a natural extension of the decommissioning process. The methods employed in decontamination and dismantling are generally destructive and indiscriminate in inflicting collateral damage. With a work force mobilized to support decommissioning operations, non-radiological demolition can be an integrated activity and a logical expansion of the work being performed in the process of terminating the operating license. Prompt demolition reduces future liabilities and can be more cost effective than deferral, due to the deterioration of the facilities (and therefore the working conditions) with time.

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

Decontamination is used to reduce the plant's radiation fields and minimize worker exposure. Slightly contaminated material or material located within a contaminated area is sent to an off-site processing center, i.e., this analysis does not assume that

contaminated plant components and equipment can be decontaminated for uncontrolled release in-situ. Centralized processing centers have proven to be a more economical means of handling the large volumes of material produced in the dismantling of a nuclear station.

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

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

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

Cost Element	Total	%
Decontamination	16,487	1.5
Removal	124,532	11.6
Packaging	25,873	2.4
Transportation	13,667	1.3
Waste Disposal	97,223	9.1
Off-site Waste Processing	32,565	3.0
Program Management [1]	273,921	25.5
Site Security	236,859	22.1
Corporate Allocations	3,225	0.3
Spent Fuel Pool Isolation	14,576	1.4
Spent Fuel Management - Direct Costs [2]	109,651	10.2
Insurance and Regulatory Fees	37,634	3.5
Energy	11,388	1.1
Characterization and Licensing Surveys	21,532	2.0
Property Taxes	47,192	4.4
Miscellaneous Equipment	7,317	0.7
Total [3]	1,073,642	100.0

Cost Element	Total	%
License Termination	670,864	62.5
Spent Fuel Management	343,044	32.0
Site Restoration	59,734	5.5
Total [3]	1,073,642	100.0

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

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

Cost Element	Total	%
Decontamination	14,677	1.0
Removal	134,086	9.5
Packaging	18,393	1.3
Transportation	11,008	0.8
Waste Disposal	72,363	5.1
Off-site Waste Processing	36,405	2.6
Program Management [1]	425,082	30.1
Site Security	359,495	25.5
Corporate Allocations	5,887	0.4
Spent Fuel Pool Isolation	14,576	1.0
Spent Fuel Management - Direct Costs [2]	101,003	7.2
Insurance and Regulatory Fees	63,652	4.5
Energy	28,610	2.0
Characterization and Licensing Surveys	25,477	1.8
Property Taxes	75,009	5.3
Miscellaneous Equipment	25,264	1.8
Total [3]	1,410,987	100.0

Cost Element	Total	%
License Termination	1,050,876	74.5
Spent Fuel Management	298,581	21.1
Site Restoration	61,530	4.4
Total [3]	1,410,987	100.0

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

7. REFERENCES

1. "Decommissioning Cost Analysis for the Wolf Creek Nuclear Plant," Document W11-1741-001, Rev. 0, TLG Services, Inc., August 2017

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

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

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

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

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

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

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

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

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

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

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

14. "Acceptance Priority Ranking & Annual Capacity Report," DOE/RW-0567, July 2004 [Open]

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

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

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

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

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

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

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

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

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

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

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

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

28. "Building Construction Cost Data 2020," RSMeans (From the Gordian Group), Rockland, Massachusetts [Open]

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

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

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33. U.S. Department of Transportation, Title 49 of the Code of Federal Regulations, "Transportation," Parts 173 through 178 [Open]

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39. "Microsoft Project Professional," Microsoft Corporation, Redmond, WA

40. "Atomic Energy Act of 1954," (68 Stat. 919) [Open]

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 (37.1% of critical duration)	95
Adjusted work duration	478
+ Protective clothing adjustment (30% of adjusted duration)	143
Productive work duration	621
+ Work break adjustment (8.33 % of productive duration)	52
Total work duration (minutes)	673

*** Total duration = 11.217 hour ***

* alpha designators indicate activities that can be performed in parallel

APPENDIX A
(continued)

3. LABOR REQUIRED

Crew	Number	Duration (hours)	Rate ($/hour)	Cost
Laborers	3.00	11.217	$19.73	$663.93
Craftsmen	2.00	11.217	$36.87	$827.14
Foreman	1.00	11.217	$40.58	$455.19
General Foreman	0.25	11.217	$44.83	$125.71
Fire Watch	0.05	11.217	$19.73	$11.07
Health Physics Technician	1.00	11.217	$49.51	$555.35
Total Labor Cost				$2,638.39

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Universal Sorbent 50 @ $0.68 sq. ft. {1}	$34.00
-Tarpaulins (oil resistant/fire retardant) 50 @ $0.52/sq. ft. {2}	$26.60
-Gas torch consumables 1 @ $22.56/hr. x 1 hr. {3}	$22.56
Subtotal cost of equipment and materials	$82.56
Overhead & profit on equipment and materials @ 18.50 %	$15.27
Total costs, equipment & material	$97.83

TOTAL COST:

Removal of contaminated heat exchanger <3000 pounds:	$2,736.22
Total labor cost:	$2,638.39
Total equipment/material costs:	$97.83
Total craft labor man-hours required per unit:	81.88

5. NOTES AND REFERENCES

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

- References for equipment & consumables costs:

    1. www.mcmaster.com online catalog, McMaster Carr Spill Control (7193T88)
    2. R.S. Means (2020) Division 01 56, Section 13.60-0600, page 23
    3. R.S. Means (2020) Division 01 54 33, Section 40-6360, page 736

- 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	0.25
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	2.58
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	3.90
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	8.10
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	14.97
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	19.72
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	28.96
Removal of clean pipe >36 inches diameter, $/linear foot	34.29
Removal of clean valve >2 to 4 inches	53.63
Removal of clean valve >4 to 8 inches	80.96
Removal of clean valve >8 to 14 inches	149.74
Removal of clean valve >14 to 20 inches	197.24
Removal of clean valve >20 to 36 inches	289.56
Removal of clean valve >36 inches	342.94
Removal of clean pipe hanger for small bore piping	21.25
Removal of clean pipe hanger for large bore piping	65.85
Removal of clean pump, <300 pound	141.92
Removal of clean pump, 300-1000 pound	398.43
Removal of clean pump, 1000-10,000 pound	1,524.90
Removal of clean pump, >10,000 pound	2,967.74
Removal of clean pump motor, 300-1000 pound	162.32
Removal of clean pump motor, 1000-10,000 pound	627.43
Removal of clean pump motor, >10,000 pound	1,411.70
Removal of clean heat exchanger <3000 pound	831.38
Removal of clean heat exchanger >3000 pound	2,118.67
Removal of clean feedwater heater/deaerator	5,883.78
Removal of clean moisture separator/reheater	11,978.05
Removal of clean tank, <300 gallons	181.91
Removal of clean tank, 300-3000 gallon	563.42
Removal of clean tank, >3000 gallons, $/square foot surface area	4.97

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of clean electrical equipment, <300 pound	73.30
Removal of clean electrical equipment, 300-1000 pound	264.28
Removal of clean electrical equipment, 1000-10,000 pound	528.55
Removal of clean electrical equipment, >10,000 pound	1,286.90
Removal of clean electrical transformer < 30 tons	893.73
Removal of clean electrical transformer > 30 tons	2,573.81
Removal of clean standby diesel generator, <100 kW	912.87
Removal of clean standby diesel generator, 100 kW to 1 MW	2,037.59
Removal of clean standby diesel generator, >1 MW	4,218.23
Removal of clean electrical cable tray, $/linear foot	7.15
Removal of clean electrical conduit, $/linear foot	3.14
Removal of clean mechanical equipment, <300 pound	73.30
Removal of clean mechanical equipment, 300-1000 pound	264.28
Removal of clean mechanical equipment, 1000-10,000 pound	528.55
Removal of clean mechanical equipment, >10,000 pound	1,286.90
Removal of clean HVAC equipment, <300 pound	88.63
Removal of clean HVAC equipment, 300-1000 pound	317.55
Removal of clean HVAC equipment, 1000-10,000 pound	632.88
Removal of clean HVAC equipment, >10,000 pound	1,286.90
Removal of clean HVAC ductwork, $/pound	0.26
Removal of contaminated instrument and sampling tubing, $/linear foot	0.99
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	16.58
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	25.76
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	42.17
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	77.68
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	91.92
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	124.05
Removal of contaminated pipe >36 inches diameter, $/linear foot	145.02
Removal of contaminated valve >2 to 4 inches	306.19
Removal of contaminated valve >4 to 8 inches	360.64

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated valve >8 to 14 inches	705.69
Removal of contaminated valve >14 to 20 inches	888.30
Removal of contaminated valve >20 to 36 inches	1,169.36
Removal of contaminated valve >36 inches	1,379.06
Removal of contaminated pipe hanger for small bore piping	102.24
Removal of contaminated pipe hanger for large bore piping	321.17
Removal of contaminated pump, <300 pound	652.35
Removal of contaminated pump, 300-1000 pound	1,490.37
Removal of contaminated pump, 1000-10,000 pound	4,419.79
Removal of contaminated pump, >10,000 pound	10,759.54
Removal of contaminated pump motor, 300-1000 pound	676.52
Removal of contaminated pump motor, 1000-10,000 pound	1,843.53
Removal of contaminated pump motor, >10,000 pound	4,139.39
Removal of contaminated heat exchanger <3000 pound	2,736.22
Removal of contaminated heat exchanger >3000 pound	8,076.14
Removal of contaminated tank, <300 gallons	1,094.80
Removal of contaminated tank, >300 gallons, $/square foot	20.14
Removal of contaminated electrical equipment, <300 pound	480.78
Removal of contaminated electrical equipment, 300-1000 pound	1,180.61
Removal of contaminated electrical equipment, 1000-10,000 pound	2,276.53
Removal of contaminated electrical equipment, >10,000 pound	4,526.62
Removal of contaminated electrical cable tray, $/linear foot	23.36
Removal of contaminated electrical conduit, $/linear foot	12.97
Removal of contaminated mechanical equipment, <300 pound	533.88
Removal of contaminated mechanical equipment, 300-1000 pound	1,300.17
Removal of contaminated mechanical equipment, 1000-10,000 pound	2,502.86
Removal of contaminated mechanical equipment, >10,000 pound	4,526.62
Removal of contaminated HVAC equipment, <300 pound	533.88
Removal of contaminated HVAC equipment, 300-1000 pound	1,300.17
Removal of contaminated HVAC equipment, 1000-10,000 pound	2,502.86

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated HVAC equipment, >10,000 pound	4,526.62
Removal of contaminated HVAC ductwork, $/pound	1.62
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	2.49
Additional decontamination of surface by washing, $/square foot	5.20
Additional decontamination of surfaces by hydrolasing, $/square foot	24.24
Decontamination rig hook up and flush, $/ 250 foot length	4,428.04
Chemical flush of components/systems, $/gallon	23.60
Removal of clean standard reinforced concrete, $/cubic yard	68.50
Removal of grade slab concrete, $/cubic yard	77.83
Removal of clean concrete floors, $/cubic yard	315.45
Removal of sections of clean concrete floors, $/cubic yard	879.78
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	98.58
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	1,642.92
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	133.53
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	2,168.70
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cubic yard	363.82
Removal of below-grade suspended floors, $/cubic yard	187.03
Removal of clean monolithic concrete structures, $/cubic yard	688.52
Removal of contaminated monolithic concrete structures, $/cubic yard	1,622.18
Removal of clean foundation concrete, $/cubic yard	546.46
Removal of contaminated foundation concrete, $/cubic yard	1,512.48
Explosive demolition of bulk concrete, $/cubic yard	40.02
Removal of clean hollow masonry block wall, $/cubic yard	23.76
Removal of contaminated hollow masonry block wall, $/cubic yard	62.09
Removal of clean solid masonry block wall, $/cubic yard	23.76
Removal of contaminated solid masonry block wall, $/cubic yard	62.09
Backfill of below-grade voids, $/cubic yard	37.56
Removal of subterranean tunnels/voids, $/linear foot	80.35
Placement of concrete for below-grade voids, $/cubic yard	141.81
Excavation of clean material, $/cubic yard	2.72

APPENDIX B

UNIT COST FACTOR LISTING
(Power Block Structures Only)

Unit Cost Factor	Cost/Unit($)
Excavation of contaminated material, $/cubic yard	35.65
Removal of clean concrete rubble (tipping fee included), $/cubic yard	24.34
Removal of contaminated concrete rubble, $/cubic yard	21.67
Removal of building by volume, $/cubic foot	0.24
Removal of clean building metal siding, $/square foot	0.95
Removal of contaminated building metal siding, $/square foot	3.51
Removal of standard asphalt roofing, $/square foot	1.17
Removal of transite panels, $/square foot	1.67
Scarifying contaminated concrete surfaces (drill & spall), $/square foot	10.43
Scabbling contaminated concrete floors, $/square foot	5.94
Scabbling contaminated concrete walls, $/square foot	15.09
Scabbling contaminated ceilings, $/square foot	51.20
Scabbling structural steel, $/square foot	4.73
Removal of clean overhead crane/monorail < 10 ton capacity	387.92
Removal of contaminated overhead crane/monorail < 10 ton capacity	1,232.78
Removal of clean overhead crane/monorail >10-50 ton capacity	931.03
Removal of contaminated overhead crane/monorail >10-50 ton capacity	2,958.16
Removal of polar crane > 50 ton capacity	3,965.52
Removal of gantry crane > 50 ton capacity	14,370.41
Removal of structural steel, $/pound	0.13
Removal of clean steel floor grating, $/square foot	3.29
Removal of contaminated steel floor grating, $/square foot	10.09
Removal of clean free standing steel liner, $/square foot	7.45
Removal of contaminated free standing steel liner, $/square foot	23.32
Removal of clean concrete-anchored steel liner, $/square foot	3.72
Removal of contaminated concrete-anchored steel liner, $/square foot	27.23
Placement of scaffolding in clean areas, $/square foot	16.03
Placement of scaffolding in contaminated areas, $/square foot	22.74
Landscaping with topsoil, $/acre	25,663.28
Cost of CPC B-88 LSA box & preparation for use	2,267.02

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	1,827.28
Cost of CPC B-12V 12 gauge LSA box & preparation for use	1,744.96
Cost of CPC B-144 LSA box & preparation for use	11,750.52
Cost of LSA drum & preparation for use	221.75
Cost of cask liner for CNSI 8 120A cask (resins)	13,099.53
Cost of cask liner for CNSI 8 120A cask (filters)	9,236.41
Decontamination of surfaces with vacuuming, $/square foot	0.60

APPENDIX C

DETAILED COST ANALYSIS

DECON

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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	-	-	-	-	-	-	156	23	179	179	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	240	36	276	276	-	-	-	-	-	-	-	-	-	2,000
1a.1.7	Review plant dwgs & specs.	-	-	-	-	-	-	552	83	635	635	-	-	-	-	-	-	-	-	-	4,600
1a.1.8	Perform detailed rad survey									a											
1a.1.9	Estimate by-product inventory	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
1a.1.10	End product description	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	Detailed by-product inventory	-	-	-	-	-	-	156	23	179	179	-	-	-	-	-	-	-	-	-	1,300
1a.1.12	Define major work sequence	-	-	-	-	-	-	900	135	1,035	1,035	-	-	-	-	-	-	-	-	-	7,500
1a.1.13	Perform SER and EA	-	-	-	-	-	-	372	56	428	428	-	-	-	-	-	-	-	-	-	3,100
1a.1.14	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	900	135	1,035	1,035	-	-	-	-	-	-	-	-	-	7,500
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	600	90	690	690	-	-	-	-	-	-	-	-	-	5,000
1a.1.16	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
1a.1.17.1	Plant & temporary facilities	-	-	-	-	-	-	590	89	679	611	-	68	-	-	-	-	-	-	-	4,920
1a.1.17.2	Plant systems	-	-	-	-	-	-	500	75	575	518	-	58	-	-	-	-	-	-	-	4,167
1a.1.17.3	NSSS Decontamination Flush	-	-	-	-	-	-	60	9	69	69	-	-	-	-	-	-	-	-	-	500
1a.1.17.4	Reactor internals	-	-	-	-	-	-	852	128	980	980	-	-	-	-	-	-	-	-	-	7,100
1a.1.17.5	Reactor vessel	-	-	-	-	-	-	780	117	897	897	-	-	-	-	-	-	-	-	-	6,500
1a.1.17.6	Biological shield	-	-	-	-	-	-	60	9	69	69	-	-	-	-	-	-	-	-	-	500
1a.1.17.7	Steam generators	-	-	-	-	-	-	374	56	431	431	-	-	-	-	-	-	-	-	-	3,120
1a.1.17.8	Reinforced concrete	-	-	-	-	-	-	192	29	221	110	-	110	-	-	-	-	-	-	-	1,600
1a.1.17.9	Main Turbine	-	-	-	-	-	-	48	7	55	-	-	55	-	-	-	-	-	-	-	400
1a.1.17.10	Main Condensers	-	-	-	-	-	-	48	7	55	-	-	55	-	-	-	-	-	-	-	400
1a.1.17.11	Plant structures & buildings	-	-	-	-	-	-	374	56	431	215	-	215	-	-	-	-	-	-	-	3,120
1a.1.17.12	Waste management	-	-	-	-	-	-	552	83	635	635	-	-	-	-	-	-	-	-	-	4,600
1a.1.17.13	Facility & site closeout	-	-	-	-	-	-	108	16	124	62	-	62	-	-	-	-	-	-	-	900
1a.1.17	Total	-	-	-	-	-	-	4,540	681	5,221	4,597	-	624	-	-	-	-	-	-	-	37,827
Planning & Site Preparations																					
1a.1.18	Prepare dismantling sequence	-	-	-	-	-	-	288	43	331	331	-	-	-	-	-	-	-	-	-	2,400
1a.1.19	Plant prep. & temp. svces	-	-	-	-	-	-	3,500	525	4,025	4,025	-	-	-	-	-	-	-	-	-	-
1a.1.20	Design water clean-up system	-	-	-	-	-	-	168	25	193	193	-	-	-	-	-	-	-	-	-	1,400
1a.1.21	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,400	360	2,760	2,760	-	-	-	-	-	-	-	-	-	-
1a.1.22	Procure casks/liners & containers	-	-	-	-	-	-	148	22	170	170	-	-	-	-	-	-	-	-	-	1,230
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	15,280	2,292	17,572	16,948	-	624	-	-	-	-	-	-	-	78,157
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	432	65	497	-	497	-	-	-	-	-	-	-	-	-
1a.3.2	NEI Annual Fees	-	-	-	-	-	-	555	83	638	638	-	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	987	148	1,135	638	497	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	3,521	352	3,873	3,873	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	3,324	332	3,656	3,656	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	614	-	-	-	-	-	153	767	767	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	753	-	-	-	-	-	113	866	866	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	12	5	-	35	-	11	63	63	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	2,058	309	2,366	2,366	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	1,122	112	1,234	1,234	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,414	141	1,555	-	1,555	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	346	52	398	398	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	845	127	971	-	971	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	112	17	129	-	129	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate A&G Cost	-	-	-	-	-	-	579	87	666	666	-	-	-	-	-	-	-	-	-	-
1a.4.13	Security Staff Cost	-	-	-	-	-	-	20,309	3,046	23,356	23,356	-	-	-	-	-	-	-	-	-	316,295
1a.4.14	Utility Staff Cost	-	-	-	-	-	-	31,075	4,661	35,736	35,736	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,367	12	5	-	35	64,704	9,514	75,636	72,981	2,655	-	-	610	-	-	-	12,190	20	738,535
1a.0	TOTAL PERIOD 1a COST	-	1,367	12	5	-	35	80,970	11,954	94,343	90,567	3,152	624	-	610	-	-	-	12,190	20	816,691

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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	-	-	-	-	-	-	568	85	653	588	-	65	-	-	-	-	-	-	-	4,733
1b.1.1.2	NSSS Decontamination Flush	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.3	Reactor internals	-	-	-	-	-	-	300	45	345	345	-	-	-	-	-	-	-	-	-	2,500
1b.1.1.4	Remaining buildings	-	-	-	-	-	-	162	24	186	47	-	140	-	-	-	-	-	-	-	1,350
1b.1.1.5	CRD cooling assembly	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.6	CRD housings & ICI tubes	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.7	Incore instrumentation	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
1b.1.1.8	Reactor vessel	-	-	-	-	-	-	436	65	501	501	-	-	-	-	-	-	-	-	-	3,630
1b.1.1.9	Facility closeout	-	-	-	-	-	-	144	22	166	83	-	83	-	-	-	-	-	-	-	1,200
1b.1.1.10	Missile shields	-	-	-	-	-	-	54	8	62	62	-	-	-	-	-	-	-	-	-	450
1b.1.1.11	Biological shield	-	-	-	-	-	-	144	22	166	166	-	-	-	-	-	-	-	-	-	1,200
1b.1.1.12	Steam generators	-	-	-	-	-	-	552	83	635	635	-	-	-	-	-	-	-	-	-	4,600
1b.1.1.13	Reinforced concrete	-	-	-	-	-	-	120	18	138	69	-	69	-	-	-	-	-	-	-	1,000
1b.1.1.14	Main Turbine	-	-	-	-	-	-	187	28	215	-	-	215	-	-	-	-	-	-	-	1,560
1b.1.1.15	Main Condensers	-	-	-	-	-	-	187	28	215	-	-	215	-	-	-	-	-	-	-	1,560
1b.1.1.16	Auxiliary building	-	-	-	-	-	-	328	49	377	339	-	38	-	-	-	-	-	-	-	2,730
1b.1.1.17	Reactor building	-	-	-	-	-	-	328	49	377	339	-	38	-	-	-	-	-	-	-	2,730
1b.1.1	Total	-	-	-	-	-	-	3,989	598	4,588	3,725	-	863	-	-	-	-	-	-	-	33,243
1b.1.2	Decon primary loop	780	-	-	-	-	-	-	390	1,169	1,169	-	-	-	-	-	-	-	-	1,067	-
1b.1	Subtotal Period 1b Activity Costs	780	-	-	-	-	-	3,989	988	5,757	4,895	-	863	-	-	-	-	-	-	1,067	33,243
Period 1b Additional Costs																					
1b.2.1	Spent Fuel Pool Isolation	-	-	-	-	-	-	12,675	1,901	14,576	14,576	-	-	-	-	-	-	-	-	-	-
1b.2.2	Site Characterization	-	-	-	-	-	-	3,109	933	4,042	4,042	-	-	-	-	-	-	-	-	19,100	7,852
1b.2.3	Misc/Hazardous Waste	-	-	85	30	58	-	-	22	196	196	-	-	11,790	-	-	-	-	137,800	740	-
1b.2	Subtotal Period 1b Additional Costs	-	-	85	30	58	-	15,785	2,856	18,814	18,814	-	-	11,790	-	-	-	-	137,800	19,840	7,852
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	1,055	-	-	-	-	-	-	158	1,213	1,213	-	-	-	-	-	-	-	-	-	-
1b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,348	202	1,550	1,550	-	-	-	-	-	-	-	-	-	-
1b.3.3	Process decommissioning water waste	46	-	31	51	-	135	-	67	330	330	-	-	-	283	-	-	-	16,989	55	-
1b.3.4	Process decommissioning chemical flush waste	2	-	83	254	-	2,825	-	754	3,918	3,918	-	-	-	-	788	-	-	83,917	147	-
1b.3.5	Small tool allowance	-	2	-	-	-	-	-	0	2	2	-	-	-	-	-	-	-	-	-	-
1b.3.6	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-
1b.3.7	Decon rig	2,133	-	-	-	-	-	-	320	2,453	2,453	-	-	-	-	-	-	-	-	-	-
1b.3.8	Spent Fuel Capital and Transfer	-	-	-	-	-	-	1,153	173	1,326	-	1,326	-	-	-	-	-	-	-	-	-
1b.3.9	NEI Annual Fees	-	-	-	-	-	-	280	42	322	322	-	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	3,236	1,202	113	305	-	2,961	2,780	1,897	12,494	11,168	1,326	-	-	283	788	-	-	100,906	203	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	38	-	-	-	-	-	-	10	48	48	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	1,775	177	1,952	1,952	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	1,676	168	1,843	1,843	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	351	-	-	-	-	-	88	439	439	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	380	-	-	-	-	-	57	436	436	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	7	3	-	21	-	6	37	37	-	-	-	360	-	-	-	7,197	12	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	2,075	311	2,386	2,386	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	318	32	350	350	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	713	71	784	-	784	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	426	64	490	-	490	-	-	-	-	-	-	-	-	-
1b.4.11	ISFSI Operating Costs	-	-	-	-	-	-	56	8	65	-	65	-	-	-	-	-	-	-	-	-
1b.4.12	Corporate A&G Cost	-	-	-	-	-	-	293	44	337	337	-	-	-	-	-	-	-	-	-	-
1b.4.13	Security Staff Cost	-	-	-	-	-	-	10,031	1,505	11,536	11,536	-	-	-	-	-	-	-	-	-	156,127
1b.4.14	DOC Staff Cost	-	-	-	-	-	-	5,747	862	6,609	6,609	-	-	-	-	-	-	-	-	-	63,961
1b.4.15	Utility Staff Cost	-	-	-	-	-	-	15,749	2,362	18,111	18,111	-	-	-	-	-	-	-	-	-	213,904
1b.4	Subtotal Period 1b Period-Dependent Costs	38	731	7	3	-	21	38,859	5,765	45,425	44,086	1,339	-	-	360	-	-	-	7,197	12	433,992
1b.0	TOTAL PERIOD 1b COST	4,054	1,933	206	338	58	2,982	61,413	11,506	82,490	78,963	2,664	863	11,790	643	788	-	-	245,903	21,120	475,087
PERIOD 1 TOTALS		4,054	3,300	219	343	58	3,017	142,383	23,460	176,833	169,530	5,817	1,486	11,790	1,253	788	-	-	258,093	21,140	1,291,778

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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	128	141	39	65	-	735	-	297	1,406	1,406	-	-	-	2,046	-	-	-	142,726	6,863	-
2a.1.1.2	Pressurizer Relief Tank	22	18	11	19	-	208	-	71	348	348	-	-	-	578	-	-	-	40,338	1,077	-
2a.1.1.3	Reactor Coolant Pumps & Motors	65	65	137	238	-	1,150	-	386	2,040	2,040	-	-	-	3,386	-	-	-	816,140	4,188	100
2a.1.1.4	Pressurizer	-	37	641	169	-	1,270	-	416	2,534	2,534	-	-	-	3,739	-	-	-	293,734	1,666	1,875
2a.1.1.5	Steam Generators	-	5,793	4,181	3,462	3,622	7,885	-	4,900	29,843	29,843	-	-	40,845	23,217	-	-	-	3,577,181	23,227	5,750
2a.1.1.6	CRDMs/ICIs/Service Structure Removal	108	199	276	72	-	865	-	359	1,880	1,880	-	-	-	4,534	-	-	-	168,041	8,136	-
2a.1.1.7	Reactor Vessel Internals	73	7,050	8,881	1,168	-	15,128	389	15,459	48,148	48,148	-	-	-	2,336	963	393	-	330,668	32,673	1,465
2a.1.1.8	Reactor Vessel	78	8,699	2,868	1,080	-	4,825	389	10,021	27,959	27,959	-	-	-	13,554	-	-	-	972,836	32,673	1,465
2a.1.1	Totals	474	22,002	17,034	6,273	3,622	32,066	779	31,908	114,157	114,157	-	-	40,845	53,390	963	393	-	6,341,664	110,503	10,656
Removal of Major Equipment																					
2a.1.2	Main Turbine/Generator	-	332	391	98	834	834	-	470	2,960	2,960	-	-	4,844	2,698	-	-	-	462,027	9,734	-
2a.1.3	Main Condensers	-	926	225	121	995	1,052	-	684	4,003	4,003	-	-	7,701	3,216	-	-	-	550,847	27,762	-
Cascading Costs from Clean Building Demolition																					
2a.1.4.1	Reactor	-	452	-	-	-	-	-	68	519	519	-	-	-	-	-	-	-	-	4,871	-
2a.1.4.2	Auxiliary	-	231	-	-	-	-	-	35	266	266	-	-	-	-	-	-	-	-	2,194	-
2a.1.4.3	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	7	-
2a.1.4.4	Radwaste	-	45	-	-	-	-	-	7	52	52	-	-	-	-	-	-	-	-	387	-
2a.1.4.5	Fuel Building	-	99	-	-	-	-	-	15	114	114	-	-	-	-	-	-	-	-	773	-
2a.1.4	Totals	-	828	-	-	-	-	-	124	952	952	-	-	-	-	-	-	-	-	8,233	-
Disposal of Plant Systems																					
2a.1.5.1	AB - Main Steam	-	159	-	-	-	-	-	24	183	-	-	183	-	-	-	-	-	-	5,833	-
2a.1.5.2	AB - Main Steam RCA	-	60	5	16	251	-	-	56	388	388	-	-	2,156	-	-	-	-	87,550	1,515	-
2a.1.5.3	AC - Main Turbine	-	159	-	-	-	-	-	24	183	-	-	183	-	-	-	-	-	-	5,641	-
2a.1.5.4	AD - Condensate	-	177	-	-	-	-	-	27	204	-	-	204	-	-	-	-	-	-	6,144	-
2a.1.5.5	AE - Feedwater	-	121	-	-	-	-	-	18	139	-	-	139	-	-	-	-	-	-	4,271	-
2a.1.5.6	AF - Feedwater Hter Extrction, Drn & Vnt	-	149	-	-	-	-	-	22	171	-	-	171	-	-	-	-	-	-	5,352	-
2a.1.5.7	AK - Condensate Demineralizer	-	55	-	-	-	-	-	8	64	-	-	64	-	-	-	-	-	-	1,944	-
2a.1.5.8	AL - Auxiliary Feedwater	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	1,174	-
2a.1.5.9	AL-Auxiliary Feedwater Surge Tanks	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	72	-
2a.1.5.10	AN - Demineralized Wtr Storage & xfer	-	44	-	-	-	-	-	7	50	-	-	50	-	-	-	-	-	-	1,548	-
2a.1.5.11	AP - Condensate Storage & Transfer	-	52	-	-	-	-	-	8	60	-	-	60	-	-	-	-	-	-	1,660	-
2a.1.5.12	AQ - Condensate & Feedwater Chem Additn	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	468	-
2a.1.5.13	AX - Acid Feed	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	754	-
2a.1.5.14	Auxiliary Bldg Non-System Specific	-	86	6	9	55	92	-	55	303	303	-	-	474	282	-	-	-	37,164	2,282	-
2a.1.5.15	Auxiliary Bldg Non-System Specific RCA	-	541	16	58	889	-	-	279	1,783	1,783	-	-	7,629	-	-	-	-	309,812	13,471	-
2a.1.5.16	BL - Reactor Makeup Water	-	224	25	30	225	281	-	167	951	951	-	-	1,928	850	-	-	-	132,796	5,872	-
2a.1.5.17	BM - Steam Generator Blowdown	-	455	11	39	601	-	-	211	1,317	1,317	-	-	5,160	-	-	-	-	209,560	11,982	-
2a.1.5.18	CA - Steam Seal	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	455	-
2a.1.5.19	CB - Main Turbine Lube Oil	-	37	-	-	-	-	-	6	42	-	-	42	-	-	-	-	-	-	1,207	-
2a.1.5.20	CC - Generator Hydrogen & CO2	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	198	-
2a.1.5.21	CD - Generator Seal Oil	-	8	-	-	-	-	-	1	10	-	-	10	-	-	-	-	-	-	287	-
2a.1.5.22	CE - Stator Cooling Water	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	241	-
2a.1.5.23	CF - Lube Oil Strg, Xfer & Purification	-	24	-	-	-	-	-	4	27	-	-	27	-	-	-	-	-	-	812	-
2a.1.5.24	CG - Condenser Air Removal	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	657	-
2a.1.5.25	CH - Main Turbine Control Oil	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	1,219	-
2a.1.5.26	CL - Chlorination	-	16	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	569	-
2a.1.5.27	CO - Carbon Dioxide	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	121	-
2a.1.5.28	CW - Circulating Water	-	214	-	-	-	-	-	32	247	-	-	247	-	-	-	-	-	-	7,858	-
2a.1.5.29	CZ - Caustic Acid	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	111	-
2a.1.5.30	Control Bldg Non-System Specific	-	140	5	16	249	-	-	75	485	485	-	-	2,139	-	-	-	-	86,849	3,413	-
2a.1.5.31	Control Bldg Non-System Specific Cln	-	979	-	-	-	-	-	147	1,126	-	-	1,126	-	-	-	-	-	-	29,076	-
2a.1.5.32	DA - Circulating Water System	-	218	-	-	-	-	-	33	251	-	-	251	-	-	-	-	-	-	7,953	-
2a.1.5.33	DM - Equipment Drains	-	35	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,223	-
2a.1.5.34	DM - Equipment Drains RCA	-	112	33	118	1,800	-	-	319	2,382	2,382	-	-	15,445	-	-	-	-	627,223	2,840	-
2a.1.5.35	EB - Closed Cooling Water	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,267	-
2a.1.5.36	EG - Component Cooling Water RCA	-	564	30	108	1,650	-	-	408	2,760	2,760	-	-	14,161	-	-	-	-	575,071	13,646	-
2a.1.5.37	EJ - Residual Heat Removal	-	288	57	63	318	792	-	333	1,851	1,851	-	-	2,727	2,411	-	-	-	264,564	7,897	-
2a.1.5.38	EM - High Pressure Coolant Injection	-	242	19	21	147	215	-	141	784	784	-	-	1,260	648	-	-	-	92,828	6,201	-
2a.1.5.39	EN - Containment Spray	-	172	6	23	353	-	-	100	654	654	-	-	3,026	-	-	-	-	122,874	4,134	-
2a.1.5.40	EP - Accumulator Safety Injection	-	124	11	17	183	94	-	86	515	515	-	-	1,568	283	-	-	-	81,940	3,246	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Disposal of Plant Systems (continued)																					
2a.1.5.41	FA - Auxiliary Steam Generator	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	521	-
2a.1.5.42	FB - Auxiliary Steam	-	59	-	-	-	-	-	9	68	-	-	68	-	-	-	-	-	-	2,106	-
2a.1.5.43	FB - Auxiliary Steam RCA	-	67	2	6	95	-	-	32	202	202	-	-	816	-	-	-	-	33,148	1,537	-
2a.1.5.44	FC - Auxiliary Turbines	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	1,301	-
2a.1.5.45	FE - Auxiliary Steam Chemical Addition	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	105	-
2a.1.5.46	FP - Fire Protection	-	105	-	-	-	-	-	16	120	-	-	120	-	-	-	-	-	-	3,826	-
2a.1.5.47	GA - Plant Heating	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	1,912	-
2a.1.5.48	GB - Central Chilled Water	-	51	-	-	-	-	-	8	58	-	-	58	-	-	-	-	-	-	1,803	-
2a.1.5.49	GE - Turbine Bldg HVAC	-	83	-	-	-	-	-	13	96	-	-	96	-	-	-	-	-	-	3,189	-
2a.1.5.50	GF - Miscellaneous Building HVAC	-	25	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	987	-
2a.1.5.51	GL - Auxiliary Building HVAC	-	366	15	43	590	75	-	207	1,296	1,296	-	-	5,064	228	-	-	-	220,197	8,491	-
2a.1.5.52	GS - Containment Hydrogen Control	-	58	5	7	77	35	-	36	218	218	-	-	658	104	-	-	-	33,502	1,559	-
2a.1.5.53	HE - Boron Recycle	300	385	41	45	303	466	-	419	1,959	1,959	-	-	2,600	1,411	-	-	-	196,130	16,660	-
2a.1.5.54	HF - Secondary Liquid Waste	552	743	91	104	721	1,057	-	859	4,126	4,126	-	-	6,186	3,203	-	-	-	456,359	31,896	-
2a.1.5.55	HY - Hydrogen	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	223	-
2a.1.5.56	KC - Fire Protection	-	256	-	-	-	-	-	38	295	-	-	295	-	-	-	-	-	-	9,256	-
2a.1.5.57	KH - Service Gas	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	644	-
2a.1.5.58	LA - Sanitary Drains	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	290	-
2a.1.5.59	LE - Oily Waste	-	72	-	-	-	-	-	11	83	-	-	83	-	-	-	-	-	-	2,575	-
2a.1.5.60	LE - Oily Waste RCA	-	156	4	13	200	-	-	71	445	445	-	-	1,718	-	-	-	-	69,785	3,518	-
2a.1.5.61	NT - Nitrogen	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	149	-
2a.1.5.62	OX - Oxygen	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	171	-
2a.1.5.63	RM - Process Sampling & Analysis	-	100	10	9	77	81	-	59	336	336	-	-	661	240	-	-	-	42,525	2,774	-
2a.1.5.64	Radwaste Bldg Non-System Specific	-	140	11	14	82	162	-	91	500	500	-	-	705	497	-	-	-	60,190	3,653	-
2a.1.5.65	SJ - Nuclear Sampling	-	57	7	7	49	62	-	39	220	220	-	-	423	184	-	-	-	29,191	1,620	-
2a.1.5.66	SW - Screen Wash	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	635	-
2a.1.5.67	SZ - Service Air	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	1,892	-
2a.1.5.68	Turbine Bldg Non-System Specific	-	462	-	-	-	-	-	69	531	-	-	531	-	-	-	-	-	-	15,405	-
2a.1.5.69	VA - I&C Shop HVAC	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	155	-
2a.1.5.70	VB - I&C Shop Computer Room HVAC	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	106	-
2a.1.5.71	VH - Circ Water & Makeup Water Scrnhs	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	272	-
2a.1.5.72	VJ - Shop Bldg Machine Shop Area Vent	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	57	-
2a.1.5.73	VL - Shop Building HVAC	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	101	-
2a.1.5.74	VV - Misc Bldg HVAC	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	148	-
2a.1.5.75	WG - Gland Water & Motor Cooling Water	-	15	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	593	-
2a.1.5.76	WL - Cooling Lake Makeup & Blowdown	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	745	-
2a.1.5.77	WM - Makeup Demineralizer	-	111	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	3,929	-
2a.1.5.78	WS - Plant Services Water	-	91	-	-	-	-	-	14	105	-	-	105	-	-	-	-	-	-	3,297	-
2a.1.5.79	Yard Non-System Specific	-	18	-	-	-	-	-	3	20	-	-	20	-	-	-	-	-	-	603	-
2a.1.5	Totals	852	9,343	408	765	8,917	3,411	-	4,681	28,378	23,476	-	4,903	76,504	10,341	-	-	-	3,769,256	293,319	-
2a.1.6	Scaffolding in support of decommissioning	-	1,015	27	12	156	35	-	290	1,535	1,535	-	-	1,206	106	-	-	-	61,032	36,964	-
2a.1	Subtotal Period 2a Activity Costs	1,326	34,446	18,086	7,270	14,523	37,398	779	38,159	151,986	147,083	-	4,903	131,100	69,751	963	393	-	11,184,830	486,514	10,656
Period 2a Collateral Costs																					
2a.3.1	Process decommissioning water waste	203	-	139	228	-	610	-	302	1,484	1,484	-	-	-	1,276	-	-	-	76,553	249	-
2a.3.2	Process decommissioning chemical flush waste	1	-	43	132	-	348	-	112	637	637	-	-	-	410	-	-	-	43,711	77	-
2a.3.3	Small tool allowance	-	324	-	-	-	-	-	49	373	336	-	37	-	-	-	-	-	-	-	-
2a.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	16,967	2,545	19,512	-	19,512	-	-	-	-	-	-	-	-	-
2a.3.5	NEI Annual Fees	-	-	-	-	-	-	960	144	1,104	1,104	-	-	-	-	-	-	-	-	-	-
2a.3.6	On-site survey and release of 120.7 tons clean metallic waste	-	-	-	-	-	-	174	17	191	191	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	205	324	182	361	-	959	18,101	3,169	23,300	3,751	19,512	37	-	1,686	-	-	-	120,264	326	-
Period 2a Period-Dependent Costs																					
2a.4.1	Decon supplies	132	-	-	-	-	-	-	33	165	165	-	-	-	-	-	-	-	-	-	-
2a.4.2	Insurance	-	-	-	-	-	-	1,200	120	1,320	1,320	-	-	-	-	-	-	-	-	-	-
2a.4.3	Property taxes	-	-	-	-	-	-	5,755	576	6,331	6,331	-	-	-	-	-	-	-	-	-	-
2a.4.4	Health physics supplies	-	3,856	-	-	-	-	-	964	4,820	4,820	-	-	-	-	-	-	-	-	-	-
2a.4.5	Heavy equipment rental	-	4,333	-	-	-	-	-	650	4,983	4,983	-	-	-	-	-	-	-	-	-	-
2a.4.6	Disposal of DAW generated	-	-	137	56	-	388	-	119	701	701	-	-	-	6,761	-	-	-	135,218	221	-
2a.4.7	Plant energy budget	-	-	-	-	-	-	3,385	508	3,893	3,893	-	-	-	-	-	-	-	-	-	-
2a.4.8	NRC Fees	-	-	-	-	-	-	995	100	1,095	1,095	-	-	-	-	-	-	-	-	-	-
2a.4.9	Emergency Planning Fees	-	-	-	-	-	-	1,453	145	1,599	-	1,599	-	-	-	-	-	-	-	-	-
2a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	1,462	219	1,682	-	1,682	-	-	-	-	-	-	-	-	-
2a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	194	29	223	-	223	-	-	-	-	-	-	-	-	-
2a.4.12	Corporate A&G Cost	-	-	-	-	-	-	699	105	804	804	-	-	-	-	-	-	-	-	-	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 2a Period-Dependent Costs (continued)																					
2a.4.13	Remedial Actions Surveys	-	-	-	-	-	-	1,782	267	2,049	2,049	-	-	-	-	-	-	-	-	-	-
2a.4.14	Security Staff Cost	-	-	-	-	-	-	30,579	4,587	35,166	35,166	-	-	-	-	-	-	-	-	-	475,077
2a.4.15	DOC Staff Cost	-	-	-	-	-	-	24,104	3,616	27,719	27,719	-	-	-	-	-	-	-	-	-	273,717
2a.4.16	Utility Staff Cost	-	-	-	-	-	-	38,762	5,814	44,577	44,577	-	-	-	-	-	-	-	-	-	509,617
2a.4	Subtotal Period 2a Period-Dependent Costs	132	8,189	137	56	-	388	110,371	17,852	137,126	133,623	3,503	-	-	6,761	-	-	-	135,218	221	1,258,411
2a.0	TOTAL PERIOD 2a COST	1,663	42,959	18,405	7,687	14,523	38,745	129,251	59,180	312,412	284,457	23,015	4,940	131,100	78,198	963	393	-	11,440,310	487,060	1,269,067
PERIOD 2b - Site Decontamination																					
Period 2b Direct Decommissioning Activities																					
Disposal of Plant Systems																					
2b.1.1.1	AN - Demineralized Wtr Strg & xfer RCA	-	15	0	1	14	-	-	6	37	37	-	-	120	-	-	-	-	4,855	334	-
2b.1.1.2	BB - Reactor Coolant	-	226	39	43	204	547	-	234	1,292	1,292	-	-	1,746	1,669	-	-	-	177,118	6,412	-
2b.1.1.3	BG - Chemical & Volume Control	761	726	122	124	571	1,622	-	1,084	5,010	5,010	-	-	4,899	4,925	-	-	-	513,906	27,846	-
2b.1.1.4	BN - Borated Refueling Water Storage	-	245	23	51	642	175	-	211	1,348	1,348	-	-	5,512	533	-	-	-	257,802	6,939	-
2b.1.1.5	DO - Diesel Oil	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	48	-
2b.1.1.6	EA - Service Water	-	73	-	-	-	-	-	11	83	-	-	83	-	-	-	-	-	-	2,592	-
2b.1.1.7	EF - Essential Service Water	-	106	-	-	-	-	-	16	122	-	-	122	-	-	-	-	-	-	3,800	-
2b.1.1.8	EF - Essential Service Water RCA	-	71	3	11	166	-	-	45	296	296	-	-	1,427	-	-	-	-	57,959	1,734	-
2b.1.1.9	FO - Fuel Oil	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	486	-
2b.1.1.10	FP - Fire Protection RCA	-	152	10	34	524	-	-	123	842	842	-	-	4,492	-	-	-	-	182,411	3,541	-
2b.1.1.11	GA - Plant Heating RCA	-	93	2	6	87	-	-	37	225	225	-	-	746	-	-	-	-	30,275	2,072	-
2b.1.1.12	GB - Central Chilled Water RCA	-	22	0	1	22	-	-	9	54	54	-	-	187	-	-	-	-	7,591	482	-
2b.1.1.13	GD - Esstl Srvc Wtr Pumphs Bldg HVAC	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	284	-
2b.1.1.14	GH - Radwaste Building HVAC	-	146	7	20	283	32	-	91	579	579	-	-	2,425	98	-	-	-	104,702	3,455	-
2b.1.1.15	GK - Control Building HVAC	-	96	-	-	-	-	-	14	111	-	-	111	-	-	-	-	-	-	3,959	-
2b.1.1.16	GM - Diesel Generator Building HVAC	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	695	-
2b.1.1.17	GN - Containment Cooling	-	395	28	67	857	211	-	293	1,851	1,851	-	-	7,354	643	-	-	-	339,572	9,502	-
2b.1.1.18	GP - Containmnt Integratd Leak Rate Test	-	30	1	4	68	-	-	18	122	122	-	-	580	-	-	-	-	23,570	750	-
2b.1.1.19	GR - Containment Atmospheric Control	-	14	3	9	127	13	-	27	193	193	-	-	1,086	41	-	-	-	46,686	392	-
2b.1.1.20	GT - Contaiment Purge HVAC	-	93	7	18	227	56	-	75	476	476	-	-	1,948	170	-	-	-	89,946	2,259	-
2b.1.1.21	HA - Gaseous Radwaste	-	280	26	33	324	223	-	182	1,068	1,068	-	-	2,782	666	-	-	-	156,216	7,037	-
2b.1.1.22	HB - Liquid Radwaste	587	660	84	91	646	908	-	805	3,781	3,781	-	-	5,544	2,742	-	-	-	401,460	30,762	-
2b.1.1.23	HC - Solid Radwaste	-	371	54	58	324	684	-	327	1,818	1,818	-	-	2,781	2,076	-	-	-	245,800	9,589	-
2b.1.1.24	HD - Decontamination	-	78	7	11	115	57	-	53	320	320	-	-	983	171	-	-	-	50,973	2,051	-
2b.1.1.25	JE - Emergency Fuel Oil	-	39	-	-	-	-	-	6	45	-	-	45	-	-	-	-	-	-	1,260	-
2b.1.1.26	KA - Compressed Air and Instrument	-	175	-	-	-	-	-	26	201	-	-	201	-	-	-	-	-	-	6,089	-
2b.1.1.27	KB - Breathing Air	-	31	-	-	-	-	-	5	35	-	-	35	-	-	-	-	-	-	1,075	-
2b.1.1.28	KC - Fire Protection RCA	-	274	13	45	693	-	-	181	1,206	1,206	-	-	5,944	-	-	-	-	241,384	6,383	-
2b.1.1.29	KD - Domestic Water	-	49	-	-	-	-	-	7	56	-	-	56	-	-	-	-	-	-	1,708	-
2b.1.1.30	KE - Fuel Hndlg & Strg Reactor Vssl Serv	-	14	4	8	77	52	-	29	184	184	-	-	661	158	-	-	-	36,889	375	-
2b.1.1.31	KJ - Standby Diesel Engine	-	204	-	-	-	-	-	31	235	-	-	235	-	-	-	-	-	-	6,749	-
2b.1.1.32	LA - Sanitary Drains RCA	-	21	1	2	32	-	-	10	66	66	-	-	272	-	-	-	-	11,053	422	-
2b.1.1.33	LB - Roof Drains	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,276	-
2b.1.1.34	LB - Roof Drains RCA	-	115	5	16	249	-	-	69	454	454	-	-	2,139	-	-	-	-	86,858	2,694	-
2b.1.1.35	LC - Yard Drains	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	96	-
2b.1.1.36	LD - Chemical & Detergent Waste	55	92	6	8	59	69	-	78	366	366	-	-	504	211	-	-	-	33,951	3,490	-
2b.1.1.37	LF - Floor & Equipment Drains	-	1,137	126	129	436	1,878	-	851	4,557	4,557	-	-	3,739	5,724	-	-	-	516,484	29,320	-
2b.1.1.38	Main Access Facility	-	10	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	339	-
2b.1.1.39	Radwaste Bldg Non-System Specific RCA	-	903	27	97	1,478	-	-	465	2,969	2,969	-	-	12,684	-	-	-	-	515,103	21,919	-
2b.1.1.40	Reactor Bldg Non-System Specific	-	72	4	5	31	61	-	39	212	212	-	-	269	186	-	-	-	22,727	1,760	-
2b.1.1.41	Reactor Bldg Non-System Specific RCA	-	468	10	36	556	-	-	207	1,277	1,277	-	-	4,768	-	-	-	-	193,612	10,425	-
2b.1.1.42	SBO Diesel Generator	-	111	-	-	-	-	-	17	128	-	-	128	-	-	-	-	-	-	3,610	-
2b.1.1.43	ST - Sewage Treatment	-	66	-	-	-	-	-	10	76	-	-	76	-	-	-	-	-	-	2,316	-
2b.1.1.44	VC - Health Physics Computer Room HVAC	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	208	-
2b.1.1.45	VS - Admin Bldg HVAC	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	262	-
2b.1.1.46	VT - Tech Support Building HVAC	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	87	-
2b.1.1.47	VW - Waste Water Treatment Ventilation	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	52	-
2b.1.1.48	WD - Domestic Water	-	24	-	-	-	-	-	4	27	-	-	27	-	-	-	-	-	-	870	-
2b.1.1.49	WS - Plant Services Water RCA	-	29	4	14	214	-	-	42	303	303	-	-	1,838	-	-	-	-	74,625	782	-
2b.1.1.50	WT - Waste Water Treatment	-	21	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	769	-
2b.1.1.51	WZ - Radioactive Liquid Waste	-	36	5	5	14	85	-	34	179	179	-	-	120	258	-	-	-	21,303	879	-
2b.1.1	Totals	1,403	7,879	621	947	9,038	6,672	-	5,789	32,350	31,085	-	1,265	77,549	20,271	-	-	-	4,444,833	232,233	-
2b.1.2	Scaffolding in support of decommissioning	-	1,269	33	15	195	43	-	363	1,919	1,919	-	-	1,508	133	-	-	-	76,290	46,205	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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	877	844	67	272	694	2,354	-	1,389	6,497	6,497	-	-	5,955	17,517	-	-	-	997,209	44,353	-
2b.1.3.2	Auxiliary	458	312	30	125	255	444	-	478	2,102	2,102	-	-	2,185	6,943	-	-	-	417,552	19,560	-
2b.1.3.3	Communication Corridor - Contaminated	10	5	1	3	2	9	-	9	39	39	-	-	17	152	-	-	-	7,854	395	-
2b.1.3.4	Hot Machine Shop	13	11	1	3	-	11	-	12	51	51	-	-	-	188	-	-	-	8,892	597	-
2b.1.3.5	RWST Foundation Decon	-	7	1	5	-	20	-	8	42	42	-	-	-	335	-	-	-	15,840	108	-
2b.1.3.6	Radwaste	244	149	15	64	98	233	-	243	1,047	1,047	-	-	844	3,681	-	-	-	208,617	10,005	-
2b.1.3.7	Radwaste Drum Storage	27	15	2	7	8	26	-	26	111	111	-	-	66	413	-	-	-	22,243	1,093	-
2b.1.3.8	Radwaste Storage Building	70	33	4	17	-	66	-	63	254	254	-	-	-	1,090	-	-	-	51,480	2,634	-
2b.1.3	Totals	1,700	1,377	119	496	1,057	3,164	-	2,230	10,144	10,144	-	-	9,068	30,319	-	-	-	1,729,687	78,745	-
2b.1.4	Prepare/submit License Termination Plan	-	-	-	-	-	-	492	74	565	565	-	-	-	-	-	-	-	-	-	4,096
2b.1.5	Receive NRC approval of termination plan									a											
2b.1	Subtotal Period 2b Activity Costs	3,103	10,525	774	1,459	10,290	9,880	492	8,456	44,978	43,713	-	1,265	88,124	50,723	-	-	-	6,250,810	357,184	4,096
Period 2b Additional Costs																					
2b.2.1	Operational Equipment	-	-	23	75	844	-	-	140	1,083	1,083	-	-	11,760	-	-	-	-	294,000	32	-
2b.2.2	Excavation of Underground Services	-	2,677	-	-	-	-	608	760	4,045	4,045	-	-	-	-	-	-	-	-	8,981	-
2b.2	Subtotal Period 2b Additional Costs	-	2,677	23	75	844	-	608	901	5,127	5,127	-	-	11,760	-	-	-	-	294,000	9,013	-
Period 2b Collateral Costs																					
2b.3.1	Process decommissioning water waste	197	-	136	222	-	595	-	294	1,443	1,443	-	-	-	1,244	-	-	-	74,611	242	-
2b.3.2	Process decommissioning chemical flush waste	3	-	140	432	-	1,136	-	365	2,076	2,076	-	-	-	1,338	-	-	-	142,540	250	-
2b.3.3	Small tool allowance	-	205	-	-	-	-	-	31	235	235	-	-	-	-	-	-	-	-	-	-
2b.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	19,029	2,854	21,883	-	21,883	-	-	-	-	-	-	-	-	-
2b.3.5	NEI Annual Fees	-	-	-	-	-	-	425	64	489	489	-	-	-	-	-	-	-	-	-	-
2b.3.6	On-site survey and release of 39.39 tons clean metallic waste	-	-	-	-	-	-	57	6	62	62	-	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	200	205	276	654	-	1,731	19,510	3,613	26,188	4,306	21,883	-	-	2,581	-	-	-	217,152	493	-
Period 2b Period-Dependent Costs																					
2b.4.1	Decon supplies	1,623	-	-	-	-	-	-	406	2,029	2,029	-	-	-	-	-	-	-	-	-	-
2b.4.2	Insurance	-	-	-	-	-	-	532	53	585	585	-	-	-	-	-	-	-	-	-	-
2b.4.3	Property taxes	-	-	-	-	-	-	2,550	255	2,805	2,805	-	-	-	-	-	-	-	-	-	-
2b.4.4	Health physics supplies	-	2,561	-	-	-	-	-	640	3,201	3,201	-	-	-	-	-	-	-	-	-	-
2b.4.5	Heavy equipment rental	-	1,972	-	-	-	-	-	296	2,267	2,267	-	-	-	-	-	-	-	-	-	-
2b.4.6	Disposal of DAW generated	-	-	101	42	-	287	-	88	518	518	-	-	-	4,996	-	-	-	99,921	163	-
2b.4.7	Plant energy budget	-	-	-	-	-	-	1,184	178	1,362	1,362	-	-	-	-	-	-	-	-	-	-
2b.4.8	NRC Fees	-	-	-	-	-	-	441	44	485	485	-	-	-	-	-	-	-	-	-	-
2b.4.9	Emergency Planning Fees	-	-	-	-	-	-	644	64	708	-	708	-	-	-	-	-	-	-	-	-
2b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	648	97	745	-	745	-	-	-	-	-	-	-	-	-
2b.4.11	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	163	24	187	187	-	-	-	-	-	-	-	-	-	-
2b.4.12	ISFSI Operating Costs	-	-	-	-	-	-	86	13	99	-	99	-	-	-	-	-	-	-	-	-
2b.4.13	Corporate A&G Cost	-	-	-	-	-	-	297	44	341	341	-	-	-	-	-	-	-	-	-	-
2b.4.14	Remedial Actions Surveys	-	-	-	-	-	-	790	118	908	908	-	-	-	-	-	-	-	-	-	-
2b.4.15	Security Staff Cost	-	-	-	-	-	-	13,595	2,039	15,635	15,635	-	-	-	-	-	-	-	-	-	210,477
2b.4.16	DOC Staff Cost	-	-	-	-	-	-	10,287	1,543	11,831	11,831	-	-	-	-	-	-	-	-	-	116,480
2b.4.17	Utility Staff Cost	-	-	-	-	-	-	16,486	2,473	18,959	18,959	-	-	-	-	-	-	-	-	-	216,206
2b.4	Subtotal Period 2b Period-Dependent Costs	1,623	4,532	101	42	-	287	47,701	8,377	62,662	61,110	1,552	-	-	4,996	-	-	-	99,921	163	543,163
2b.0	TOTAL PERIOD 2b COST	4,926	17,938	1,175	2,230	11,134	11,897	68,311	21,346	138,956	114,256	23,435	1,265	99,884	58,300	-	-	-	6,861,883	366,852	547,259
PERIOD 2d - Decontamination Following Wet Fuel Storage																					
Period 2d Direct Decommissioning Activities																					
2d.1.1	Remove spent fuel racks	516	49	262	109	-	2,045	-	824	3,806	3,806	-	-	-	6,250	-	-	-	397,077	1,722	-
Disposal of Plant Systems																					
2d.1.2.1	EC - Fuel Pool Cooling & Cleanup	-	307	29	39	303	358	-	220	1,256	1,256	-	-	2,600	1,088	-	-	-	175,058	8,041	-
2d.1.2.2	Fuel Bldg Non-System Specific	-	37	3	3	20	39	-	23	126	126	-	-	170	120	-	-	-	14,568	954	-
2d.1.2.3	Fuel Bldg Non-System Specific RCA	-	249	7	24	373	-	-	122	775	775	-	-	3,200	-	-	-	-	129,974	5,859	-
2d.1.2.4	Fuel Building Fire Protection	-	120	6	22	343	-	-	85	577	577	-	-	2,941	-	-	-	-	119,444	2,802	-
2d.1.2.5	GG - Fuel Building HVAC	-	201	11	31	435	51	-	134	863	863	-	-	3,729	155	-	-	-	161,297	4,673	-
2d.1.2	Totals	-	915	55	120	1,473	448	-	585	3,597	3,597	-	-	12,641	1,364	-	-	-	600,340	22,329	-
Decontamination of Site Buildings																					
2d.1.3.1	Fuel Building	565	609	15	48	315	142	-	526	2,221	2,221	-	-	2,705	1,864	-	-	-	199,762	31,564	-
2d.1.3	Totals	565	609	15	48	315	142	-	526	2,221	2,221	-	-	2,705	1,864	-	-	-	199,762	31,564	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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			
2d.1.4	Scaffolding in support of decommissioning	-	254	7	3	39	9	-	73	384	384	-	-	302	27	-	-	-	15,258	9,241	-
2d.1	Subtotal Period 2d Activity Costs	1,081	1,827	339	280	1,828	2,644	-	2,008	10,007	10,007	-	-	15,647	9,505	-	-	-	1,212,437	64,856	-
Period 2d Additional Costs																					
2d.2.1	License Termination Survey Planning	-	-	-	-	-	-	1,425	428	1,853	1,853	-	-	-	-	-	-	-	-	-	12,480
2d.2	Subtotal Period 2d Additional Costs	-	-	-	-	-	-	1,425	428	1,853	1,853	-	-	-	-	-	-	-	-	-	12,480
Period 2d Collateral Costs																					
2d.3.1	Process decommissioning water waste	104	-	72	118	-	317	-	156	767	767	-	-	-	662	-	-	-	39,712	129	-
2d.3.3	Small tool allowance	-	45	-	-	-	-	-	7	52	52	-	-	-	-	-	-	-	-	-	-
2d.3.4	Decommissioning Equipment Disposition	-	-	133	68	775	173	-	183	1,332	1,332	-	-	6,000	529	-	-	-	303,608	147	-
2d.3	Subtotal Period 2d Collateral Costs	104	45	205	186	775	490	-	346	2,151	2,151	-	-	6,000	1,191	-	-	-	343,320	276	-
Period 2d Period-Dependent Costs																					
2d.4.1	Decon supplies	248	-	-	-	-	-	-	62	310	310	-	-	-	-	-	-	-	-	-	-
2d.4.2	Insurance	-	-	-	-	-	-	467	47	514	514	-	-	-	-	-	-	-	-	-	-
2d.4.3	Property taxes	-	-	-	-	-	-	931	93	1,024	1,024	-	-	-	-	-	-	-	-	-	-
2d.4.4	Health physics supplies	-	746	-	-	-	-	-	187	933	933	-	-	-	-	-	-	-	-	-	-
2d.4.5	Heavy equipment rental	-	1,732	-	-	-	-	-	260	1,992	1,992	-	-	-	-	-	-	-	-	-	-
2d.4.6	Disposal of DAW generated	-	-	42	17	-	119	-	36	214	214	-	-	-	2,066	-	-	-	41,322	67	-
2d.4.7	Plant energy budget	-	-	-	-	-	-	555	83	638	638	-	-	-	-	-	-	-	-	-	-
2d.4.8	NRC Fees	-	-	-	-	-	-	368	37	405	405	-	-	-	-	-	-	-	-	-	-
2d.4.9	Emergency Planning Fees	-	-	-	-	-	-	566	57	622	-	622	-	-	-	-	-	-	-	-	-
2d.4.10	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	286	43	329	329	-	-	-	-	-	-	-	-	-	-
2d.4.11	ISFSI Operating Costs	-	-	-	-	-	-	75	11	87	-	87	-	-	-	-	-	-	-	-	-
2d.4.12	Corporate A&G Cost	-	-	-	-	-	-	184	28	211	211	-	-	-	-	-	-	-	-	-	-
2d.4.13	Remedial Actions Surveys	-	-	-	-	-	-	694	104	798	798	-	-	-	-	-	-	-	-	-	-
2d.4.14	Security Staff Cost	-	-	-	-	-	-	7,380	1,107	8,487	5,288	3,200	-	-	-	-	-	-	-	-	114,874
2d.4.15	DOC Staff Cost	-	-	-	-	-	-	6,289	943	7,233	7,233	-	-	-	-	-	-	-	-	-	70,093
2d.4.16	Utility Staff Cost	-	-	-	-	-	-	10,561	1,584	12,145	11,222	923	-	-	-	-	-	-	-	-	133,878
2d.4	Subtotal Period 2d Period-Dependent Costs	248	2,478	42	17	-	119	28,356	4,682	35,942	31,110	4,832	-	-	2,066	-	-	-	41,322	67	318,845
2d.0	TOTAL PERIOD 2d COST	1,432	4,351	587	484	2,602	3,252	29,781	7,463	49,953	45,121	4,832	-	21,647	12,762	-	-	-	1,597,079	65,199	331,325
PERIOD 2f - License Termination																					
Period 2f Direct Decommissioning Activities																					
2f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	163	49	212	212	-	-	-	-	-	-	-	-	-	-
2f.1.2	Terminate license									a											
2f.1	Subtotal Period 2f Activity Costs	-	-	-	-	-	-	163	49	212	212	-	-	-	-	-	-	-	-	-	-
Period 2f Additional Costs																					
2f.2.1	License Termination Survey	-	-	-	-	-	-	6,538	1,961	8,499	8,499	-	-	-	-	-	-	-	-	152,819	6,240
2f.2	Subtotal Period 2f Additional Costs	-	-	-	-	-	-	6,538	1,961	8,499	8,499	-	-	-	-	-	-	-	-	152,819	6,240
Period 2f Collateral Costs																					
2f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,348	202	1,550	1,550	-	-	-	-	-	-	-	-	-	-
2f.3.2	Spent Fuel Capital and Transfer	-	-	-	-	-	-	292	44	336	-	336	-	-	-	-	-	-	-	-	-
2f.3	Subtotal Period 2f Collateral Costs	-	-	-	-	-	-	1,640	246	1,886	1,550	336	-	-	-	-	-	-	-	-	-
Period 2f Period-Dependent Costs																					
2f.4.1	Insurance	-	-	-	-	-	-	537	54	591	591	-	-	-	-	-	-	-	-	-	-
2f.4.2	Property taxes	-	-	-	-	-	-	1,071	107	1,178	1,178	-	-	-	-	-	-	-	-	-	-
2f.4.3	Health physics supplies	-	919	-	-	-	-	-	230	1,149	1,149	-	-	-	-	-	-	-	-	-	-
2f.4.4	Disposal of DAW generated	-	-	7	3	-	21	-	6	38	38	-	-	-	365	-	-	-	7,304	12	-
2f.4.5	Plant energy budget	-	-	-	-	-	-	319	48	367	367	-	-	-	-	-	-	-	-	-	-
2f.4.6	NRC Fees	-	-	-	-	-	-	426	43	468	468	-	-	-	-	-	-	-	-	-	-
2f.4.7	Emergency Planning Fees	-	-	-	-	-	-	651	65	716	-	716	-	-	-	-	-	-	-	-	-
2f.4.8	ISFSI Operating Costs	-	-	-	-	-	-	87	13	100	-	100	-	-	-	-	-	-	-	-	-
2f.4.9	Corporate A&G Cost	-	-	-	-	-	-	114	17	131	131	-	-	-	-	-	-	-	-	-	-
2f.4.10	Security Staff Cost	-	-	-	-	-	-	4,268	640	4,908	1,227	3,681	-	-	-	-	-	-	-	-	66,076
2f.4.11	DOC Staff Cost	-	-	-	-	-	-	5,436	815	6,252	6,252	-	-	-	-	-	-	-	-	-	58,864
2f.4.12	Utility Staff Cost	-	-	-	-	-	-	6,992	1,049	8,041	6,980	1,061	-	-	-	-	-	-	-	-	83,055
2f.4	Subtotal Period 2f Period-Dependent Costs	-	919	7	3	-	21	19,901	3,087	23,938	18,380	5,558	-	-	365	-	-	-	7,304	12	207,995
2f.0	TOTAL PERIOD 2f COST	-	919	7	3	-	21	28,241	5,343	34,535	28,641	5,894	-	-	365	-	-	-	7,304	152,831	214,235
PERIOD 2 TOTALS		8,022	66,167	20,174	10,403	28,259	53,915	255,584	93,333	535,856	472,476	57,175	6,205	252,631	149,625	963	393	-	19,906,570	1,071,942	2,361,886

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
PERIOD 3b - Site Restoration																					
Period 3b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
3b.1.1.1	Reactor	-	2,566	-	-	-	-	-	385	2,951	-	-	2,951	-	-	-	-	-	-	27,724	-
3b.1.1.2	Access Vaults	-	10	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	59	-
3b.1.1.3	Administration	-	120	-	-	-	-	-	18	138	-	-	138	-	-	-	-	-	-	1,724	-
3b.1.1.4	Auxiliary	-	2,083	-	-	-	-	-	312	2,396	-	-	2,396	-	-	-	-	-	-	19,753	-
3b.1.1.5	Auxiliary Boiler	-	17	-	-	-	-	-	3	19	-	-	19	-	-	-	-	-	-	248	-
3b.1.1.6	Chemical Addition Structure	-	32	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	469	-
3b.1.1.7	Circ Water Pump Enclosure	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	164	-
3b.1.1.8	Circ Water Travel Screen Enclosure	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	160	-
3b.1.1.9	Circulating Water Discharge Structure	-	93	-	-	-	-	-	14	107	-	-	107	-	-	-	-	-	-	542	-
3b.1.1.10	Circulating Water Intake & Screenhouse	-	85	-	-	-	-	-	13	98	-	-	98	-	-	-	-	-	-	683	-
3b.1.1.11	Communication Corridor - Clean	-	681	-	-	-	-	-	102	783	-	-	783	-	-	-	-	-	-	8,280	-
3b.1.1.12	Communication Corridor - Contaminated	-	31	-	-	-	-	-	5	35	-	-	35	-	-	-	-	-	-	184	-
3b.1.1.13	Covered Walkways	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	242	-
3b.1.1.14	Diesel Generator	-	242	-	-	-	-	-	36	279	-	-	279	-	-	-	-	-	-	2,185	-
3b.1.1.15	E.S.W.S. Pumphouse	-	128	-	-	-	-	-	19	148	-	-	148	-	-	-	-	-	-	801	-
3b.1.1.16	ESWS Valve House	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	42	-
3b.1.1.17	FLEX Building No. 1 & 2	-	353	-	-	-	-	-	53	406	-	-	406	-	-	-	-	-	-	2,880	-
3b.1.1.18	GOB - Administration Building	-	196	-	-	-	-	-	29	226	-	-	226	-	-	-	-	-	-	2,962	-
3b.1.1.19	Hot Machine Shop	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	243	-
3b.1.1.20	M.M.O. Building	-	212	-	-	-	-	-	32	244	-	-	244	-	-	-	-	-	-	2,389	-
3b.1.1.21	Main Access Facility	-	356	-	-	-	-	-	53	409	-	-	409	-	-	-	-	-	-	4,717	-
3b.1.1.22	Material Center West	-	73	-	-	-	-	-	11	84	-	-	84	-	-	-	-	-	-	1,379	-
3b.1.1.23	Misc Structures and Additions	-	57	-	-	-	-	-	8	65	-	-	65	-	-	-	-	-	-	910	-
3b.1.1.24	Miscellaneous Site Foundations	-	211	-	-	-	-	-	32	242	-	-	242	-	-	-	-	-	-	1,242	-
3b.1.1.25	Miscellaneous Site Structures	-	1,212	-	-	-	-	-	182	1,393	-	-	1,393	-	-	-	-	-	-	13,693	-
3b.1.1.26	New Covered Walkway	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	79	-
3b.1.1.27	Oil Separator and Waste Tank	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	8	-
3b.1.1.28	Radwaste	-	876	-	-	-	-	-	131	1,007	-	-	1,007	-	-	-	-	-	-	8,111	-
3b.1.1.29	Radwaste Drum Storage	-	127	-	-	-	-	-	19	146	-	-	146	-	-	-	-	-	-	1,449	-
3b.1.1.30	Radwaste Storage Building	-	68	-	-	-	-	-	10	78	-	-	78	-	-	-	-	-	-	1,028	-
3b.1.1.31	SBO Diesel Generator	-	237	-	-	-	-	-	36	273	-	-	273	-	-	-	-	-	-	3,079	-
3b.1.1.32	Security Main Gate North	-	68	-	-	-	-	-	10	78	-	-	78	-	-	-	-	-	-	1,123	-
3b.1.1.33	Security Additions	-	28	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	405	-
3b.1.1.34	Security/Guardhouse	-	31	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	342	-
3b.1.1.35	Site Diesel Generator	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	18	-
3b.1.1.36	Support Complex	-	21	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	389	-
3b.1.1.37	Turbine Building	-	2,285	-	-	-	-	-	343	2,628	-	-	2,628	-	-	-	-	-	-	47,075	-
3b.1.1.38	Turbine Pedestal	-	493	-	-	-	-	-	74	568	-	-	568	-	-	-	-	-	-	2,934	-
3b.1.1.39	Waste Water Treatment	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	172	-
3b.1.1.40	Water Treatment Building North (Z110)	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	608	-
3b.1.1.41	Fuel Building	-	923	-	-	-	-	-	138	1,061	-	-	1,061	-	-	-	-	-	-	7,874	-
3b.1.1	Totals	-	14,026	-	-	-	-	-	2,104	16,130	-	-	16,130	-	-	-	-	-	-	168,368	-
Site Closeout Activities																					
3b.1.2	Remove Rubble	-	1,005	-	-	-	-	-	151	1,156	-	-	1,156	-	-	-	-	-	-	5,660	-
3b.1.3	Grade & landscape site	-	104	-	-	-	-	-	16	120	-	-	120	-	-	-	-	-	-	512	-
3b.1.4	Final report to NRC	-	-	-	-	-	-	187	28	215	215	-	-	-	-	-	-	-	-	-	1,560
3b.1	Subtotal Period 3b Activity Costs	-	15,136	-	-	-	-	187	2,298	17,621	215	-	17,406	-	-	-	-	-	-	174,540	1,560
Period 3b Additional Costs																					
3b.2.1	Concrete Crushing	-	1,018	-	-	-	-	13	155	1,185	-	-	1,185	-	-	-	-	-	-	4,700	-
3b.2.2	Circulating Water Intake Cofferdam	-	327	-	-	-	-	-	49	376	-	-	376	-	-	-	-	-	-	2,584	-
3b.2.3	E.S.W.S. Pumphouse Cofferdam	-	427	-	-	-	-	-	64	491	-	-	491	-	-	-	-	-	-	3,552	-
3b.2.4	Construction Debris	-	-	-	-	-	-	4,050	608	4,658	-	-	4,658	-	-	-	-	-	-	-	-
3b.2.5	Firing Range Closure	-	-	-	-	-	-	750	113	863	-	-	863	-	-	-	-	-	-	-	-
3b.2	Subtotal Period 3b Additional Costs	-	1,772	-	-	-	-	4,813	988	7,573	-	-	7,573	-	-	-	-	-	-	10,836	-
Period 3b Collateral Costs																					
3b.3.1	Small tool allowance	-	101	-	-	-	-	-	15	116	-	-	116	-	-	-	-	-	-	-	-
3b.3.2	Spent Fuel Capital and Transfer	-	-	-	-	-	-	709	106	815	-	815	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	-	101	-	-	-	-	709	122	932	-	815	116	-	-	-	-	-	-	-	-

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 3b Period-Dependent Costs																					
3b.4.1	Insurance	-	-	-	-	-	-	1,031	103	1,134	1,134	-	-	-	-	-	-	-	-	-	-
3b.4.2	Property taxes	-	-	-	-	-	-	1,419	142	1,561	-	1,561	-	-	-	-	-	-	-	-	-
3b.4.3	Heavy equipment rental	-	5,012	-	-	-	-	-	752	5,763	-	-	5,763	-	-	-	-	-	-	-	-
3b.4.4	Plant energy budget	-	-	-	-	-	-	306	46	352	-	352	-	-	-	-	-	-	-	-	-
3b.4.5	NRC ISFSI Fees	-	-	-	-	-	-	281	-	281	-	281	-	-	-	-	-	-	-	-	-
3b.4.6	Emergency Planning Fees	-	-	-	-	-	-	1,249	125	1,373	-	1,373	-	-	-	-	-	-	-	-	-
3b.4.7	ISFSI Operating Costs	-	-	-	-	-	-	167	25	191	-	191	-	-	-	-	-	-	-	-	-
3b.4.8	Corporate A&G Cost	-	-	-	-	-	-	116	17	133	33	100	-	-	-	-	-	-	-	-	-
3b.4.9	Security Staff Cost	-	-	-	-	-	-	8,217	1,233	9,450	0	7,059	2,391	-	-	-	-	-	-	-	126,782
3b.4.10	DOC Staff Cost	-	-	-	-	-	-	9,971	1,496	11,467	-	-	11,467	-	-	-	-	-	-	-	105,208
3b.4.11	Utility Staff Cost	-	-	-	-	-	-	6,775	1,016	7,792	(0)	2,034	5,758	-	-	-	-	-	-	-	84,321
3b.4	Subtotal Period 3b Period-Dependent Costs	-	5,012	-	-	-	-	29,533	4,954	39,499	1,167	12,953	25,379	-	-	-	-	-	-	-	316,311
3b.0	TOTAL PERIOD 3b COST	-	22,020	-	-	-	-	35,242	8,362	65,624	1,382	13,768	50,474	-	-	-	-	-	-	185,376	317,871
PERIOD 3c - Fuel Storage Operations/Shipping																					
Period 3c Direct Decommissioning Activities																					
Period 3c Collateral Costs																					
3c.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	14,083	2,112	16,196	-	16,196	-	-	-	-	-	-	-	-	-
3c.3	Subtotal Period 3c Collateral Costs	-	-	-	-	-	-	14,083	2,112	16,196	-	16,196	-	-	-	-	-	-	-	-	-
Period 3c Period-Dependent Costs																					
3c.4.1	Insurance	-	-	-	-	-	-	18,612	1,861	20,473	-	20,473	-	-	-	-	-	-	-	-	-
3c.4.2	Property taxes	-	-	-	-	-	-	25,623	2,562	28,186	-	28,186	-	-	-	-	-	-	-	-	-
3c.4.4	NRC ISFSI Fees	-	-	-	-	-	-	8,360	-	8,360	-	8,360	-	-	-	-	-	-	-	-	-
3c.4.5	Emergency Planning Fees	-	-	-	-	-	-	22,539	2,254	24,793	-	24,793	-	-	-	-	-	-	-	-	-
3c.4.6	ISFSI Operating Costs	-	-	-	-	-	-	3,006	451	3,457	-	3,457	-	-	-	-	-	-	-	-	-
3c.4.7	Corporate A&G Cost	-	-	-	-	-	-	517	78	595	-	595	-	-	-	-	-	-	-	-	-
3c.4.8	Security Staff Cost	-	-	-	-	-	-	110,845	16,627	127,472	-	127,472	-	-	-	-	-	-	-	-	1,730,412
3c.4.9	Utility Staff Cost	-	-	-	-	-	-	31,910	4,787	36,697	-	36,697	-	-	-	-	-	-	-	-	377,041
3c.4	Subtotal Period 3c Period-Dependent Costs	-	-	-	-	-	-	221,412	28,619	250,031	-	250,031	-	-	-	-	-	-	-	-	2,107,453
3c.0	TOTAL PERIOD 3c COST	-	-	-	-	-	-	235,495	30,732	266,227	-	266,227	-	-	-	-	-	-	-	-	2,107,453
PERIOD 3d - GTCC shipping																					
Period 3d Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
3d.1.1.1	Vessel & Internals GTCC Disposal	-	-	1,143	-	-	14,453	-	2,454	18,050	18,050	-	-	-	-	-	-	2,217	433,180	-	-
3d.1.1	Totals	-	-	1,143	-	-	14,453	-	2,454	18,050	18,050	-	-	-	-	-	-	2,217	433,180	-	-
3d.1	Subtotal Period 3d Activity Costs	-	-	1,143	-	-	14,453	-	2,454	18,050	18,050	-	-	-	-	-	-	2,217	433,180	-	-
Period 3d Collateral Costs																					
3d.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	9	1	10	-	10	-	-	-	-	-	-	-	-	-
3d.3	Subtotal Period 3d Collateral Costs	-	-	-	-	-	-	9	1	10	-	10	-	-	-	-	-	-	-	-	-
Period 3d Period-Dependent Costs																					
3d.4.1	Insurance	-	-	-	-	-	-	27	3	29	29	-	-	-	-	-	-	-	-	-	-
3d.4.2	Property taxes	-	-	-	-	-	-	37	4	40	40	-	-	-	-	-	-	-	-	-	-
3d.4.4	NRC ISFSI Fees	-	-	-	-	-	-	7	-	7	-	7	-	-	-	-	-	-	-	-	-
3d.4.5	Emergency Planning Fees	-	-	-	-	-	-	32	3	35	-	35	-	-	-	-	-	-	-	-	-
3d.4.6	ISFSI Operating Costs	-	-	-	-	-	-	4	1	5	-	5	-	-	-	-	-	-	-	-	-
3d.4.7	Corporate A&G Cost	-	-	-	-	-	-	1	0	1	1	-	-	-	-	-	-	-	-	-	-
3d.4.8	Security Staff Cost	-	-	-	-	-	-	158	24	182	182	-	-	-	-	-	-	-	-	-	2,472
3d.4.9	Utility Staff Cost	-	-	-	-	-	-	46	7	52	52	-	-	-	-	-	-	-	-	-	539
3d.4	Subtotal Period 3d Period-Dependent Costs	-	-	-	-	-	-	312	41	352	305	48	-	-	-	-	-	-	-	-	3,010
3d.0	TOTAL PERIOD 3d COST	-	-	1,143	-	-	14,453	320	2,496	18,413	18,355	58	-	-	-	-	-	2,217	433,180	-	3,010

Table C
Wolf Creek Generating Station
DECON Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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 3e - ISFSI Decontamination																					
Period 3e Direct Decommissioning Activities																					
Period 3e Additional Costs																					
3e.2.1	License Termination ISFSI	-	8	200	867	-	3,560	1,497	1,533	7,664	7,664	-	-	-	20,377	-	-	-	2,555,426	6,204	2,225
3e.2	Subtotal Period 3e Additional Costs	-	8	200	867	-	3,560	1,497	1,533	7,664	7,664	-	-	-	20,377	-	-	-	2,555,426	6,204	2,225
Period 3e Period-Dependent Costs																					
3e.4.1	Insurance	-	-	-	-	-	-	140	35	175	175	-	-	-	-	-	-	-	-	-	-
3e.4.2	Property taxes	-	-	-	-	-	-	316	79	395	395	-	-	-	-	-	-	-	-	-	-
3e.4.3	Plant energy budget	-	-	-	-	-	-	14	3	17	17	-	-	-	-	-	-	-	-	-	-
3e.4.4	Corporate A&G Cost	-	-	-	-	-	-	5	1	7	7	-	-	-	-	-	-	-	-	-	-
3e.4.5	Security Staff Cost	-	-	-	-	-	-	366	92	458	458	-	-	-	-	-	-	-	-	-	4,999
3e.4.6	Utility Staff Cost	-	-	-	-	-	-	323	81	404	404	-	-	-	-	-	-	-	-	-	3,792
3e.4	Subtotal Period 3e Period-Dependent Costs	-	-	-	-	-	-	1,165	291	1,456	1,456	-	-	-	-	-	-	-	-	-	8,792
3e.0	TOTAL PERIOD 3e COST	-	8	200	867	-	3,560	2,662	1,824	9,120	9,120	-	-	-	20,377	-	-	-	2,555,426	6,204	11,017
PERIOD 3f - ISFSI Site Restoration																					
Period 3f Direct Decommissioning Activities																					
Period 3f Additional Costs																					
3f.2.1	Site Restoration ISFSI	-	479	-	-	-	-	302	117	898	-	-	898	-	-	-	-	-	-	2,034	160
3f.2	Subtotal Period 3f Additional Costs	-	479	-	-	-	-	302	117	898	-	-	898	-	-	-	-	-	-	2,034	160
Period 3f Collateral Costs																					
3f.3.1	Small tool allowance	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	-	-
3f.3	Subtotal Period 3f Collateral Costs	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	-	-
Period 3f Period-Dependent Costs																					
3f.4.2	Property taxes	-	-	-	-	-	-	157	16	173	-	-	173	-	-	-	-	-	-	-	-
3f.4.3	Heavy equipment rental	-	115	-	-	-	-	-	17	132	-	-	132	-	-	-	-	-	-	-	-
3f.4.4	Plant energy budget	-	-	-	-	-	-	7	1	8	-	-	8	-	-	-	-	-	-	-	-
3f.4.5	Security Staff Cost	-	-	-	-	-	-	182	27	209	-	-	209	-	-	-	-	-	-	-	2,479
3f.4.6	Utility Staff Cost	-	-	-	-	-	-	127	19	147	-	-	147	-	-	-	-	-	-	-	1,539
3f.4	Subtotal Period 3f Period-Dependent Costs	-	115	-	-	-	-	473	80	667	-	-	667	-	-	-	-	-	-	-	4,018
3f.0	TOTAL PERIOD 3f COST	-	596	-	-	-	-	774	198	1,569	-	-	1,569	-	-	-	-	-	-	2,034	4,178
PERIOD 3 TOTALS		-	22,624	1,343	867	-	18,013	274,494	43,612	360,953	28,858	280,053	52,043	-	20,377	-	-	2,217	2,988,606	193,614	2,443,529
TOTAL COST TO DECOMMISSION		12,075	92,091	21,735	11,614	28,317	74,944	672,462	160,404	1,073,642	670,864	343,044	59,734	264,421	171,255	1,750	393	2,217	23,153,270	1,286,696	6,097,192

TOTAL COST TO DECOMMISSION WITH 17.56% CONTINGENCY:	**$1,073,642**	**thousands of 2020 dollars**
TOTAL NRC LICENSE TERMINATION COST IS 62.48% OR:	**$670,864**	**thousands of 2020 dollars**
SPENT FUEL MANAGEMENT COST IS 31.95% OR:	**$343,044**	**thousands of 2020 dollars**
NON-NUCLEAR DEMOLITION COST IS 5.56% OR:	**$59,734**	**thousands of 2020 dollars**
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	**173,398**	**Cubic Feet**
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	**2,217**	**Cubic Feet**
TOTAL SCRAP METAL REMOVED:	**69,944**	**Tons**
TOTAL CRAFT LABOR REQUIREMENTS:	**1,286,696**	**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 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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	-	-	-	-	-	-	385	115	500	500	-	-	-	-	-	-	-	-	-	-
1a.1.2	Prepare preliminary decommissioning cost	-	-	-	-	-	-	156	23	179	179	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	240	36	276	276	-	-	-	-	-	-	-	-	-	2,000
1a.1.8	Review plant dwgs & specs.	-	-	-	-	-	-	156	23	179	179	-	-	-	-	-	-	-	-	-	1,300
1a.1.9	Perform detailed rad survey									a											
1a.1.10	Estimate by-product inventory	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	End product description	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
1a.1.12	Detailed by-product inventory	-	-	-	-	-	-	180	27	207	207	-	-	-	-	-	-	-	-	-	1,500
1a.1.13	Define major work sequence	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
1a.1.14	Perform SER and EA	-	-	-	-	-	-	372	56	428	428	-	-	-	-	-	-	-	-	-	3,100
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	600	90	690	690	-	-	-	-	-	-	-	-	-	5,000
Activity Specifications																					
1a.1.16.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	590	89	679	679	-	-	-	-	-	-	-	-	-	4,920
1a.1.16.2	Plant systems	-	-	-	-	-	-	500	75	575	575	-	-	-	-	-	-	-	-	-	4,167
1a.1.16.3	Plant structures and buildings	-	-	-	-	-	-	374	56	431	431	-	-	-	-	-	-	-	-	-	3,120
1a.1.16.4	Waste management	-	-	-	-	-	-	240	36	276	276	-	-	-	-	-	-	-	-	-	2,000
1a.1.16.5	Facility and site dormancy	-	-	-	-	-	-	240	36	276	276	-	-	-	-	-	-	-	-	-	2,000
1a.1.16	Total	-	-	-	-	-	-	1,945	292	2,237	2,237	-	-	-	-	-	-	-	-	-	16,207
Detailed Work Procedures																					
1a.1.17.1	Plant systems	-	-	-	-	-	-	142	21	163	163	-	-	-	-	-	-	-	-	-	1,183
1a.1.17.2	Facility closeout & dormancy	-	-	-	-	-	-	144	22	166	166	-	-	-	-	-	-	-	-	-	1,200
1a.1.17	Total	-	-	-	-	-	-	286	43	329	329	-	-	-	-	-	-	-	-	-	2,383
1a.1.18	Procure vacuum drying system	-	-	-	-	-	-	12	2	14	14	-	-	-	-	-	-	-	-	-	100
1a.1.19	Drain/de-energize non-cont. systems									a											
1a.1.20	Drain & dry NSSS									a											
1a.1.21	Drain/de-energize contaminated systems									a											
1a.1.22	Decon/secure contaminated systems									a											
1a.1	Subtotal Period 1a Activity Costs	-	-	-	-	-	-	4,692	761	5,453	5,453	-	-	-	-	-	-	-	-	-	35,890
Period 1a Collateral Costs																					
1a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	432	65	497	-	497	-	-	-	-	-	-	-	-	-
1a.3.2	NEI Annual Fees	-	-	-	-	-	-	555	83	638	638	-	-	-	-	-	-	-	-	-	-
1a.3	Subtotal Period 1a Collateral Costs	-	-	-	-	-	-	987	148	1,135	638	497	-	-	-	-	-	-	-	-	-
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	3,521	352	3,873	3,873	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	3,324	332	3,656	3,656	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	614	-	-	-	-	-	153	767	767	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	753	-	-	-	-	-	113	866	866	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	12	5	-	35	-	11	63	63	-	-	-	610	-	-	-	12,190	20	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	2,058	309	2,366	2,366	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	876	88	964	964	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	1,414	141	1,555	-	1,555	-	-	-	-	-	-	-	-	-
1a.4.9	INPO Fees	-	-	-	-	-	-	346	52	398	398	-	-	-	-	-	-	-	-	-	-
1a.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	845	127	971	-	971	-	-	-	-	-	-	-	-	-
1a.4.11	ISFSI Operating Costs	-	-	-	-	-	-	112	17	129	-	129	-	-	-	-	-	-	-	-	-
1a.4.12	Corporate A&G Cost	-	-	-	-	-	-	579	87	666	666	-	-	-	-	-	-	-	-	-	-
1a.4.13	Security Staff Cost	-	-	-	-	-	-	20,309	3,046	23,356	23,356	-	-	-	-	-	-	-	-	-	316,295
1a.4.14	Utility Staff Cost	-	-	-	-	-	-	31,075	4,661	35,736	35,736	-	-	-	-	-	-	-	-	-	422,240
1a.4	Subtotal Period 1a Period-Dependent Costs	-	1,367	12	5	-	35	64,458	9,489	75,367	72,711	2,655	-	-	610	-	-	-	12,190	20	738,535
1a.0	TOTAL PERIOD 1a COST	-	1,367	12	5	-	35	70,137	10,399	81,955	78,803	3,152	-	-	610	-	-	-	12,190	20	774,425

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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	864	-	-	-	-	-	-	432	1,296	1,296	-	-	-	-	-	-	-	-	24,102	-
1b.1.1.2	Auxiliary	431	-	-	-	-	-	-	216	647	647	-	-	-	-	-	-	-	-	12,527	-
1b.1.1.3	Communication Corridor - Contaminated	10	-	-	-	-	-	-	5	14	14	-	-	-	-	-	-	-	-	276	-
1b.1.1.4	Fuel Building	557	-	-	-	-	-	-	279	836	836	-	-	-	-	-	-	-	-	14,371	-
1b.1.1.5	Hot Machine Shop	12	-	-	-	-	-	-	6	18	18	-	-	-	-	-	-	-	-	344	-
1b.1.1.6	Radwaste	230	-	-	-	-	-	-	115	345	345	-	-	-	-	-	-	-	-	6,671	-
1b.1.1.7	Radwaste Drum Storage	26	-	-	-	-	-	-	13	39	39	-	-	-	-	-	-	-	-	750	-
1b.1.1.8	Radwaste Storage Building	66	-	-	-	-	-	-	33	99	99	-	-	-	-	-	-	-	-	1,901	-
1b.1.1	Totals	2,196	-	-	-	-	-	-	1,098	3,293	3,293	-	-	-	-	-	-	-	-	60,943	-
1b.1	Subtotal Period 1b Activity Costs	2,196	-	-	-	-	-	-	1,098	3,293	3,293	-	-	-	-	-	-	-	-	60,943	-
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	1,055	-	-	-	-	-	-	158	1,213	1,213	-	-	-	-	-	-	-	-	-	-
1b.3.2	Process decommissioning water waste	177	-	119	194	-	520	-	259	1,268	1,268	-	-	-	1,087	-	-	-	65,194	212	-
1b.3.4	Small tool allowance	-	35	-	-	-	-	-	5	40	40	-	-	-	-	-	-	-	-	-	-
1b.3.5	Spent Fuel Capital and Transfer	-	-	-	-	-	-	576	86	663	-	663	-	-	-	-	-	-	-	-	-
1b.3.6	NEI Annual Fees	-	-	-	-	-	-	140	21	161	161	-	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	1,231	35	119	194	-	520	716	530	3,345	2,682	663	-	-	1,087	-	-	-	65,194	212	-
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	1,627	-	-	-	-	-	-	407	2,033	2,033	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	887	89	976	976	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	838	84	922	922	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	503	-	-	-	-	-	126	628	628	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	190	-	-	-	-	-	28	218	218	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	15	6	-	43	-	13	78	78	-	-	-	756	-	-	-	15,111	25	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	519	78	596	596	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	159	16	175	175	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	356	36	392	-	392	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	213	32	245	-	245	-	-	-	-	-	-	-	-	-
1b.4.11	ISFSI Operating Costs	-	-	-	-	-	-	28	4	32	-	32	-	-	-	-	-	-	-	-	-
1b.4.12	Corporate A&G Cost	-	-	-	-	-	-	146	22	168	168	-	-	-	-	-	-	-	-	-	-
1b.4.13	Security Staff Cost	-	-	-	-	-	-	5,016	752	5,768	5,768	-	-	-	-	-	-	-	-	-	78,063
1b.4.14	Utility Staff Cost	-	-	-	-	-	-	7,833	1,175	9,007	9,007	-	-	-	-	-	-	-	-	-	106,428
1b.4	Subtotal Period 1b Period-Dependent Costs	1,627	692	15	6	-	43	15,994	2,861	21,240	20,570	669	-	-	756	-	-	-	15,111	25	184,491
1b.0	TOTAL PERIOD 1b COST	5,053	727	134	201	-	563	16,711	4,489	27,878	26,546	1,332	-	-	1,842	-	-	-	80,305	61,179	184,491
PERIOD 1c - Preparations for SAFSTOR Dormancy																					
Period 1c Direct Decommissioning Activities																					
1c.1.1	Prepare support equipment for storage	-	407	-	-	-	-	-	61	468	468	-	-	-	-	-	-	-	-	3,000	-
1c.1.2	Install containment pressure equal. lines	-	26	-	-	-	-	-	4	30	30	-	-	-	-	-	-	-	-	700	-
1c.1.3	Interim survey prior to dormancy	-	-	-	-	-	-	733	220	953	953	-	-	-	-	-	-	-	-	13,933	-
1c.1.4	Secure building accesses									a											
1c.1.5	Prepare & submit interim report	-	-	-	-	-	-	70	11	81	81	-	-	-	-	-	-	-	-	-	583
1c.1	Subtotal Period 1c Activity Costs	-	432	-	-	-	-	803	295	1,531	1,531	-	-	-	-	-	-	-	-	17,633	583
Period 1c Additional Costs																					
1c.2.1	Spent Fuel Pool Isolation	-	-	-	-	-	-	12,675	1,901	14,576	14,576	-	-	-	-	-	-	-	-	-	-
1c.2	Subtotal Period 1c Additional Costs	-	-	-	-	-	-	12,675	1,901	14,576	14,576	-	-	-	-	-	-	-	-	-	-
Period 1c Collateral Costs																					
1c.3.1	Process decommissioning water waste	192	-	129	212	-	566	-	282	1,380	1,380	-	-	-	1,183	-	-	-	70,961	231	-
1c.3.3	Small tool allowance	-	2	-	-	-	-	-	0	3	3	-	-	-	-	-	-	-	-	-	-
1c.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	576	86	663	-	663	-	-	-	-	-	-	-	-	-
1c.3.5	NEI Annual Fees	-	-	-	-	-	-	140	21	161	161	-	-	-	-	-	-	-	-	-	-
1c.3	Subtotal Period 1c Collateral Costs	192	2	129	212	-	566	716	390	2,206	1,544	663	-	-	1,183	-	-	-	70,961	231	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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																					
1c.4.1	Insurance	-	-	-	-	-	-	887	89	976	976	-	-	-	-	-	-	-	-	-	-
1c.4.2	Property taxes	-	-	-	-	-	-	838	84	922	922	-	-	-	-	-	-	-	-	-	-
1c.4.3	Health physics supplies	-	256	-	-	-	-	-	64	320	320	-	-	-	-	-	-	-	-	-	-
1c.4.4	Heavy equipment rental	-	190	-	-	-	-	-	28	218	218	-	-	-	-	-	-	-	-	-	-
1c.4.5	Disposal of DAW generated	-	-	3	1	-	9	-	3	16	16	-	-	-	154	-	-	-	3,073	5	-
1c.4.6	Plant energy budget	-	-	-	-	-	-	519	78	596	596	-	-	-	-	-	-	-	-	-	-
1c.4.7	NRC Fees	-	-	-	-	-	-	159	16	175	175	-	-	-	-	-	-	-	-	-	-
1c.4.8	Emergency Planning Fees	-	-	-	-	-	-	356	36	392	-	392	-	-	-	-	-	-	-	-	-
1c.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	213	32	245	-	245	-	-	-	-	-	-	-	-	-
1c.4.10	ISFSI Operating Costs	-	-	-	-	-	-	28	4	32	-	32	-	-	-	-	-	-	-	-	-
1c.4.11	Corporate A&G Cost	-	-	-	-	-	-	146	22	168	168	-	-	-	-	-	-	-	-	-	-
1c.4.12	Security Staff Cost	-	-	-	-	-	-	5,016	752	5,768	5,768	-	-	-	-	-	-	-	-	-	78,063
1c.4.13	Utility Staff Cost	-	-	-	-	-	-	7,833	1,175	9,007	9,007	-	-	-	-	-	-	-	-	-	106,428
1c.4	Subtotal Period 1c Period-Dependent Costs	-	446	3	1	-	9	15,994	2,382	18,836	18,167	669	-	-	154	-	-	-	3,073	5	184,491
1c.0	TOTAL PERIOD 1c COST	192	881	132	213	-	574	30,189	4,969	37,150	35,818	1,332	-	-	1,336	-	-	-	74,034	17,869	185,074
PERIOD 1 TOTALS		5,245	2,975	279	419	-	1,172	117,037	19,856	146,983	141,166	5,817	-	-	3,788	-	-	-	166,529	79,068	1,143,990
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	-	-	-	-	-	-	275	41	316	316	-	-	-	-	-	-	-	-	-	-
2a.1.5	Maintenance supplies	-	-	-	-	-	-	378	95	473	473	-	-	-	-	-	-	-	-	-	-
2a.1	Subtotal Period 2a Activity Costs	-	-	-	-	-	-	653	136	789	789	-	-	-	-	-	-	-	-	-	-
Period 2a Collateral Costs																					
2a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	35,995	5,399	41,395	-	41,395	-	-	-	-	-	-	-	-	-
2a.3.2	NEI Annual Fees	-	-	-	-	-	-	1,385	208	1,593	1,593	-	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	-	-	-	-	-	-	37,381	5,607	42,988	1,593	41,395	-	-	-	-	-	-	-	-	-
Period 2a Period-Dependent Costs																					
2a.4.1	Insurance	-	-	-	-	-	-	1,732	173	1,905	1,905	-	-	-	-	-	-	-	-	-	-
2a.4.2	Property taxes	-	-	-	-	-	-	8,305	831	9,136	9,136	-	-	-	-	-	-	-	-	-	-
2a.4.3	Health physics supplies	-	615	-	-	-	-	-	154	769	769	-	-	-	-	-	-	-	-	-	-
2a.4.4	Disposal of DAW generated	-	-	12	5	-	33	-	10	60	60	-	-	-	575	-	-	-	11,498	19	-
2a.4.5	Plant energy budget	-	-	-	-	-	-	1,028	154	1,183	1,183	-	-	-	-	-	-	-	-	-	-
2a.4.6	NRC Fees	-	-	-	-	-	-	569	57	626	626	-	-	-	-	-	-	-	-	-	-
2a.4.7	Emergency Planning Fees	-	-	-	-	-	-	2,097	210	2,307	-	2,307	-	-	-	-	-	-	-	-	-
2a.4.8	Spent Fuel Pool O&M	-	-	-	-	-	-	2,110	317	2,427	-	2,427	-	-	-	-	-	-	-	-	-
2a.4.9	ISFSI Operating Costs	-	-	-	-	-	-	280	42	322	-	322	-	-	-	-	-	-	-	-	-
2a.4.10	Corporate A&G Cost	-	-	-	-	-	-	282	42	324	324	-	-	-	-	-	-	-	-	-	-
2a.4.11	Security Staff Cost	-	-	-	-	-	-	44,175	6,626	50,801	38,964	11,837	-	-	-	-	-	-	-	-	685,554
2a.4.12	Utility Staff Cost	-	-	-	-	-	-	15,389	2,308	17,698	14,282	3,416	-	-	-	-	-	-	-	-	205,288
2a.4	Subtotal Period 2a Period-Dependent Costs	-	615	12	5	-	33	75,966	10,924	87,555	67,247	20,307	-	-	575	-	-	-	11,498	19	890,842
2a.0	TOTAL PERIOD 2a COST	-	615	12	5	-	33	114,000	16,667	131,331	69,629	61,702	-	-	575	-	-	-	11,498	19	890,842
PERIOD 2b - SAFSTOR Dormancy with Dry Spent Fuel Storage																					
Period 2b Direct Decommissioning Activities																					
2b.1.1	Quarterly Inspection									a											
2b.1.2	Semi-annual environmental survey									a											
2b.1.3	Prepare reports									a											
2b.1.4	Bituminous roof replacement	-	-	-	-	-	-	3,280	492	3,772	3,772	-	-	-	-	-	-	-	-	-	-
2b.1.5	Maintenance supplies	-	-	-	-	-	-	4,518	1,129	5,647	5,647	-	-	-	-	-	-	-	-	-	-
2b.1	Subtotal Period 2b Activity Costs	-	-	-	-	-	-	7,798	1,621	9,420	9,420	-	-	-	-	-	-	-	-	-	-
Period 2b Collateral Costs																					
2b.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	15,093	2,264	17,357	-	17,357	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	-	-	-	-	-	-	15,093	2,264	17,357	-	17,357	-	-	-	-	-	-	-	-	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 2b Period-Dependent Costs																					
2b.4.1	Insurance	-	-	-	-	-	-	20,674	2,067	22,741	22,741	-	-	-	-	-	-	-	-	-	-
2b.4.2	Property taxes	-	-	-	-	-	-	28,462	2,846	31,309	31,309	-	-	-	-	-	-	-	-	-	-
2b.4.3	Health physics supplies	-	3,563	-	-	-	-	-	891	4,454	4,454	-	-	-	-	-	-	-	-	-	-
2b.4.4	Disposal of DAW generated	-	-	67	27	-	189	-	58	342	342	-	-	-	3,297	-	-	-	65,938	108	-
2b.4.5	Plant energy budget	-	-	-	-	-	-	6,138	921	7,059	7,059	-	-	-	-	-	-	-	-	-	-
2b.4.6	NRC Fees	-	-	-	-	-	-	6,308	631	6,939	6,939	-	-	-	-	-	-	-	-	-	-
2b.4.7	Emergency Planning Fees	-	-	-	-	-	-	25,036	2,504	27,540	-	27,540	-	-	-	-	-	-	-	-	-
2b.4.8	ISFSI Operating Costs	-	-	-	-	-	-	3,339	501	3,840	-	3,840	-	-	-	-	-	-	-	-	-
2b.4.9	Corporate A&G Cost	-	-	-	-	-	-	1,361	204	1,566	1,566	-	-	-	-	-	-	-	-	-	-
2b.4.10	Security Staff Cost	-	-	-	-	-	-	164,756	24,713	189,469	47,936	141,533	-	-	-	-	-	-	-	-	2,542,173
2b.4.11	Utility Staff Cost	-	-	-	-	-	-	74,365	11,155	85,520	44,727	40,793	-	-	-	-	-	-	-	-	992,747
2b.4	Subtotal Period 2b Period-Dependent Costs	-	3,563	67	27	-	189	330,440	46,491	380,778	167,072	213,706	-	-	3,297	-	-	-	65,938	108	3,534,920
2b.0	TOTAL PERIOD 2b COST	-	3,563	67	27	-	189	353,331	50,376	407,554	176,492	231,063	-	-	3,297	-	-	-	65,938	108	3,534,920
PERIOD 2c - SAFSTOR Dormancy without Spent Fuel Storage																					
Period 2c Direct Decommissioning Activities																					
2c.1.1	Quarterly Inspection									a											
2c.1.2	Semi-annual environmental survey									a											
2c.1.3	Prepare reports									a											
2c.1.4	Bituminous roof replacement	-	-	-	-	-	-	2,186	328	2,514	2,514	-	-	-	-	-	-	-	-	-	-
2c.1.5	Maintenance supplies	-	-	-	-	-	-	3,011	753	3,764	3,764	-	-	-	-	-	-	-	-	-	-
2c.1	Subtotal Period 2c Activity Costs	-	-	-	-	-	-	5,197	1,081	6,278	6,278	-	-	-	-	-	-	-	-	-	-
Period 2c Period-Dependent Costs																					
2c.4.1	Insurance	-	-	-	-	-	-	8,725	872	9,597	9,597	-	-	-	-	-	-	-	-	-	-
2c.4.2	Property taxes	-	-	-	-	-	-	18,971	1,897	20,868	20,868	-	-	-	-	-	-	-	-	-	-
2c.4.3	Health physics supplies	-	2,234	-	-	-	-	-	558	2,792	2,792	-	-	-	-	-	-	-	-	-	-
2c.4.4	Disposal of DAW generated	-	-	41	17	-	116	-	36	210	210	-	-	-	2,024	-	-	-	40,476	66	-
2c.4.5	Plant energy budget	-	-	-	-	-	-	4,091	614	4,705	4,705	-	-	-	-	-	-	-	-	-	-
2c.4.6	NRC Fees	-	-	-	-	-	-	3,761	376	4,137	4,137	-	-	-	-	-	-	-	-	-	-
2c.4.7	Corporate A&G Cost	-	-	-	-	-	-	496	74	571	571	-	-	-	-	-	-	-	-	-	-
2c.4.8	Security Staff Cost	-	-	-	-	-	-	46,318	6,948	53,266	53,266	-	-	-	-	-	-	-	-	-	620,324
2c.4.9	Utility Staff Cost	-	-	-	-	-	-	25,154	3,773	28,927	28,927	-	-	-	-	-	-	-	-	-	361,856
2c.4	Subtotal Period 2c Period-Dependent Costs	-	2,234	41	17	-	116	107,516	15,149	125,073	125,073	-	-	-	2,024	-	-	-	40,476	66	982,180
2c.0	TOTAL PERIOD 2c COST	-	2,234	41	17	-	116	112,714	16,230	131,351	131,351	-	-	-	2,024	-	-	-	40,476	66	982,180
PERIOD 2 TOTALS		-	6,413	120	49	-	338	580,045	83,273	670,237	377,473	292,765	-	-	5,896	-	-	-	117,911	192	5,407,942
PERIOD 3a - Reactivate Site Following SAFSTOR Dormancy																					
Period 3a Direct Decommissioning Activities																					
3a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	156	23	179	179	-	-	-	-	-	-	-	-	-	1,300
3a.1.2	Review plant dwgs & specs.	-	-	-	-	-	-	552	83	635	635	-	-	-	-	-	-	-	-	-	4,600
3a.1.3	Perform detailed rad survey									a											
3a.1.4	End product description	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
3a.1.5	Detailed by-product inventory	-	-	-	-	-	-	156	23	179	179	-	-	-	-	-	-	-	-	-	1,300
3a.1.6	Define major work sequence	-	-	-	-	-	-	900	135	1,035	1,035	-	-	-	-	-	-	-	-	-	7,500
3a.1.7	Perform SER and EA	-	-	-	-	-	-	372	56	428	428	-	-	-	-	-	-	-	-	-	3,100
3a.1.8	Prepare/submit Defueled Technical Specifications	-	-	-	-	-	-	900	135	1,035	1,035	-	-	-	-	-	-	-	-	-	7,500
3a.1.9	Perform Site-Specific Cost Study	-	-	-	-	-	-	600	90	690	690	-	-	-	-	-	-	-	-	-	5,000
3a.1.10	Prepare/submit Irradiated Fuel Management Plan	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
Activity Specifications																					
3a.1.11.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	884	133	1,017	915	-	102	-	-	-	-	-	-	-	7,370
3a.1.11.2	Plant systems	-	-	-	-	-	-	500	75	575	518	-	58	-	-	-	-	-	-	-	4,167
3a.1.11.3	Reactor internals	-	-	-	-	-	-	852	128	980	980	-	-	-	-	-	-	-	-	-	7,100
3a.1.11.4	Reactor vessel	-	-	-	-	-	-	780	117	897	897	-	-	-	-	-	-	-	-	-	6,500
3a.1.11.5	Biological shield	-	-	-	-	-	-	60	9	69	69	-	-	-	-	-	-	-	-	-	500
3a.1.11.6	Steam generators	-	-	-	-	-	-	374	56	431	431	-	-	-	-	-	-	-	-	-	3,120
3a.1.11.7	Reinforced concrete	-	-	-	-	-	-	192	29	221	110	-	110	-	-	-	-	-	-	-	1,600
3a.1.11.8	Main Turbine	-	-	-	-	-	-	48	7	55	-	-	55	-	-	-	-	-	-	-	400
3a.1.11.9	Main Condensers	-	-	-	-	-	-	48	7	55	-	-	55	-	-	-	-	-	-	-	400
3a.1.11.10	Plant structures & buildings	-	-	-	-	-	-	374	56	431	215	-	215	-	-	-	-	-	-	-	3,120
3a.1.11.11	Waste management	-	-	-	-	-	-	552	83	635	635	-	-	-	-	-	-	-	-	-	4,600
3a.1.11.12	Facility & site closeout	-	-	-	-	-	-	108	16	124	62	-	62	-	-	-	-	-	-	-	900
3a.1.11	Total	-	-	-	-	-	-	4,774	716	5,490	4,832	-	657	-	-	-	-	-	-	-	39,777

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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			
Planning & Site Preparations																					
3a.1.12	Prepare dismantling sequence	-	-	-	-	-	-	288	43	331	331	-	-	-	-	-	-	-	-	-	2,400
3a.1.13	Plant prep. & temp. svces	-	-	-	-	-	-	3,500	525	4,025	4,025	-	-	-	-	-	-	-	-	-	-
3a.1.14	Design water clean-up system	-	-	-	-	-	-	168	25	193	193	-	-	-	-	-	-	-	-	-	1,400
3a.1.15	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,400	360	2,760	2,760	-	-	-	-	-	-	-	-	-	-
3a.1.16	Procure casks/liners & containers	-	-	-	-	-	-	148	22	170	170	-	-	-	-	-	-	-	-	-	1,230
3a.1	Subtotal Period 3a Activity Costs	-	-	-	-	-	-	15,154	2,273	17,427	16,769	-	657	-	-	-	-	-	-	-	77,107
Period 3a Additional Costs																					
3a.2.1	Site Characterization	-	-	-	-	-	-	3,109	933	4,042	4,042	-	-	-	-	-	-	-	-	19,100	7,852
3a.2.2	Misc/Hazardous Waste	-	-	85	30	58	-	-	22	196	196	-	-	11,790	-	-	-	-	137,800	740	-
3a.2	Subtotal Period 3a Additional Costs	-	-	85	30	58	-	3,109	955	4,238	4,238	-	-	11,790	-	-	-	-	137,800	19,840	7,852
Period 3a Period-Dependent Costs																					
3a.4.1	Insurance	-	-	-	-	-	-	439	44	483	483	-	-	-	-	-	-	-	-	-	-
3a.4.2	Property taxes	-	-	-	-	-	-	954	95	1,050	1,050	-	-	-	-	-	-	-	-	-	-
3a.4.3	Health physics supplies	-	541	-	-	-	-	-	135	676	676	-	-	-	-	-	-	-	-	-	-
3a.4.4	Heavy equipment rental	-	753	-	-	-	-	-	113	866	866	-	-	-	-	-	-	-	-	-	-
3a.4.5	Disposal of DAW generated	-	-	10	4	-	30	-	9	53	53	-	-	-	514	-	-	-	10,287	17	-
3a.4.6	Plant energy budget	-	-	-	-	-	-	2,058	309	2,366	2,366	-	-	-	-	-	-	-	-	-	-
3a.4.7	NRC Fees	-	-	-	-	-	-	319	32	350	350	-	-	-	-	-	-	-	-	-	-
3a.4.8	Corporate A&G Cost	-	-	-	-	-	-	354	53	407	407	-	-	-	-	-	-	-	-	-	-
3a.4.9	Security Staff Cost	-	-	-	-	-	-	4,156	623	4,779	4,779	-	-	-	-	-	-	-	-	-	65,000
3a.4.10	Utility Staff Cost	-	-	-	-	-	-	19,259	2,889	22,148	22,148	-	-	-	-	-	-	-	-	-	257,920
3a.4	Subtotal Period 3a Period-Dependent Costs	-	1,294	10	4	-	30	27,538	4,302	33,178	33,178	-	-	-	514	-	-	-	10,287	17	322,920
3a.0	TOTAL PERIOD 3a COST	-	1,294	96	34	58	30	45,801	7,530	54,843	54,185	-	657	11,790	514	-	-	-	148,087	19,856	407,879
PERIOD 3b - Decommissioning Preparations																					
Period 3b Direct Decommissioning Activities																					
Detailed Work Procedures																					
3b.1.1.1	Plant systems	-	-	-	-	-	-	568	85	653	588	-	65	-	-	-	-	-	-	-	4,733
3b.1.1.2	Reactor internals	-	-	-	-	-	-	300	45	345	345	-	-	-	-	-	-	-	-	-	2,500
3b.1.1.3	Remaining buildings	-	-	-	-	-	-	162	24	186	47	-	140	-	-	-	-	-	-	-	1,350
3b.1.1.4	CRD cooling assembly	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.5	CRD housings & ICI tubes	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.6	Incore instrumentation	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.7	Reactor vessel	-	-	-	-	-	-	436	65	501	501	-	-	-	-	-	-	-	-	-	3,630
3b.1.1.8	Facility closeout	-	-	-	-	-	-	144	22	166	83	-	83	-	-	-	-	-	-	-	1,200
3b.1.1.9	Missile shields	-	-	-	-	-	-	54	8	62	62	-	-	-	-	-	-	-	-	-	450
3b.1.1.10	Biological shield	-	-	-	-	-	-	144	22	166	166	-	-	-	-	-	-	-	-	-	1,200
3b.1.1.11	Steam generators	-	-	-	-	-	-	552	83	635	635	-	-	-	-	-	-	-	-	-	4,600
3b.1.1.12	Reinforced concrete	-	-	-	-	-	-	120	18	138	69	-	69	-	-	-	-	-	-	-	1,000
3b.1.1.13	Main Turbine	-	-	-	-	-	-	187	28	215	-	-	215	-	-	-	-	-	-	-	1,560
3b.1.1.14	Main Condensers	-	-	-	-	-	-	187	28	215	-	-	215	-	-	-	-	-	-	-	1,560
3b.1.1.15	Auxiliary building	-	-	-	-	-	-	328	49	377	339	-	38	-	-	-	-	-	-	-	2,730
3b.1.1.16	Reactor building	-	-	-	-	-	-	328	49	377	339	-	38	-	-	-	-	-	-	-	2,730
3b.1.1	Total	-	-	-	-	-	-	3,869	580	4,450	3,587	-	863	-	-	-	-	-	-	-	32,243
3b.1	Subtotal Period 3b Activity Costs	-	-	-	-	-	-	3,869	580	4,450	3,587	-	863	-	-	-	-	-	-	-	32,243
Period 3b Collateral Costs																					
3b.3.1	Decon equipment	1,055	-	-	-	-	-	-	158	1,213	1,213	-	-	-	-	-	-	-	-	-	-
3b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	1,348	202	1,550	1,550	-	-	-	-	-	-	-	-	-	-
3b.3.3	Pipe cutting equipment	-	1,200	-	-	-	-	-	180	1,380	1,380	-	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	1,055	1,200	-	-	-	-	1,348	540	4,143	4,143	-	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Decon supplies	38	-	-	-	-	-	-	10	48	48	-	-	-	-	-	-	-	-	-	-
3b.4.2	Insurance	-	-	-	-	-	-	349	35	384	384	-	-	-	-	-	-	-	-	-	-
3b.4.3	Property taxes	-	-	-	-	-	-	481	48	529	529	-	-	-	-	-	-	-	-	-	-
3b.4.4	Health physics supplies	-	298	-	-	-	-	-	75	373	373	-	-	-	-	-	-	-	-	-	-
3b.4.5	Heavy equipment rental	-	380	-	-	-	-	-	57	436	436	-	-	-	-	-	-	-	-	-	-
3b.4.6	Disposal of DAW generated	-	-	6	2	-	17	-	5	30	30	-	-	-	293	-	-	-	5,866	10	-
3b.4.7	Plant energy budget	-	-	-	-	-	-	1,037	156	1,193	1,193	-	-	-	-	-	-	-	-	-	-
3b.4.8	NRC Fees	-	-	-	-	-	-	161	16	177	177	-	-	-	-	-	-	-	-	-	-
3b.4.9	Corporate A&G Cost	-	-	-	-	-	-	178	27	205	205	-	-	-	-	-	-	-	-	-	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Period 3b Period-Dependent Costs (continued)																					
3b.4.10	Security Staff Cost	-	-	-	-	-	-	2,095	314	2,409	2,409	-	-	-	-	-	-	-	-	-	32,767
3b.4.11	DOC Staff Cost	-	-	-	-	-	-	5,229	784	6,013	6,013	-	-	-	-	-	-	-	-	-	58,719
3b.4.12	Utility Staff Cost	-	-	-	-	-	-	9,709	1,456	11,165	11,165	-	-	-	-	-	-	-	-	-	130,020
3b.4	Subtotal Period 3b Period-Dependent Costs	38	678	6	2	-	17	19,239	2,983	22,963	22,963	-	-	-	293	-	-	-	5,866	10	221,506
3b.0	TOTAL PERIOD 3b COST	1,093	1,878	6	2	-	17	24,456	4,103	31,555	30,693	-	863	-	293	-	-	-	5,866	10	253,749
PERIOD 3 TOTALS		1,093	3,171	102	37	58	46	70,257	11,633	86,398	84,878	-	1,520	11,790	808	-	-	-	153,953	19,866	661,628
PERIOD 4a - Large Component Removal																					
Period 4a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
4a.1.1.1	Reactor Coolant Piping	25	130	39	40	185	368	-	175	961	961	-	-	967	1,023	-	-	-	135,750	3,982	-
4a.1.1.2	Pressurizer Relief Tank	4	16	11	11	52	104	-	43	242	242	-	-	273	289	-	-	-	38,367	602	-
4a.1.1.3	Reactor Coolant Pumps & Motors	14	57	68	222	-	1,150	-	349	1,861	1,861	-	-	-	3,386	-	-	-	816,140	2,474	80
4a.1.1.4	Pressurizer	-	37	438	156	-	1,270	-	394	2,295	2,295	-	-	-	3,739	-	-	-	241,053	1,346	1,500
4a.1.1.5	Steam Generators	-	5,793	3,117	3,407	3,622	7,657	-	4,728	28,324	28,324	-	-	40,845	22,546	-	-	-	3,356,336	20,507	4,500
4a.1.1.6	CRDMs/ICIs/Service Structure Removal	21	176	268	50	130	595	-	257	1,498	1,498	-	-	1,227	3,012	-	-	-	160,939	5,371	-
4a.1.1.7	Reactor Vessel Internals	41	6,464	6,817	771	-	10,631	309	12,128	37,161	37,161	-	-	-	3,485	501	393	-	330,677	25,073	1,161
4a.1.1.8	Vessel & Internals GTCC Disposal	-	-	-	-	-	14,453	-	2,168	16,621	16,621	-	-	-	-	-	-	2,217	433,180	-	-
4a.1.1.9	Reactor Vessel	-	8,113	2,009	667	-	5,309	309	9,454	25,861	25,861	-	-	-	15,631	-	-	-	979,036	25,073	1,161
4a.1.1	Totals	106	20,786	12,769	5,324	3,989	41,536	617	29,696	114,823	114,823	-	-	43,312	53,112	501	393	2,217	6,491,479	84,428	8,403
Removal of Major Equipment																					
4a.1.2	Main Turbine/Generator	-	294	264	57	878	-	-	240	1,733	1,733	-	-	5,099	-	-	-	-	305,952	8,585	-
4a.1.3	Main Condensers	-	833	164	68	1,047	-	-	392	2,505	2,505	-	-	8,106	-	-	-	-	364,767	24,802	-
Cascading Costs from Clean Building Demolition																					
4a.1.4.1	Reactor	-	452	-	-	-	-	-	68	519	519	-	-	-	-	-	-	-	-	4,871	-
4a.1.4.2	Auxiliary	-	231	-	-	-	-	-	35	266	266	-	-	-	-	-	-	-	-	2,194	-
4a.1.4.3	Fuel Building	-	99	-	-	-	-	-	15	114	114	-	-	-	-	-	-	-	-	773	-
4a.1.4.4	Hot Machine Shop	-	1	-	-	-	-	-	0	1	1	-	-	-	-	-	-	-	-	7	-
4a.1.4.5	Radwaste	-	45	-	-	-	-	-	7	52	52	-	-	-	-	-	-	-	-	387	-
4a.1.4	Totals	-	828	-	-	-	-	-	124	952	952	-	-	-	-	-	-	-	-	8,233	-
Disposal of Plant Systems																					
4a.1.5.1	AB - Main Steam	-	159	-	-	-	-	-	24	183	-	-	183	-	-	-	-	-	-	5,833	-
4a.1.5.2	AB - Main Steam RCA	-	60	5	16	251	-	-	56	388	388	-	-	2,156	-	-	-	-	87,550	1,515	-
4a.1.5.3	AC - Main Turbine	-	159	-	-	-	-	-	24	183	-	-	183	-	-	-	-	-	-	5,641	-
4a.1.5.4	AD - Condensate	-	177	-	-	-	-	-	27	204	-	-	204	-	-	-	-	-	-	6,144	-
4a.1.5.5	AE - Feedwater	-	121	-	-	-	-	-	18	139	-	-	139	-	-	-	-	-	-	4,271	-
4a.1.5.6	AF - Feedwater Hter Extrction, Drn & Vnt	-	149	-	-	-	-	-	22	171	-	-	171	-	-	-	-	-	-	5,352	-
4a.1.5.7	AK - Condensate Demineralizer	-	55	-	-	-	-	-	8	64	-	-	64	-	-	-	-	-	-	1,944	-
4a.1.5.8	AL - Auxiliary Feedwater	-	34	-	-	-	-	-	5	39	-	-	39	-	-	-	-	-	-	1,174	-
4a.1.5.9	AL-Auxiliary Feedwater Surge Tanks	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	87	-
4a.1.5.10	AQ - Condensate & Feedwater Chem Additn	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	468	-
4a.1.5.11	AX - Acid Feed	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	754	-
4a.1.5.12	Auxiliary Bldg Non-System Specific	-	78	2	7	96	10	-	38	231	231	-	-	824	31	-	-	-	35,454	2,031	-
4a.1.5.13	Auxiliary Bldg Non-System Specific RCA	-	541	16	58	889	-	-	279	1,783	1,783	-	-	7,629	-	-	-	-	309,812	13,471	-
4a.1.5.14	BL - Reactor Makeup Water	-	204	16	27	295	139	-	136	816	816	-	-	2,529	418	-	-	-	129,620	5,227	-
4a.1.5.15	BM - Steam Generator Blowdown	-	416	11	39	601	-	-	201	1,268	1,268	-	-	5,160	-	-	-	-	209,560	10,703	-
4a.1.5.16	CA - Steam Seal	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	455	-
4a.1.5.17	CB - Main Turbine Lube Oil	-	37	-	-	-	-	-	6	42	-	-	42	-	-	-	-	-	-	1,207	-
4a.1.5.18	CC - Generator Hydrogen & CO2	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	198	-
4a.1.5.19	CD - Generator Seal Oil	-	8	-	-	-	-	-	1	10	-	-	10	-	-	-	-	-	-	287	-
4a.1.5.20	CE - Stator Cooling Water	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	241	-
4a.1.5.21	CF - Lube Oil Strg, Xfer & Purification	-	24	-	-	-	-	-	4	27	-	-	27	-	-	-	-	-	-	812	-
4a.1.5.22	CG - Condenser Air Removal	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	657	-
4a.1.5.23	CH - Main Turbine Control Oil	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	1,219	-
4a.1.5.24	CL - Chlorination	-	16	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	569	-
4a.1.5.25	CO - Carbon Dioxide	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	121	-
4a.1.5.26	CW - Circulating Water	-	214	-	-	-	-	-	32	247	-	-	247	-	-	-	-	-	-	7,858	-
4a.1.5.27	CZ - Caustic Acid	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	111	-
4a.1.5.28	DA - Circulating Water System	-	218	-	-	-	-	-	33	251	-	-	251	-	-	-	-	-	-	7,953	-
4a.1.5.29	DM - Equipment Drains	-	35	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,223	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Disposal of Plant Systems (continued)																					
4a.1.5.30	DM - Equipment Drains RCA	-	112	33	118	1,800	-	-	319	2,382	2,382	-	-	15,445	-	-	-	-	627,223	2,840	-
4a.1.5.31	EG - Component Cooling Water RCA	-	564	30	108	1,650	-	-	408	2,760	2,760	-	-	14,161	-	-	-	-	575,071	13,646	-
4a.1.5.32	EJ - Residual Heat Removal	-	262	34	54	520	383	-	251	1,505	1,505	-	-	4,461	1,166	-	-	-	255,554	7,018	-
4a.1.5.33	EM - High Pressure Coolant Injection	-	223	4	16	252	-	-	96	591	591	-	-	2,159	-	-	-	-	87,663	5,527	-
4a.1.5.34	EN - Containment Spray	-	172	6	23	353	-	-	100	654	654	-	-	3,026	-	-	-	-	122,874	4,134	-
4a.1.5.35	FB - Auxiliary Steam	-	59	-	-	-	-	-	9	68	-	-	68	-	-	-	-	-	-	2,106	-
4a.1.5.36	FB - Auxiliary Steam RCA	-	67	2	6	95	-	-	32	202	202	-	-	816	-	-	-	-	33,148	1,537	-
4a.1.5.37	FC - Auxiliary Turbines	-	38	-	-	-	-	-	6	44	-	-	44	-	-	-	-	-	-	1,301	-
4a.1.5.38	FE - Auxiliary Steam Chemical Addition	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	105	-
4a.1.5.39	GE - Turbine Bldg HVAC	-	83	-	-	-	-	-	13	96	-	-	96	-	-	-	-	-	-	3,189	-
4a.1.5.40	GF - Miscellaneous Building HVAC	-	25	-	-	-	-	-	4	29	-	-	29	-	-	-	-	-	-	987	-
4a.1.5.41	GS - Containment Hydrogen Control	-	53	2	6	93	-	-	28	183	183	-	-	801	-	-	-	-	32,539	1,395	-
4a.1.5.42	HF - Secondary Liquid Waste	-	679	56	92	983	525	-	468	2,803	2,803	-	-	8,431	1,588	-	-	-	444,251	17,832	-
4a.1.5.43	HY - Hydrogen	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	223	-
4a.1.5.44	KH - Service Gas	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	644	-
4a.1.5.45	LE - Oily Waste	-	72	-	-	-	-	-	11	83	-	-	83	-	-	-	-	-	-	2,575	-
4a.1.5.46	LE - Oily Waste RCA	-	156	4	13	200	-	-	71	445	445	-	-	1,718	-	-	-	-	69,785	3,518	-
4a.1.5.47	NT - Nitrogen	-	4	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	149	-
4a.1.5.48	OX - Oxygen	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	171	-
4a.1.5.49	SW - Screen Wash	-	19	-	-	-	-	-	3	22	-	-	22	-	-	-	-	-	-	635	-
4a.1.5.50	Turbine Bldg Non-System Specific	-	462	-	-	-	-	-	69	531	-	-	531	-	-	-	-	-	-	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	-	15	-	-	-	-	-	2	18	-	-	18	-	-	-	-	-	-	593	-
4a.1.5.54	WL - Cooling Lake Makeup & Blowdown	-	21	-	-	-	-	-	3	24	-	-	24	-	-	-	-	-	-	745	-
4a.1.5	Totals	-	5,968	221	585	8,079	1,056	-	2,840	18,748	16,011	-	2,738	69,317	3,203	-	-	-	3,020,102	174,218	-
4a.1.6	Scaffolding in support of decommissioning	-	929	27	12	156	35	-	269	1,427	1,427	-	-	1,206	106	-	-	-	61,032	33,925	-
4a.1	Subtotal Period 4a Activity Costs	106	29,639	13,445	6,046	14,149	42,627	617	33,561	140,189	137,451	-	2,738	127,040	56,421	501	393	2,217	10,243,330	334,191	8,403
Period 4a Collateral Costs																					
4a.3.1	Process decommissioning water waste	5	-	8	14	-	37	-	14	78	78	-	-	-	76	-	-	-	4,587	15	-
4a.3.3	Small tool allowance	-	226	-	-	-	-	-	34	260	234	-	26	-	-	-	-	-	-	-	-
4a.3.4	On-site survey and release of 116.8 tons clean metallic waste	-	-	-	-	-	-	168	17	185	185	-	-	-	-	-	-	-	-	-	-
4a.3	Subtotal Period 4a Collateral Costs	5	226	8	14	-	37	168	65	523	497	-	26	-	76	-	-	-	4,587	15	-
Period 4a Period-Dependent Costs																					
4a.4.1	Decon supplies	104	-	-	-	-	-	-	26	130	130	-	-	-	-	-	-	-	-	-	-
4a.4.2	Insurance	-	-	-	-	-	-	944	94	1,038	1,038	-	-	-	-	-	-	-	-	-	-
4a.4.3	Property taxes	-	-	-	-	-	-	1,299	130	1,429	1,429	-	-	-	-	-	-	-	-	-	-
4a.4.4	Health physics supplies	-	2,725	-	-	-	-	-	681	3,406	3,406	-	-	-	-	-	-	-	-	-	-
4a.4.5	Heavy equipment rental	-	3,407	-	-	-	-	-	511	3,918	3,918	-	-	-	-	-	-	-	-	-	-
4a.4.6	Disposal of DAW generated	-	-	102	42	-	289	-	89	522	522	-	-	-	5,032	-	-	-	100,648	164	-
4a.4.7	Plant energy budget	-	-	-	-	-	-	2,662	399	3,061	3,061	-	-	-	-	-	-	-	-	-	-
4a.4.8	NRC Fees	-	-	-	-	-	-	637	64	701	701	-	-	-	-	-	-	-	-	-	-
4a.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	578	87	665	665	-	-	-	-	-	-	-	-	-	-
4a.4.10	Corporate A&G Cost	-	-	-	-	-	-	486	73	558	558	-	-	-	-	-	-	-	-	-	-
4a.4.11	Remedial Actions Surveys	-	-	-	-	-	-	1,401	210	1,612	1,612	-	-	-	-	-	-	-	-	-	-
4a.4.12	Security Staff Cost	-	-	-	-	-	-	5,659	849	6,507	6,507	-	-	-	-	-	-	-	-	-	88,507
4a.4.13	DOC Staff Cost	-	-	-	-	-	-	16,886	2,533	19,419	19,419	-	-	-	-	-	-	-	-	-	195,423
4a.4.14	Utility Staff Cost	-	-	-	-	-	-	26,545	3,982	30,526	30,526	-	-	-	-	-	-	-	-	-	354,027
4a.4	Subtotal Period 4a Period-Dependent Costs	104	6,132	102	42	-	289	57,097	9,727	73,493	73,493	-	-	-	5,032	-	-	-	100,648	164	637,957
4a.0	TOTAL PERIOD 4a COST	215	35,997	13,555	6,102	14,149	42,953	57,882	43,354	214,206	211,442	-	2,764	127,040	61,530	501	393	2,217	10,348,570	334,370	646,360
PERIOD 4b - Site Decontamination																					
Period 4b Direct Decommissioning Activities																					
4b.1.1	Remove spent fuel racks	471	49	262	109	-	2,045	-	802	3,739	3,739	-	-	-	6,250	-	-	-	397,077	1,722	-
Disposal of Plant Systems																					
4b.1.2.1	AN - Demineralized Wtr Storage & xfer	-	44	-	-	-	-	-	7	50	-	-	50	-	-	-	-	-	-	1,548	-
4b.1.2.2	AN - Demineralized Wtr Strg & xfer RCA	-	15	0	1	14	-	-	6	37	37	-	-	120	-	-	-	-	4,855	334	-
4b.1.2.3	AP - Condensate Storage & Transfer	-	52	-	-	-	-	-	8	60	-	-	60	-	-	-	-	-	-	1,660	-
4b.1.2.4	BB - Reactor Coolant	-	205	29	39	293	367	-	196	1,128	1,128	-	-	2,511	1,121	-	-	-	173,293	5,731	-
4b.1.2.5	BG - Chemical & Volume Control	-	666	78	108	950	853	-	546	3,201	3,201	-	-	8,155	2,586	-	-	-	496,849	17,005	-

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															Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet			
Disposal of Plant Systems (continued)																					
4b.1.2.6	BN - Borated Refueling Water Storage	-	221	13	48	729	-	-	173	1,183	1,183	-	-	6,255	-	-	-	-	254,024	6,161	-
4b.1.2.7	Control Bldg Non-System Specific	-	140	5	16	249	-	-	75	485	485	-	-	2,139	-	-	-	-	86,849	3,413	-
4b.1.2.8	Control Bldg Non-System Specific Cln	-	979	-	-	-	-	-	147	1,126	-	-	1,126	-	-	-	-	-	-	29,076	-
4b.1.2.9	DO - Diesel Oil	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	48	-
4b.1.2.10	EA - Service Water	-	73	-	-	-	-	-	11	83	-	-	83	-	-	-	-	-	-	2,592	-
4b.1.2.11	EB - Closed Cooling Water	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,267	-
4b.1.2.12	EC - Fuel Pool Cooling & Cleanup	-	281	8	31	480	-	-	148	949	949	-	-	4,115	-	-	-	-	167,129	7,154	-
4b.1.2.13	EF - Essential Service Water	-	106	-	-	-	-	-	16	122	-	-	122	-	-	-	-	-	-	3,800	-
4b.1.2.14	EF - Essential Service Water RCA	-	71	3	11	166	-	-	45	296	296	-	-	1,427	-	-	-	-	57,959	1,734	-
4b.1.2.15	EP - Accumulator Safety Injection	-	114	4	15	228	-	-	65	427	427	-	-	1,958	-	-	-	-	79,502	2,904	-
4b.1.2.16	FA - Auxiliary Steam Generator	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	521	-
4b.1.2.17	FO - Fuel Oil	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	486	-
4b.1.2.18	FP - Fire Protection	-	105	-	-	-	-	-	16	120	-	-	120	-	-	-	-	-	-	3,826	-
4b.1.2.19	FP - Fire Protection RCA	-	152	10	34	524	-	-	123	842	842	-	-	4,492	-	-	-	-	182,411	3,541	-
4b.1.2.20	Fuel Bldg Non-System Specific	-	34	1	3	37	4	-	16	95	95	-	-	322	12	-	-	-	13,829	850	-
4b.1.2.21	Fuel Bldg Non-System Specific RCA	-	249	7	24	373	-	-	122	775	775	-	-	3,200	-	-	-	-	129,974	5,859	-
4b.1.2.22	Fuel Building Fire Protection	-	120	6	22	343	-	-	85	577	577	-	-	2,941	-	-	-	-	119,444	2,802	-
4b.1.2.23	GA - Plant Heating	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	1,912	-
4b.1.2.24	GA - Plant Heating RCA	-	93	2	6	87	-	-	37	225	225	-	-	746	-	-	-	-	30,275	2,072	-
4b.1.2.25	GB - Central Chilled Water	-	51	-	-	-	-	-	8	58	-	-	58	-	-	-	-	-	-	1,803	-
4b.1.2.26	GB - Central Chilled Water RCA	-	22	0	1	22	-	-	9	54	54	-	-	187	-	-	-	-	7,591	482	-
4b.1.2.27	GD - Esstl Srvc Wtr Pumphs Bldg HVAC	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	284	-
4b.1.2.28	GG - Fuel Building HVAC	-	185	8	30	460	-	-	120	803	803	-	-	3,945	-	-	-	-	160,195	4,052	-
4b.1.2.29	GH - Radwaste Building HVAC	-	134	5	20	299	-	-	82	539	539	-	-	2,561	-	-	-	-	104,012	3,004	-
4b.1.2.30	GK - Control Building HVAC	-	96	-	-	-	-	-	14	111	-	-	111	-	-	-	-	-	-	3,959	-
4b.1.2.31	GL - Auxiliary Building HVAC	-	336	11	41	627	-	-	185	1,200	1,200	-	-	5,381	-	-	-	-	218,514	7,364	-
4b.1.2.32	GM - Diesel Generator Building HVAC	-	17	-	-	-	-	-	2	19	-	-	19	-	-	-	-	-	-	695	-
4b.1.2.33	GN - Containment Cooling	-	362	17	63	962	-	-	246	1,650	1,650	-	-	8,250	-	-	-	-	335,052	8,317	-
4b.1.2.34	GP - Containmnt Integratd Leak Rate Test	-	30	1	4	68	-	-	18	122	122	-	-	580	-	-	-	-	23,570	750	-
4b.1.2.35	GR - Containment Atmospheric Control	-	13	2	9	133	-	-	25	182	182	-	-	1,143	-	-	-	-	46,407	350	-
4b.1.2.36	GT - Containment Purge HVAC	-	85	5	17	255	-	-	62	423	423	-	-	2,185	-	-	-	-	88,746	1,973	-
4b.1.2.37	HA - Gaseous Radwaste	-	258	8	28	431	-	-	134	859	859	-	-	3,699	-	-	-	-	150,219	6,296	-
4b.1.2.38	HB - Liquid Radwaste	-	606	56	82	856	482	-	418	2,500	2,500	-	-	7,343	1,450	-	-	-	391,794	15,380	-
4b.1.2.39	HC - Solid Radwaste	-	342	37	52	465	400	-	266	1,561	1,561	-	-	3,986	1,211	-	-	-	239,489	8,570	-
4b.1.2.40	HD - Decontamination	-	71	3	9	142	-	-	41	266	266	-	-	1,220	-	-	-	-	49,558	1,828	-
4b.1.2.41	HE - Boron Recycle	-	354	28	40	403	263	-	224	1,312	1,312	-	-	3,460	794	-	-	-	191,531	8,970	-
4b.1.2.42	JE - Emergency Fuel Oil	-	39	-	-	-	-	-	6	45	-	-	45	-	-	-	-	-	-	1,260	-
4b.1.2.43	KA - Compressed Air and Instrument	-	175	-	-	-	-	-	26	201	-	-	201	-	-	-	-	-	-	6,089	-
4b.1.2.44	KB - Breathing Air	-	31	-	-	-	-	-	5	35	-	-	35	-	-	-	-	-	-	1,075	-
4b.1.2.45	KC - Fire Protection	-	256	-	-	-	-	-	38	295	-	-	295	-	-	-	-	-	-	9,256	-
4b.1.2.46	KC - Fire Protection RCA	-	274	13	45	693	-	-	181	1,206	1,206	-	-	5,944	-	-	-	-	241,384	6,383	-
4b.1.2.47	KD - Domestic Water	-	49	-	-	-	-	-	7	56	-	-	56	-	-	-	-	-	-	1,708	-
4b.1.2.48	KE - Fuel Hndlg & Strg Reactor Vssl Serv	-	12	2	7	103	-	-	20	143	143	-	-	882	-	-	-	-	35,813	332	-
4b.1.2.49	KJ - Standby Diesel Engine	-	204	-	-	-	-	-	31	235	-	-	235	-	-	-	-	-	-	6,749	-
4b.1.2.50	LA - Sanitary Drains	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	290	-
4b.1.2.51	LA - Sanitary Drains RCA	-	21	1	2	32	-	-	10	66	66	-	-	272	-	-	-	-	11,053	422	-
4b.1.2.52	LB - Roof Drains	-	36	-	-	-	-	-	5	41	-	-	41	-	-	-	-	-	-	1,276	-
4b.1.2.53	LB - Roof Drains RCA	-	115	5	16	249	-	-	69	454	454	-	-	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	-	84	2	6	93	-	-	36	221	221	-	-	797	-	-	-	-	32,369	2,139	-
4b.1.2.56	LF - Floor & Equipment Drains	-	1,045	88	114	776	1,189	-	701	3,914	3,914	-	-	6,660	3,627	-	-	-	501,387	26,164	-
4b.1.2.57	Main Access Facility	-	10	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	339	-
4b.1.2.58	RM - Process Sampling & Analysis	-	90	2	8	115	-	-	41	256	256	-	-	990	-	-	-	-	40,200	2,450	-
4b.1.2.59	Radwaste Bldg Non-System Specific	-	127	4	11	155	16	-	61	374	374	-	-	1,329	50	-	-	-	57,145	3,253	-
4b.1.2.60	Radwaste Bldg Non-System Specific RCA	-	903	27	97	1,478	-	-	465	2,969	2,969	-	-	12,684	-	-	-	-	515,103	21,919	-
4b.1.2.61	Reactor Bldg Non-System Specific	-	65	1	4	59	6	-	27	163	163	-	-	502	19	-	-	-	21,590	1,569	-
4b.1.2.62	Reactor Bldg Non-System Specific RCA	-	468	10	36	556	-	-	207	1,277	1,277	-	-	4,768	-	-	-	-	193,612	10,425	-
4b.1.2.63	SBO Diesel Generator	-	111	-	-	-	-	-	17	128	-	-	128	-	-	-	-	-	-	3,610	-
4b.1.2.64	SJ - Nuclear Sampling	-	51	1	5	79	-	-	25	162	162	-	-	677	-	-	-	-	27,501	1,430	-
4b.1.2.65	ST - Sewage Treatment	-	66	-	-	-	-	-	10	76	-	-	76	-	-	-	-	-	-	2,316	-
4b.1.2.66	SZ - Service Air	-	53	-	-	-	-	-	8	61	-	-	61	-	-	-	-	-	-	1,892	-
4b.1.2.67	VA - I&C Shop HVAC	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	155	-
4b.1.2.68	VB - I&C Shop Computer Room HVAC	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	106	-
4b.1.2.69	VC - Health Physics Computer Room HVAC	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	208	-
4b.1.2.70	VJ - Shop Bldg Machine Shop Area Vent	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	57	-
4b.1.2.71	VL - Shop Building HVAC	-	3	-	-	-	-	-	0	4	-	-	4	-	-	-	-	-	-	101	-
4b.1.2.72	VS - Admin Bldg HVAC	-	8	-	-	-	-	-	1	9	-	-	9	-	-	-	-	-	-	262	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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.1.2.73	VT - Tech Support Building HVAC	-	3	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	87	-
4b.1.2.74	VW - Waste Water Treatment Ventilation	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	52	-
4b.1.2.75	WD - Domestic Water	-	24	-	-	-	-	-	4	27	-	-	27	-	-	-	-	-	-	870	-
4b.1.2.76	WM - Makeup Demineralizer	-	111	-	-	-	-	-	17	127	-	-	127	-	-	-	-	-	-	3,929	-
4b.1.2.77	WS - Plant Services Water	-	91	-	-	-	-	-	14	105	-	-	105	-	-	-	-	-	-	3,297	-
4b.1.2.78	WS - Plant Services Water RCA	-	29	4	14	214	-	-	42	303	303	-	-	1,838	-	-	-	-	74,625	782	-
4b.1.2.79	WT - Waste Water Treatment	-	21	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	769	-
4b.1.2.80	WZ - Radioactive Liquid Waste	-	33	4	5	29	55	-	27	152	152	-	-	247	167	-	-	-	20,647	783	-
4b.1.2.81	Yard Non-System Specific	-	18	-	-	-	-	-	3	20	-	-	20	-	-	-	-	-	-	603	-
4b.1.2	Totals	-	11,461	507	1,124	14,225	3,636	-	5,829	36,781	33,351	-	3,431	122,048	11,036	-	-	-	5,662,357	307,568	-
4b.1.3	Scaffolding in support of decommissioning	-	1,394	40	18	234	52	-	403	2,141	2,141	-	-	1,809	160	-	-	-	91,548	50,887	-
Decontamination of Site Buildings																					
4b.1.4.1	Reactor	791	695	63	252	694	872	-	935	4,302	4,302	-	-	5,955	13,318	-	-	-	874,477	38,225	-
4b.1.4.2	Auxiliary	406	184	18	70	255	236	-	359	1,529	1,529	-	-	2,185	3,518	-	-	-	255,780	15,363	-
4b.1.4.3	Communication Corridor - Contaminated	9	3	0	1	2	5	-	7	27	27	-	-	17	76	-	-	-	4,296	306	-
4b.1.4.4	Fuel Building	505	513	12	34	315	89	-	456	1,923	1,923	-	-	2,705	984	-	-	-	158,200	27,457	-
4b.1.4.5	Hot Machine Shop	11	5	0	2	-	6	-	9	32	32	-	-	-	94	-	-	-	4,446	421	-
4b.1.4.6	RWST Foundation Decon	-	3	1	3	-	10	-	4	20	20	-	-	-	168	-	-	-	7,920	48	-
4b.1.4.7	Radwaste	216	83	9	35	98	122	-	180	744	744	-	-	844	1,857	-	-	-	122,469	7,815	-
4b.1.4.8	Radwaste Drum Storage	24	8	1	4	8	13	-	19	78	78	-	-	66	208	-	-	-	12,565	850	-
4b.1.4.9	Radwaste Storage Building	62	15	2	9	-	33	-	44	165	165	-	-	-	545	-	-	-	25,740	2,013	-
4b.1.4	Totals	2,025	1,510	106	409	1,372	1,385	-	2,014	8,820	8,820	-	-	11,773	20,770	-	-	-	1,465,893	92,498	-
4b.1.5	Prepare/submit License Termination Plan	-	-	-	-	-	-	492	74	565	565	-	-	-	-	-	-	-	-	-	4,096
4b.1.6	Receive NRC approval of termination plan									a											
4b.1	Subtotal Period 4b Activity Costs	2,496	14,413	915	1,661	15,831	7,118	492	9,121	52,046	48,616	-	3,431	135,630	38,216	-	-	-	7,616,876	452,675	4,096
Period 4b Additional Costs																					
4b.2.1	License Terminatin Survey Planning	-	-	-	-	-	-	1,425	428	1,853	1,853	-	-	-	-	-	-	-	-	-	12,480
4b.2.2	Operational Equipment	-	-	23	75	844	-	-	140	1,083	1,083	-	-	11,760	-	-	-	-	294,000	32	-
4b.2.3	Excavation of Underground Services	-	2,677	-	-	-	-	608	760	4,045	4,045	-	-	-	-	-	-	-	-	15,949	-
4b.2.4	License Termination ISFSI	-	8	200	867	-	3,560	2,662	1,824	9,120	9,120	-	-	-	20,377	-	-	-	2,555,426	6,204	11,017
4b.2	Subtotal Period 4b Additional Costs	-	2,684	223	943	844	3,560	4,695	3,152	16,100	16,100	-	-	11,760	20,377	-	-	-	2,849,426	22,185	23,497
Period 4b Collateral Costs																					
4b.3.1	Process decommissioning water waste	12	-	22	37	-	98	-	38	207	207	-	-	-	204	-	-	-	12,265	40	-
4b.3.3	Small tool allowance	-	263	-	-	-	-	-	39	302	302	-	-	-	-	-	-	-	-	-	-
4b.3.4	Decommissioning Equipment Disposition	-	-	133	68	775	173	-	183	1,332	1,332	-	-	6,000	529	-	-	-	303,608	147	-
4b.3.5	On-site survey and release of 44.30 tons clean metallic waste	-	-	-	-	-	-	64	6	70	70	-	-	-	-	-	-	-	-	-	-
4b.3	Subtotal Period 4b Collateral Costs	12	263	155	105	775	271	64	267	1,912	1,912	-	-	6,000	733	-	-	-	315,873	187	-
Period 4b Period-Dependent Costs																					
4b.4.1	Decon supplies	1,812	-	-	-	-	-	-	453	2,265	2,265	-	-	-	-	-	-	-	-	-	-
4b.4.2	Insurance	-	-	-	-	-	-	1,861	186	2,047	2,047	-	-	-	-	-	-	-	-	-	-
4b.4.3	Property taxes	-	-	-	-	-	-	2,562	256	2,818	2,818	-	-	-	-	-	-	-	-	-	-
4b.4.4	Health physics supplies	-	4,263	-	-	-	-	-	1,066	5,329	5,329	-	-	-	-	-	-	-	-	-	-
4b.4.5	Heavy equipment rental	-	6,900	-	-	-	-	-	1,035	7,935	7,935	-	-	-	-	-	-	-	-	-	-
4b.4.6	Disposal of DAW generated	-	-	134	55	-	379	-	117	685	685	-	-	-	6,610	-	-	-	132,195	216	-
4b.4.7	Plant energy budget	-	-	-	-	-	-	4,144	622	4,765	4,765	-	-	-	-	-	-	-	-	-	-
4b.4.8	NRC Fees	-	-	-	-	-	-	1,256	126	1,382	1,382	-	-	-	-	-	-	-	-	-	-
4b.4.9	Liquid Radwaste Processing Equipment/Services	-	-	-	-	-	-	1,141	171	1,312	1,312	-	-	-	-	-	-	-	-	-	-
4b.4.10	Corporate A&G Cost	-	-	-	-	-	-	904	136	1,039	1,039	-	-	-	-	-	-	-	-	-	-
4b.4.11	Remedial Actions Surveys	-	-	-	-	-	-	2,763	414	3,178	3,178	-	-	-	-	-	-	-	-	-	-
4b.4.12	Security Staff Cost	-	-	-	-	-	-	11,158	1,674	12,831	12,831	-	-	-	-	-	-	-	-	-	174,521
4b.4.13	DOC Staff Cost	-	-	-	-	-	-	32,516	4,877	37,393	37,393	-	-	-	-	-	-	-	-	-	374,172
4b.4.14	Utility Staff Cost	-	-	-	-	-	-	49,673	7,451	57,124	57,124	-	-	-	-	-	-	-	-	-	658,990
4b.4	Subtotal Period 4b Period-Dependent Costs	1,812	11,163	134	55	-	379	107,978	18,583	140,105	140,105	-	-	-	6,610	-	-	-	132,195	216	1,207,682
4b.0	TOTAL PERIOD 4b COST	4,321	28,524	1,427	2,763	17,449	11,328	113,228	31,124	210,163	206,733	-	3,431	153,390	65,936	-	-	-	10,914,370	475,262	1,235,275

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Wolf Creek Generating Station
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Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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 4f - License Termination																					
Period 4f Direct Decommissioning Activities																					
4f.1.1	ORISE confirmatory survey	-	-	-	-	-	-	163	49	212	212	-	-	-	-	-	-	-	-	-	-
4f.1.2	Terminate license									a											
4f.1	Subtotal Period 4f Activity Costs	-	-	-	-	-	-	163	49	212	212	-	-	-	-	-	-	-	-	-	-
Period 4f Additional Costs																					
4f.2.1	License Termination Survey	-	-	-	-	-	-	6,538	1,961	8,499	8,499	-	-	-	-	-	-	-	-	152,819	6,240
4f.2	Subtotal Period 4f Additional Costs	-	-	-	-	-	-	6,538	1,961	8,499	8,499	-	-	-	-	-	-	-	-	152,819	6,240
Period 4f Collateral Costs																					
4f.3.1	DOC staff relocation expenses	-	-	-	-	-	-	1,348	202	1,550	1,550	-	-	-	-	-	-	-	-	-	-
4f.3	Subtotal Period 4f Collateral Costs	-	-	-	-	-	-	1,348	202	1,550	1,550	-	-	-	-	-	-	-	-	-	-
Period 4f Period-Dependent Costs																					
4f.4.1	Insurance	-	-	-	-	-	-	535	54	589	589	-	-	-	-	-	-	-	-	-	-
4f.4.2	Property taxes	-	-	-	-	-	-	737	74	811	811	-	-	-	-	-	-	-	-	-	-
4f.4.3	Health physics supplies	-	915	-	-	-	-	-	229	1,143	1,143	-	-	-	-	-	-	-	-	-	-
4f.4.4	Disposal of DAW generated	-	-	7	3	-	21	-	6	37	37	-	-	-	360	-	-	-	7,203	12	-
4f.4.5	Plant energy budget	-	-	-	-	-	-	318	48	366	366	-	-	-	-	-	-	-	-	-	-
4f.4.6	NRC Fees	-	-	-	-	-	-	424	42	466	466	-	-	-	-	-	-	-	-	-	-
4f.4.7	Corporate A&G Cost	-	-	-	-	-	-	105	16	120	120	-	-	-	-	-	-	-	-	-	-
4f.4.8	Security Staff Cost	-	-	-	-	-	-	1,350	202	1,552	1,552	-	-	-	-	-	-	-	-	-	19,284
4f.4.9	DOC Staff Cost	-	-	-	-	-	-	5,417	813	6,230	6,230	-	-	-	-	-	-	-	-	-	58,656
4f.4.10	Utility Staff Cost	-	-	-	-	-	-	6,430	964	7,394	7,394	-	-	-	-	-	-	-	-	-	76,333
4f.4	Subtotal Period 4f Period-Dependent Costs	-	915	7	3	-	21	15,316	2,448	18,709	18,709	-	-	-	360	-	-	-	7,203	12	154,273
4f.0	TOTAL PERIOD 4f COST	-	915	7	3	-	21	23,364	4,660	28,970	28,970	-	-	-	360	-	-	-	7,203	152,831	160,513
PERIOD 4 TOTALS		4,535	65,435	14,990	8,868	31,598	54,301	194,474	79,137	453,339	447,144	-	6,194	280,430	127,826	501	393	2,217	21,270,140	962,462	2,042,148
PERIOD 5b - Site Restoration																					
Period 5b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
5b.1.1.1	Reactor	-	2,566	-	-	-	-	-	385	2,951	-	-	2,951	-	-	-	-	-	-	27,724	-
5b.1.1.2	Access Vaults	-	10	-	-	-	-	-	2	12	-	-	12	-	-	-	-	-	-	59	-
5b.1.1.3	Administration	-	120	-	-	-	-	-	18	138	-	-	138	-	-	-	-	-	-	1,724	-
5b.1.1.4	Auxiliary	-	2,083	-	-	-	-	-	312	2,396	-	-	2,396	-	-	-	-	-	-	19,753	-
5b.1.1.5	Auxiliary Boiler	-	17	-	-	-	-	-	3	19	-	-	19	-	-	-	-	-	-	248	-
5b.1.1.6	Chemical Addition Structure	-	32	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	469	-
5b.1.1.7	Circ Water Pump Enclosure	-	5	-	-	-	-	-	1	6	-	-	6	-	-	-	-	-	-	164	-
5b.1.1.8	Circ Water Travel Screen Enclosure	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	160	-
5b.1.1.9	Circulating Water Discharge Structure	-	93	-	-	-	-	-	14	107	-	-	107	-	-	-	-	-	-	542	-
5b.1.1.10	Circulating Water Intake & Screenhouse	-	85	-	-	-	-	-	13	98	-	-	98	-	-	-	-	-	-	683	-
5b.1.1.11	Communication Corridor - Clean	-	681	-	-	-	-	-	102	783	-	-	783	-	-	-	-	-	-	8,280	-
5b.1.1.12	Communication Corridor - Contaminated	-	31	-	-	-	-	-	5	35	-	-	35	-	-	-	-	-	-	184	-
5b.1.1.13	Covered Walkways	-	11	-	-	-	-	-	2	13	-	-	13	-	-	-	-	-	-	242	-
5b.1.1.14	Diesel Generator	-	242	-	-	-	-	-	36	279	-	-	279	-	-	-	-	-	-	2,185	-
5b.1.1.15	E.S.W.S. Pumphouse	-	128	-	-	-	-	-	19	148	-	-	148	-	-	-	-	-	-	801	-
5b.1.1.16	ESWS Valve House	-	7	-	-	-	-	-	1	8	-	-	8	-	-	-	-	-	-	42	-
5b.1.1.17	FLEX Building NO. 1 & 2	-	353	-	-	-	-	-	53	406	-	-	406	-	-	-	-	-	-	2,880	-
5b.1.1.18	Fuel Building	-	923	-	-	-	-	-	138	1,061	-	-	1,061	-	-	-	-	-	-	7,874	-
5b.1.1.19	GOB - Administration Building	-	196	-	-	-	-	-	29	226	-	-	226	-	-	-	-	-	-	2,962	-
5b.1.1.20	Hot Machine Shop	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	243	-
5b.1.1.21	M.M.O. Building	-	212	-	-	-	-	-	32	244	-	-	244	-	-	-	-	-	-	2,389	-
5b.1.1.22	Main Access Facility	-	356	-	-	-	-	-	53	409	-	-	409	-	-	-	-	-	-	4,717	-
5b.1.1.23	Material Center West	-	73	-	-	-	-	-	11	84	-	-	84	-	-	-	-	-	-	1,379	-
5b.1.1.24	Misc Structures and Additions	-	57	-	-	-	-	-	8	65	-	-	65	-	-	-	-	-	-	910	-
5b.1.1.25	Miscellaneous Site Foundations	-	211	-	-	-	-	-	32	242	-	-	242	-	-	-	-	-	-	1,242	-
5b.1.1.26	Miscellaneous Site Structures	-	1,212	-	-	-	-	-	182	1,393	-	-	1,393	-	-	-	-	-	-	13,693	-
5b.1.1.27	New Covered Walkway	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	79	-
5b.1.1.28	Oil Separator and Waste Tank	-	1	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	8	-
5b.1.1.29	Radwaste	-	876	-	-	-	-	-	131	1,007	-	-	1,007	-	-	-	-	-	-	8,111	-
5b.1.1.30	Radwaste Drum Storage	-	127	-	-	-	-	-	19	146	-	-	146	-	-	-	-	-	-	1,449	-
5b.1.1.31	Radwaste Storage Building	-	68	-	-	-	-	-	10	78	-	-	78	-	-	-	-	-	-	1,028	-

Table D
Wolf Creek Generating Station
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2020 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes				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.1.1.32	SBO Diesel Generator	-	237	-	-	-	-	-	36	273	-	-	273	-	-	-	-	-	-	3,079	-
5b.1.1.33	Security Main Gate North	-	68	-	-	-	-	-	10	78	-	-	78	-	-	-	-	-	-	1,123	-
5b.1.1.34	Security Additions	-	28	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	405	-
5b.1.1.35	Security/Guardhouse	-	31	-	-	-	-	-	5	36	-	-	36	-	-	-	-	-	-	342	-
5b.1.1.36	Site Diesel Generator	-	2	-	-	-	-	-	0	3	-	-	3	-	-	-	-	-	-	18	-
5b.1.1.37	Support Complex	-	21	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	389	-
5b.1.1.38	Turbine Building	-	2,285	-	-	-	-	-	343	2,628	-	-	2,628	-	-	-	-	-	-	47,075	-
5b.1.1.39	Turbine Pedestal	-	493	-	-	-	-	-	74	568	-	-	568	-	-	-	-	-	-	2,934	-
5b.1.1.40	Waste Water Treatment	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	172	-
5b.1.1.41	Water Treatment Building North (Z110)	-	47	-	-	-	-	-	7	54	-	-	54	-	-	-	-	-	-	608	-
5b.1.1	Totals	-	14,026	-	-	-	-	-	2,104	16,130	-	-	16,130	-	-	-	-	-	-	168,368	-
Site Closeout Activities																					
5b.1.2	Remove Rubble	-	1,005	-	-	-	-	-	151	1,156	-	-	1,156	-	-	-	-	-	-	5,660	-
5b.1.3	Grade & landscape site	-	104	-	-	-	-	-	16	120	-	-	120	-	-	-	-	-	-	512	-
5b.1.4	Final report to NRC	-	-	-	-	-	-	187	28	215	215	-	-	-	-	-	-	-	-	-	1,560
5b.1	Subtotal Period 5b Activity Costs	-	15,136	-	-	-	-	187	2,298	17,621	215	-	17,406	-	-	-	-	-	-	174,540	1,560
Period 5b Additional Costs																					
5b.2.1	Concrete Crushing	-	1,018	-	-	-	-	13	155	1,185	-	-	1,185	-	-	-	-	-	-	4,700	-
5b.2.2	Circulating Water Intake Cofferdam	-	327	-	-	-	-	-	49	376	-	-	376	-	-	-	-	-	-	2,584	-
5b.2.3	E.S.W.S. Pumphouse Cofferdam	-	427	-	-	-	-	-	64	491	-	-	491	-	-	-	-	-	-	3,552	-
5b.2.4	Construction Debris	-	-	-	-	-	-	4,050	608	4,658	-	-	4,658	-	-	-	-	-	-	-	-
5b.2.5	Site Restoration ISFSI	-	479	-	-	-	-	302	117	898	-	-	898	-	-	-	-	-	-	2,034	160
5b.2.6	Firing Range Closure	-	-	-	-	-	-	750	113	863	-	-	863	-	-	-	-	-	-	-	-
5b.2	Subtotal Period 5b Additional Costs	-	2,251	-	-	-	-	5,115	1,105	8,471	-	-	8,471	-	-	-	-	-	-	12,870	160
Period 5b Collateral Costs																					
5b.3.1	Small tool allowance	-	104	-	-	-	-	-	16	119	-	-	119	-	-	-	-	-	-	-	-
5b.3	Subtotal Period 5b Collateral Costs	-	104	-	-	-	-	-	16	119	-	-	119	-	-	-	-	-	-	-	-
Period 5b Period-Dependent Costs																					
5b.4.2	Property taxes	-	-	-	-	-	-	1,419	142	1,561	-	-	1,561	-	-	-	-	-	-	-	-
5b.4.3	Heavy equipment rental	-	5,012	-	-	-	-	-	752	5,763	-	-	5,763	-	-	-	-	-	-	-	-
5b.4.4	Plant energy budget	-	-	-	-	-	-	306	46	352	-	-	352	-	-	-	-	-	-	-	-
5b.4.5	Corporate A&G Cost	-	-	-	-	-	-	83	12	95	-	-	95	-	-	-	-	-	-	-	-
5b.4.6	Security Staff Cost	-	-	-	-	-	-	2,599	390	2,988	-	-	2,988	-	-	-	-	-	-	-	37,132
5b.4.7	DOC Staff Cost	-	-	-	-	-	-	9,971	1,496	11,467	-	-	11,467	-	-	-	-	-	-	-	105,208
5b.4.8	Utility Staff Cost	-	-	-	-	-	-	4,863	729	5,592	-	-	5,592	-	-	-	-	-	-	-	60,340
5b.4	Subtotal Period 5b Period-Dependent Costs	-	5,012	-	-	-	-	19,241	3,567	27,819	-	-	27,819	-	-	-	-	-	-	-	202,680
5b.0	TOTAL PERIOD 5b COST	-	22,502	-	-	-	-	24,543	6,986	54,031	215	-	53,815	-	-	-	-	-	-	187,410	204,400
PERIOD 5 TOTALS		-	22,502	-	-	-	-	24,543	6,986	54,031	215	-	53,815	-	-	-	-	-	-	187,410	204,400
TOTAL COST TO DECOMMISSION		10,874	100,496	15,490	9,372	31,657	55,858	986,356	200,885	1,410,987	1,050,876	298,581	61,530	292,219	138,317	501	393	2,217	21,708,530	1,248,997	9,460,108

TOTAL COST TO DECOMMISSION WITH 16.6% CONTINGENCY:	**$1,410,987**	**thousands of 2020 dollars**
TOTAL NRC LICENSE TERMINATION COST IS 74.48% OR:	**$1,050,876**	**thousands of 2020 dollars**
SPENT FUEL MANAGEMENT COST IS 21.16% OR:	**$298,581**	**thousands of 2020 dollars**
NON-NUCLEAR DEMOLITION COST IS 4.36% OR:	**$61,530**	**thousands of 2020 dollars**
TOTAL LOW-LEVEL RADIOACTIVE WASTE VOLUME BURIED (EXCLUDING GTCC):	**139,211**	**Cubic Feet**
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED:	**2,217**	**Cubic Feet**
TOTAL SCRAP METAL REMOVED:	**70,087**	**Tons**
TOTAL CRAFT LABOR REQUIREMENTS:	**1,248,997**	**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

ISFSI DECOMMISSIONING COST SUMMARY

Table E
Wolf Creek Generating Station
ISFSI Decommissioning Cost Estimate
(thousands of 2020 dollars)

Activity Description	Removal Costs	Packaging Costs	Transport Costs	LLRW Disposal Costs	Other Costs	Total Costs	Burial Volume Class A (cubic feet)	Craft Manhours	Oversight and Contractor Manhours
Decommissioning Contractor									
Planning (characterization, specs and procedures)	-	-	-	-	203	203	-	-	1,072
Decontamination (activated disposition)	8	200	867	3,560	-	4,635	20,377	114	-
License Termination (radiological surveys)	-	-	-	-	842	842	-	6,090	-
Subtotal	**8**	**200**	**867**	**3,560**	**1,045**	**5,679**	**20,377**	**6,204**	**1,072**
Supporting Costs									
NRC and NRC Contractor Fees and Costs	-	-	-	-	452	452	-	-	1,153
Insurance	-	-	-	-	140	140	-	-	-
Property taxes	-	-	-	-	316	316	-	-	-
Plant energy budget	-	-	-	-	14	14	-	-	-
Corporate A&G Cost	-	-	-	-	5	5	-	-	-
Security Staff Cost	-	-	-	-	366	366	-	-	4,999
Utility Staff Cost	-	-	-	-	323	323	-	-	3,792
Subtotal	-	-	-	-	**1,617**	**1,617**	-	-	**9,945**
Total (w/o contingency)	**8**	**200**	**867**	**3,560**	**2,662**	**7,296**	**20,377**	**6,204**	**11,017**
Total (w/25% contingency)	**9**	**250**	**1,084**	**4,450**	**3,327**	**9,120**			

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

APPENDIX F

COST SENSITIVITY OF SHORT-TERM, POOL-BASED SPENT FUEL STORAGE

APPENDIX F

COST SENSITIVITY OF SHORT-TERM, POOL-BASED SPENT FUEL STORAGE

Introduction

As discussed in the last Decommissioning Cost Analysis for Wolf Creek issued in August 2017, 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 is ready for decommissioning. While there is still much uncertainty in this area, the probabilities that the 2017 base case estimate occurs has become unlikely, The alternative scenario in the 2017 estimate, where the spent fuel remains on site for an extended period following decommissioning of the power block, has become the most likely scenario. This 2020 estimate has therefore swapped the 2017 base and alternate cases, with the base case of extended ISFSI operations following decommissioning becoming the base case of the 2020 estimate.

For continuity and comparison of the 2017 estimate, the five years wet storage with complete transfer to DOE (the 2017 base case) is presented in this Appendix, updated to 2020 dollars. There still is much uncertainty in this area. Because the assumptions used in this Appendix F analysis are speculative at this point, the hypothetical cost effects shown here have not been included in the overall updated cost estimate in this report.

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.

Base Analyses

The estimate described in this Appendix is based in general upon 1) a 2031 start date for DOE initiating transfer of commercial spent fuel to a federal facility, and 2) a 2038 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.[1]

The assumed 2031 DOE start date is nominally based on the last position stated by the DOE. 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 had originally 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.[2] However, the Blue Ribbon Commission, in its final report, noted that: "[A]ccepting spent fuel according to the OFF [Oldest Fuel First] 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."

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

- The spent fuel pool would contain 1,221 fuel assemblies at shutdown, including the final core discharge
- Shipment of fuel from the Wolf Creek site would give priority to the spent fuel stored in the pool, followed by shipment from the ISFSI.

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

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

- The spent fuel pool would be emptied within the first four years following plant shutdown. This would allow decommissioning to be completed and the site released for unrestricted use within a relatively short time.
- The DOE is assumed to use its Transport, Aging and Disposal canister to empty the wet storage pool.[3] 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. It is estimated that post-shutdown shipment via TADs to DOE will consist 262 of fuel assemblies.
- All remaining spent fuel in the fuel pool not shipped directly to the DOE will be transferred to the onsite ISFSI. It is estimated that this will consist of 959 fuel assemblies.
- Following shutdown and decommissioning of the spent fuel pool, periodic transfers of spent fuel canisters from the ISFSI to the DOE occur. Between two and three 37-assembly canisters will ship yearly to the DOE from the ISFSI. This occurs over the period of 2050 to 2078.
- Greater-than-Class C (GTCC)[4] material generated during decommissioning will be packaged into the equivalent of dry fuel storage canisters and placed in the ISFSI, awaiting eventual transfer to the DOE. After the last of the spent fuel canisters are transferred to the DOE, the GTCC canisters will then be transferred as well, in the final year of ISFSI operations.
- The ISFSI would then be decommissioned.

Alternative Analysis

The assumed 2031 DOE start date is nominally based on the last position stated by the DOE. More importantly, the estimates assume that the DOE would give priority to fuel at shutdown sites,[5] i.e., it assumed that Congress would "(1)…direct the

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3 "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

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

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

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."[6]

It is generally necessary that spent fuel be cooled and stored for a minimum period at the generating site prior to transfer. As such, the NRC requires that licensees establish a program to manage and provide funding for the management of all irradiated fuel at the reactor site until title of the fuel is transferred to the DOE, pursuant to 10 CFR Part 50.54(bb). [7] The post-shutdown costs incurred to satisfy this requirement include the isolation and continued operation of the spent fuel pool and the ISFSI during the five and one-half years following the cessation of plant operations.

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

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. Note however that this five and one-half year period is longer than the base case scenario, incurring an additional one and one-half years of such period-dependent costs as staffing, security, insurance, and taxes among others.

This alternative analysis examines the cost impact of the spent fuel management model described previously for the caretaking and removal of the spent fuel generated during plant operations.[8] Under this scenario:

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dollars) to warrant DOE exercising its right under the Standard Contract to move this fuel first."

6 "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

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

8 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

- DOE pickup of spent fuel would begin in 2038, and would end five and one-half years after final shutdown of Wolf Creek in 2045, including assemblies already present in the on-site ISFSI prior to shutdown.
- 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 with the balance of the nuclear island and the NRC license terminated for the entire site at the end of Period 2 in 2052.

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

	Base Case	Alternative
Spent fuel pool inventory at shutdown (assemblies)	1,221	1,221
ISFSI inventory at shutdown (assemblies)	1,480	1,480
Spent fuel transferred to the DOE during plant ops	663	663
Spent fuel transferred to the DOE from pool during decommissioning (assemblies)	262	1,221
Spent fuel transferred to the ISFSI for interim storage within 4 years after shutdown (assemblies)	959	0
Number of additional dry-storage modules need to support decommissioning (excluding GTCC)	26	0
Transfer of Spent Fuel to DOE Complete (year)	2078	2050

The schedule of expenditure in the following table delineates the cost contributors by year of expenditures as well as escalation category (e.g., labor, materials, and waste disposal). Costs are reported in 2020 dollars and are not inflated, escalated, or discounted over the period of expenditure.

The cost for disposal of GTCC material is occurs as the material is generated during reactor vessel segmentation in this alternative analysis (Table F, during years 2046-2048).

While this analysis attempts to capture the cost for short-term pool-based 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 F
DECON ALTERNATIVE WITH SHORT-TERM POOL-BASED SPENT FUEL MANAGEMENT SCHEDULE OF TOTAL ANNUAL EXPENDITURES
(thousands, 2020 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2045	61,863	2,611	1,919	35	10,644	77,073
2046	84,432	22,939	3,523	15,630	30,965	157,490
2047	80,729	34,259	2,248	38,547	24,037	179,820
2048	75,927	25,460	1,982	24,306	16,554	144,230
2049	71,999	18,802	1,775	13,612	10,916	117,104
2050	61,704	15,378	1,521	14,650	10,532	103,784
2051	35,032	4,093	647	6,260	5,476	51,507
2052	20,598	11,425	270	5	4,223	36,520
2053	11,566	8,064	148	0	2,748	22,526
Total	503,850	143,031	14,033	113,045	116,096	890,056

Note: Columns may not add due to rounding

APPENDIX G

U.S. DECOMMISSIONING EXPERIENCE TO DATE

PROVIDED AS KANSAS CORPORATION COMMISSION REQUESTED INFORMATION UNDER DOCKET 15-WCNE-093-GIE

Decommissioning

The Kansas Corporation Commission has requested additional background information on decommissioning efforts to date for U.S. nuclear plants including (i) decommissioning methods employed; (ii) the reason for decommissioning if performed prior to the end of plant expectancy, and (iii) a comparison of actual costs of decommissioning to previous cost estimates for decommissioned plants. The following analysis is based on publicly available information.

1. Decommissioning Method(s) Employed

As discussed in more detail in Sections 1 and 2 of this document, when a power company decides to permanently close a nuclear power plant, the facility must be decommissioned by safely removing it from service and reducing residual radioactivity to a level that permits release of the property and termination of the operating license. Licensees may choose from three decommissioning strategies: DECON, SAFSTOR, or ENTOMB.

- DECON (immediate dismantling) - soon after the nuclear facility closes, equipment, structures, and portions of the facility containing radioactive contaminants are removed or decontaminated to a level that permits release of the property and termination of the NRC license (assuming that the spent fuel has been removed from the site).
- SAFSTOR (safe-storage and deferred dismantling) - a nuclear facility is maintained and monitored in a condition that allows the radioactivity to decay; afterwards, the plant is dismantled and the property decontaminated.
- ENTOMB - radioactive contaminants are permanently encased on site in structurally sound material such as concrete. The facility is maintained and monitored until the radioactivity decays to a level permitting restricted release of the property. (In a draft regulatory basis document published in March 2017 in support of rulemaking that would amend NRC regulations concerning nuclear plant decommissioning, the NRC staff proposes removing any discussion of the ENTOMB option from existing guidance documents since the method is not deemed practically feasible.)

The licensee may also choose to adopt a combination of the first two choices in which some portions of the facility are dismantled or decontaminated while other parts of the facility are left in SAFSTOR. The decision may be based on factors besides radioactive decay, such as availability of waste disposal sites. Decommissioning must be completed within 60 years of the plant ceasing operations. A time beyond that would be considered only when necessary to protect public health and safety in accordance with NRC regulations.

As described in Table G, the decommissioning methods employed by the 18 commercial nuclear power reactors that have shut down since 1989 have varied: 9

have employed DECON, 5 have employed SAFSTOR and 4 have employed combined SAFSTOR/DECON. Moreover, not all DECON sites have terminated their licenses. License termination is contingent upon the removal of the spent fuel from the site. For example, the plants listed in Table G that elected the DECON option still have fuel on site (excluding Shoreham[ ]) in a licensed Independent Spent Fuel Storage Installation or ISFSI. While the decommissioning of these plants is considered complete, only those portions of the site, exclusive of the ISFSI, have been released for alternative and unrestricted use.

Table G
Decommissioning Alternative(s) Selected
for Commercial Nuclear Power Reactors
(since 1989) [1]

Unit	Location	MWt	Shut Down	Decommissioning Alternative Selected
Rancho Seco	Herald, CA	2,772	7-Jun-89	SAFSTOR/DECON [2]
Shoreham	Wading River, NY	2,436	28-Jun-89	DECON
Fort St. Vrain	Platteville, CO	842	18-Aug-89	DECON
Yankee-Rowe	Rowe, MA	600	1-Oct-91	DECON
Trojan	Rainier, OR	3,411	9-Nov-92	DECON
San Onofre 1	San Clemente, CA	1,347	30-Nov-92	SAFSTOR/DECON [3]
Zion 2	Zion, Il	3,250	19-Sep-96	SAFSTOR/DECON [4]
Connecticut Yankee	Haddam Neck, CT	1,825	5-Dec-96	DECON
Maine Yankee	Wiscasset, ME	2,700	6-Dec-96	DECON
Zion 1	Zion, Il	3,250	21-Feb-97	SAFSTOR/DECON [4]
Big Rock Point	Charlevoix, MI	240	29-Aug-97	DECON
Millstone 1	Waterford, CT	2,011	21-Jul-98	SAFSTOR
Crystal River 3	Crystal River, FL	2,609	20-Feb-13	SAFSTOR
Kewaunee	Carlton, WI	1,772	7-May-13	SAFSTOR
San Onofre 2	San Clemente, CA	3,438	12-Jun-13	DECON
San Onofre 3	San Clemente, CA	3,438	12-Jun-13	DECON
Vermont Yankee	Vernon, VT	1,912	29-Dec-14	SAFSTOR [5]
Fort Calhoun	Fort Calhoun, NE	1,500	24-Oct-16	SAFSTOR
Oyster Creek	Forked River, NJ	1,930	17-Sep-18	SAFSTOR
Pilgrim	Plymouth, MA	2,028	31-May-19	SAFSTOR [6]
Indian Point 2	Buchanan, NY	3,216	30-April-20	SAFSTOR [7]

Table G Notes:

1. Source: Table G data and information on reactors shut down since 1989 extracted from Appendix C of NRC's Information Digest 2019-2020, NUREG-1350, Volume 31, August 2019. Reactors shut down prior to 1989 include TMI-2 (accident) in 1979 and a number of smaller facilities constructed in the late 1950s and 1960s, under the Atomic Energy Commission, to demonstrate the peacetime use of nuclear power. These include the GE VBWR, GE EVESR, Pathfinder, Savannah, N.S. (ship), Saxton, Fermi-1, Indian Point-1, Peach Bottom-1, Humboldt Bay-3, Dresden-1, and La Crosse reactors. All of the facilities were initially placed into safe-storage (SAFSTOR). The reactors at Pathfinder, Saxton, Fermi-1, Humboldt Bay-3, and La Crosse were subsequently decommissioned or are currently in the process of being decommissioned.
2. The Sacramento Municipal Utility District initially placed the reactor into safe-storage (until 2008). However, on January 9, 1997, the Board of Directors approved an "incremental decommissioning" project for Rancho Seco accelerating the decommissioning timeline.
3. Southern California Edison initially placed the reactor into safe-storage, planning to decommission Unit 1 along with Units 2 and 3, at the end of their licenses (2013). In 1998, the company notified the NRC that it would commence decommissioning operations in June 1999.
4. Commonwealth Edison initially placed the two reactors into safe-storage. On August 23, 2010, the Nuclear Regulatory Commission approved the transfer of Exelon's (ComEd's parent company) license to ZionSolutions for "prompt" decommissioning.
5. Entergy initially placed the reactor into safe-storage after the December 2014 shutdown. On February 9, 2016, NorthStar Group Services filed an application (along with Entergy) with the NRC to acquire the license of the shutdown plant for "prompt" decommissioning.
6. Entergy initially placed the reactor into safe-storage after the May 2019 shutdown. In August 2019, the NRC approved the transfer of the license of the shutdown plant from Entergy to Comprehensive Decommissioning International for the purpose of "prompt" decommissioning.
7. Entergy made the decision to modify its license renewal efforts for Indian Point Units 2 and 3. The license extension agreements were granted approval for expiration in 2024 and 2025 for the respective units. The company also decided to cease operation of Unit 2 in 2020 and Unit 3 in 2021. NUREG-1350 was not used as a source since the Unit 2 permanent shutdown occurred after the most recent publication of this document, however it was included in this list as it is public knowledge that the unit is permanently shut down.

2. Reason for Premature Decommissioning

The reactors identified in Table G all ceased operations prior to the expiration of their operating licenses (premature shutdown). As such, the opportunity to preplan the decommissioning was limited and often hampered by a shortfall in the funds available for decommissioning (since rate collections also disrupted).

The majority of the owners of reactors in Table G terminated operations due to economics, although poor operating histories, the prospect of expensive plant modification and repairs, and competition from less expensive generation also contributed to the decisions.

Rancho Seco Nuclear Generating Station

Reactor Type: Pressurized Water Reactor (PWR)
Operating License Issued: 16 August 1974
Shutdown: 07 June 1989

The plant operated commercially from April 1975 to June 1989, but at a lifetime capacity under 50%. A number of incidents at the plant precipitated an NRC mandated re-start program that would have involved a significant effort and cost. In accordance with the results of a public referendum on June 6, 1989, the Sacramento Municipal Utility District decided to permanently shut down the plant on June 7, 1989.

Shoreham Nuclear Power Station

Reactor Type: Boiling Water Reactor (BWR)
Operating License Issued: 21 April 1989
Shutdown: 28 June 1989

The plant was completed in 1984 and received federal permission for low-power (5 percent) testing. The owner, Long Island Lighting Company (LILCO), faced considerable public opposition after the 1979 Three Mile Island accident, with Suffolk County legislators claiming that the county could not be safely evacuated in the event of an accident. Governor Mario Cuomo ordered state officials not to approve any LILCO-sponsored evacuation plan - effectively preventing the plant from operating at full capacity. On May 19, 1989, LILCO agreed not to operate the plant in a deal with the state under which most of the $6 billion construction cost was passed on to Long Island ratepayers.

Fort St. Vrain Nuclear Generating Station

Reactor Type: GCR (Gas-Cooled Reactor)
Operating License Issued: 21 December 1973
Shutdown: 18 August 1989

The helium cooled, graphite moderated reactor went into commercial operation on July 1, 1979 and operated for a little more than 10 years. On August 18, 1989, while the plant was shut down to repair a stuck control rod pair; numerous cracks were discovered in several steam generator main steam ring headers. The required repairs were determined by the Public Service Company of Colorado Board of Directors to be too extensive to justify continued operation. On August 29, 1989, the Board decided to termination operations.

Yankee Nuclear Power Station

Reactor Type: PWR
Operating License Issued: 24 December 1963
Shutdown: 01 October 1991

The small, 185 megawatt nuclear reactor operated from 1961-1992 when it was permanently shut-down on February 26, 1992 by the Board of Directors of the Yankee Atomic Electric Company (Yankee Atomic). Although economics was cited in the decision by the board, it was the perceived viability of the plant's reactor vessel and related questions raised by the NRC's staff that likely contributed to the permeant shutdown. The inability to accurately quantify the actual level of embrittlement in the Yankee Rowe reactor vessel cast doubt on the vessel's ability to survive a thermal shock when cold water is injected during an accident condition. Potentially fixes (e.g., replacing or annealing the vessel in situ) were both untried and unproven options and very costly.

Trojan Nuclear Plant

Reactor Type: PWR
Operating License Issued: 21 November 1975
Shutdown: 09 November 1992

In announcing the permanent cessation of operations in early 1993, the Directors of Portland General Electric (PGE), cited the cost of replacing the plant's steam generators (estimated then at $200 million) as the basis for the decision. The generators had experienced significant tube degradation and failures, beginning shortly after the plant when on line. (In a 1997 Technical Issues summary, the NRC noted that steam generator tube degradation was responsible for multiple

steam generator tube rupture events across the industry, extensive repairs, forced outages, replacement of the generators at 15 plants and contributed to the decision to shut down two nuclear power plants: San Onofre, Unit 1, and Trojan.)

There was also significant environmental opposition to the operation of the Trojan plant, with the owners surviving multiple state referendums that attempted to close the plant.

San Onofre Nuclear Generating Station, Unit 1

Reactor Type: PWR
Operating License Issued: 27 March 1967
Shutdown: 31 November 1992

Unit 1 entered commercial operation in January of 1968. It had a capacity factor of approximately 73 percent over its first twelve years of operation, but half that value over the succeeding thirteen years (through 1992). The change in performance was due to several extended outages for major plant repairs (e.g., steam generator tube sleeving and redesign of the reactor vessel thermal shield supports) and upgrades (e.g., in seismic design, fire protection, and from post-Three Mile Island (TMI) requirements). Southern California Edison's (SCE) attempt to convert its Provisional Operating License to a Full-Term Operating License was hindered by its high costs and the opposition of the Ratepayer Advocate to recover such costs in rates, arguing declining performance and possible need to replace the steam generators. Ultimately, a settlement was reached to permanently shut down the unit and recoup sunk costs.

Zion Nuclear Power Station

Reactor Type: PWR
Operating License Issued: 19 October 1973 / 14 November 1973
Shutdown: 21 February 1997 / 19 September 1996

The 1998 press release announcing the permanent shutdown of the Zion reactors after nearly 25 years of operations, cited economics as the rationale. "A thorough analysis of the projected costs to produce power at the station and the expected price of electricity in a deregulated market led us to one conclusion: Zion Station will not be able to produce competitively priced power in a deregulated marketplace over the remaining useful life of the plant. The analysis was based on three factors: the cost of operating and supporting the plant, the amount of power it was expected to generate and the projected price of electricity in a deregulated market. "

The station had had a troubled past and was on the NRC's "watch list" prior to its announcement to permanent cease operations (along with two other nuclear stations operated by Commonwealth Edison). The decision to shut down followed an earlier announcement not to replace the plants steam generators. The shutdown decision was viewed by investors as an opportunity for the owner/operator to reallocate its resources to its other troubled facilities.

Connecticut Yankee Atomic Power Station

Reactor Type: PWR
Operating License Issued: 30 June 1967 (Provisional)
Operating License Issued: 27 December 1974 (Full Term)
Shutdown: 05 December 1996

The Connecticut Yankee Atomic Power Company Board of Directors voted to permanently close the Haddam Neck plant in December 1996. Press releases by the company identified three factors: the age of the plant, its relatively small size, and its high operating cost compared to alternative energy sources (e.g., oil and natural gas). The plant also had a troubled past, having been shut down since the previous July for safety reasons (as reported by the NRC in its 1997 notice of violation and referenced inspections in 1995 and 1996).

Maine Yankee Atomic Power Station

Reactor Type: PWR
Operating License Issued: 29 June 1973
Shutdown: 06 December 1996

While the plant's operating history had been one of successful low-cost, reliable generation, the two years preceding its closure were marked by unscheduled outages, increased regulatory scrutiny, and considerable media attention. As a result of extensive outages in 1995 and 1996, and growing concerns about steam generator reliability, the plant owners conducted detailed economic analyses on the viability of continuing plant operation, versus permanently closing the facility. The Maine Yankee Atomic Power Company Board voted on August 6, 1997 to decommission the plant. David Flanagan, chair of the Maine Yankee Atomic Power Company Board, stated that "an economic analysis of operations, rising expenses for plant upgrades and the projections for stable power costs fueled the decision by Maine Yankee's eight owners to explore permanent shutdown."

Big Rock Point Nuclear Plant

Reactor Type: BWR
Operating License Issued: 01 May 1964
Shutdown: 29 August 1997

Consumers Energy announced on June 11, 1997, that the nation's longest running and oldest operating unit would be permanently shut down on August 30, 1997. The announcement cited the plant's relatively small generating capacity (67 megawatts), high cost of operation in an increasingly competitive environment, improvements to the plant that would be needed to meet future regulatory requirements and the limited time left on its operating license (3 years).

Millstone Power Station, Unit 1

Reactor Type: BWR
Operating License Issued: 31 October 1970 (Provisional)
Operation License Issued: 31 October 1986 (Full Term)
Shutdown: 21 July 1998

On July 17, 1998, Northeast Utility decided to permanently shut down the Unit 1 reactor (it had been shut down for refueling in November of 1995 and not restarted). The company concluded that the cost to restore the plant to full operations would only bring a slight economic benefit to its customers. Once recognized as one of the best performing boiling water reactors, Unit 1, along with the adjacent two units at the site were on the NRC's watch list at the time the decision was made to close and the company had been assessed the largest fine ever imposed by the NRC (citing more than 50 violations from October 24, 1995 to December 31, 1996). Restart of any of the three units was contingent, at that time, on approval from an independent consultant and a vote from the regulatory agency.

Crystal River Nuclear Plant, Unit 3

Reactor Type: PWR
Operating License Issued: 03 December 1976
Shutdown: 20 February 2013

In 2009, Progress Energy replaced the unit's two steam generators during a scheduled maintenance and refueling outage. In the process, engineers discovered a delamination, or separation of concrete, within the reactor building that surrounds the reactor vessel. Although the initial damage was successfully

repaired, additional delamination was discovered in two different areas of the reactor building in 2011.

An independent review commissioned in 2012 confirmed that repairing the containment building was technically feasible but included significant risks that could raise the cost of the repair and extend the repair schedule significantly. On February 5, 2013, Duke Energy (having acquired Progress Energy in 2012) announced its decision to retire the nuclear unit instead of pursuing repair to the plant's containment building.

Kewaunee Power Station

Reactor Type: PWR
Operating License Issued: 21 December 1973
Shutdown: 07 May 2013

On October 22, 2012, Dominion Resource Inc. announced that they would shut down the nuclear unit in mid-2013 after they were unable to find a buyer for the plant. The announcement cited the low price of natural gas, (e.g., from record shale production), expiring purchase power agreements, the plant's age, and Dominion's inability to grow its nuclear fleet in the Midwest (which would have provided some economics in operations).

San Onofre Nuclear Generating Station, Units 2 and 3

Reactor Type: PWRs
Operating License Issued: 16 February 1982 / 15 November 1982
Shutdown: 13 June 2013

On June 7, 2013, Southern California Edison (SCE) decided to permanently retire Units 2 and 3 at its San Onofre Nuclear Generating Station (San Onofre). The Chairman and CEO of Edison International cited continuing uncertainty about when or if the units might return to service as the deciding factor. In particular, ongoing regulatory and administrative processes and appeals were expected to cause extended delays. Both units had been shut down since January 2012, Unit 2 for refueling and Unit 3 after small leaks were detected in the newly replaced steam generators (the steam generators had been replaced in Unit 2 in 2009 and in Unit 3 in 2010). A subsequent investigation concluded that the steam generators, manufactured by Mitsubishi Heavy Industries, had design flaws.

Vermont Yankee Nuclear Power Station

Reactor Type: BWR
Operating License Issued: 21 March 1972
Shutdown: 29 December 2014

On August 27, 2013, Entergy Corporation announced that Vermont Yankee would cease operations in the fourth quarter of 2014 for economic reasons. Reasons cited included; sustained, low natural gas prices and wholesale energy prices, a high cost structure for the single unit plant (since 2002, the company invested more than $400 million in the safe and reliable operation of the facility), the financial impact of cumulative regulation, and artificially low energy and capacity prices in the region that did not provide adequate compensation to merchant nuclear plants for the fuel diversity benefits they provide.

Fort Calhoun Station

Reactor Type: PWR
Operating License Issued: 09 August 1973
Shutdown: 24 October 2016

On June 16, 2016, the Omaha Public Power District's Board of Directors determined that it was in the best financial interest of the District and its customer-owners to retire Fort Calhoun Station by the end of 2016. Market conditions were cited as a primary factor in the decision, including historically low natural gas prices and a reduced demand for electricity. Fort Calhoun was also the smallest rated commercial unit in the United States at the time, making it difficult to absorb the higher, fixed production costs.

Oyster Creek Nuclear Generating Station

Reactor Type: BWR
Operating License Issued: 09 April 1969
Shutdown: 17 September 2018

In January 2010, the New Jersey Department of Environmental Protection (NJDEP) revised rules on water use such that once-through cooling is no longer allowed for large industrial facilities which included Oyster Creek Station. Oyster Creek entered negotiations with the State of New Jersey throughout 2010 and announced in December of 2010 that the facility would be closed by year end 2019 to preclude installation of cooling towers as mandated by the new NJDEP regulations and standards. Due to growing costs and external economic factors (mainly driven by the expiring/expired price agreements due to the announced

closure), in February 2018, Exelon announced an accelerated plant closure date of October 2018. The unit was permanently shut down on September 17, 2018.

Pilgrim Nuclear Power Station

Reactor Type: BWR
Operating License Issued: 08 June 1972
Shutdown: 31 May 2019

In 2015, Entergy announced a strategy to reduce risk and shrink its footprint of Entergy Wholesale Commodities (EWC) merchant nuclear power business. On October 10, 2015, Entergy announced it would close Pilgrim Nuclear Power Station no later than June 1, 2019. The company cited poor market conditions, reduced revenues, and increased operational costs as reason for the closure. Specifically noted were the low current and forecast wholesale energy prices, design flaws in the wholesale energy market, and increased costs associated with addressing the NRC placing the unit in regulatory Column 4. On August 23, 2019, the NRC approved the license transfer of Pilgrim to Holtec.

Indian Point Energy Center Unit 2

Reactor Type: PWR
Operating License Issued: 28 September 1973
Shutdown: 30 April 2020

In 2015, Entergy announced a strategy to reduce risk and shrink its footprint of Entergy Wholesale Commodities (EWC) merchant nuclear power business. On January 9, 2017 Entergy announced it would cease operation of both operating units at Indian Point Energy Center in 2020 (Unit 2) and 2021 (Unit 3). The early shutdown of the Units is part of a settlement under which the State of New York has agreed to drop legal challenges and support renewal of the operating licenses for both Indian Point Units. The company noted the early shutdown is in alignment with their EWC footprint reduction and cited sustained low current and projected wholesale energy prices which reduced revenues, as well as increased operational costs. The company additionally noted the $200 million spent in license renewal and associated legal costs with no foreseeable resolution as a reason for the early closure. On November 22, 2019, Holtec and Entergy jointly submitted a license transfer application to the NRC to transfer the Indian Point Energy Center following final shutdown of Unit 3.

3. Actual v. Projected Cost of Decommissioning

In general, the financial information available on the decommissioning projects that have been completed is limited, beyond that provided in periodic NRC-required filings on financial assurance. Decommissioning contractors believe that the release of detailed cost information can cause irreparable harm to their competitive position in bidding future work and plant owners generally release only what is required by regulators. As such, cost data in the public record is typically presented at a very high level or heavily redacted.

The NRC's regulations require licensees to demonstrate financial assurance throughout the operating life of the reactor, including biennial comparisons to the NRC's threshold funding amounts. In addition, licensees are required to file several, site-specific estimates as the plant nears its end of operating life and following the permanent cessation of operations:

- a preliminary decommissioning cost estimate at or about 5 years prior to the projected end of operations (10 CFR 50.75(f)(2)) which includes an up-to-date assessment of the major factors that could affect the cost to decommission;
- an estimate of expected costs for the activities being proposed in the Post-Shutdown Decommissioning Activities Report (PSDAR), submitted prior to or within 2 years following permanent cessation of operations;
- a site-specific decommissioning cost estimate within 2 years following permanent cessation of operations. This requirement may be satisfied by including a site-specific estimate as part of the PSDAR. (10 CFR 50.82(a)(8)(iii)); and
- an updated site-specific estimate of remaining decommissioning costs as part of a License Termination Plan (LTP) at least 2 years before termination of the license (10 CFR 50.82(a)(9)(ii)(F)).

The following chronologies were extracted from the licensee's NRC filings and referenced documents, as available, for projects that have been recently completed or are nearing completion. Decommissioning, for purposes of this discussion, is tied to the completion of the radiological remediation work at the site since, in most instances, the site will remain under a NRC license until the spent fuel can be removed by the Department of Energy (DOE), i.e., there is still an ongoing caretaking cost being reported at most sites for the operation of an ISFSI.

The chronologies reflect a degree of volatility in the early decommissioning cost estimates (prepared in the late 1980s and early 1990s). This can be attributed to issues such as:

- Premature shutdown adding costs with longer and less efficient transitions from plant operations to decommissioning (since little or no pre-planning had been done).
- Minimal regulatory guidance as the NRC had not anticipated the wave of early plant closures. Decommissioning planning was also more cumbersome in the pre-PSDAR era and regulatory relief was on a case-by-case basis.
- ISFSIs were required to off-load storage pools and reduce plant operating costs (earlier decommissioning estimates had assumed that the spent fuel would be removed by the DOE in accordance with the standard contract).
- The decommissioning trust funds were not fully funded due to the abbreviated operating periods – limiting options and favoring deferred action or temporary actions while funding was secured.
- Low-level radioactive waste disposal costs were in flux with the failed attempts to create state compacts and develop new disposal sites.

In 1996, in an effort to streamline the regulatory process for those plants that had prematurely ceased operations, the NRC published revisions to its general requirements for decommissioning nuclear power plants. The rule was intended to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The 1996 rule, along with other NRC staff guidance (for example, Regulatory Guide 1.184 issued in July 2000), provided a more predictable path to license termination and added an additional degree of certainty to later decommissioning estimates.

Rancho Seco Nuclear Generating Station

On May 20, 1991, the District submitted a proposed Decommissioning Plan to the NRC. The plan outlined a scenario that placed the plant into "Hardened SAFSTOR". The spent fuel would be moved into dry storage and the plant placed into a safe, dormant condition with a small site maintenance staff until 2008 (original license expiration) when a Decommissioning Operations Contractor would be brought in to complete decommissioning. The timeline allowed for the Decommissioning Trust Fund to be fully funded before dismantlement began. The NRC issued a decommissioning order and approved the Rancho Seco decommissioning funding plan on March 20, 1995.

Shortly thereafter, the District engaged TLG Services, Inc. (TLG) to develop alternatives to the SAFSTOR scenario (due to delays and increased cost of the dry fuel storage project), including using the on-site staff for limited decontamination and dismantling activities. In January of 1997, Board of Directors (the Board) approved a trial project involving the limited physical dismantlement of the

facility. In 1999, the Board approved expansion of the Incremental Decommissioning Project to include all activities necessary for license termination.

The cost estimate prepared by TLG in 1999 represented both the shift to a plant area-based approach and the schedule change associated with accelerating the decommissioning timeline. With the commencement of active decommissioning came the requirement to perform annual updates to the cost estimate. In 2000, TLG prepared an update to the 1999 area-based cost estimate. By that time, relatively long-term contracts were in place to provide labor, technical staff, transportation, radwaste packaging materials, radwaste processing, and radwaste disposal to support the decommissioning process. TLG used this actual information when preparing the 2000 cost estimate.

1999 TLG Estimate (license termination) TLG Document No. S11-1337-003, Rev. 0	$420.178 million ($1999)
2000 TLG Estimate (license termination) TLG Document No. S11-1360-002, Rev. 0	$495.416 million ($2000)
Update of Site-Specific Decommissioning Costs Rancho Seco License Termination Plan, Rev. 2 October 2014	$534.185 million ($2005)
2011 Decommissioning Cost Estimate 18 June 2012 Letter to NRC (DPG 12-305)	$517.1 million ($2011)[1]
Report on Decommissioning Funding Status 14 March 2016 Letter to NRC (DPG 16-0620	$518.34 million[2]

Rancho Seco Notes:

1. $487.2 spent to date for site remediation (site is released except for that area around the Interim Onsite Storage Building). Future costs for remaining activities are estimated at $29.9 million for a total 2011 Decommissioning Cost Estimate of $517.1 million. Remaining activities include: the transfer of Greater Than Class "C" (GTCC) Radioactive Waste to the DOE in 2027; disposal of Class B & C low-level radioactive waste (LLRW) in 2016 and oversight of the LLRW until disposal; and license termination activities following disposal of the LLRW.
2. Remaining activities include: the transfer of the used nuclear fuel and GTCC, license termination activities for the area licensed under Part 50 begun in 2015 and scheduled to be completed in 2016; and, license termination activities for the Part 72 licensed facility following removal of the material from the ISFSI.

Yankee Nuclear Power Station

The Decommissioning Plan, which was submitted in December 1993 by the Yankee Atomic, involved placing the plant into SAFSTOR until a low-level waste disposal facility was available (expected in 2000), when dismantlement (DECON) would begin. The Decommissioning Plan included a cost study for operating the facility through a safe storage period, decommissioning the facility, restoring the site, and storing spent fuel until its transfer to the DOE. In October 1994, Yankee Atomic completed a revised cost study to assist the NRC in its review of the Decommissioning Plan and to fulfill a commitment to Federal Energy Regulatory Commission (FERC). This 1994 cost study was also based on the assumption that dismantlement activities would not begin until a low-level radioactive waste disposal site became available.

In June 1995, the State of South Carolina re-opened the low-level waste facility in Barnwell, South Carolina, to radioactive waste generators throughout the United States. In response, Yankee Atomic updated the cost estimate to reflect several significant changes in parameters affecting decommissioning costs. This study, called the 1995 Cost Study, was filed with FERC in August 1995. In this study, the 1994 Cost Study was adjusted for differences in decommissioning timing, waste disposal costs, and one year of escalation. The 1995 Cost Study estimate of "to-go" costs remaining as of January 1995 was $303.2 million. In addition, as part of the final December 1995 FERC settlement, Yankee Atomic was allowed to collect another $3.2 million in the decommissioning trust fund to adjust for adjudicatory delays during re-approval of the Decommissioning Plan, bringing the total January 1995 "to-go" cost to $306.4 million (1995 dollars).

As required by the FERC settlement, an updated cost estimate was filed in December 1999.

Yankee Atomic submitted a new decommissioning cost estimate to FERC in April 2003 seeking additional revenue. The 2003 estimate superseded the 1999 "to go" cost estimate. It was reported that, as of January 1, 2003, the remaining cost to complete the NRC required decommissioning activities was estimated at $121.1 million, stated in 2003 dollars.

Decommissioning was completed and the plant's operating license was amended (for continued ISFSI operations) in August 2007.

1995 Cost Study ("to go" costs)	$306.4 million (1995 dollars)
1999 Cost Estimate	$453.0 million (1999 dollars)[3]
Yankee Atomic LTP, Rev. 1 YAEC to NRC, BYR 2004-133 19 November 2004	$636.4 million ($2003)[4]

Yankee-Rowe Notes:

3. The total includes $207.1 million spent to date, $147.7 million in projected expenditures for dismantling and $98.3 million in spent fuel storage costs
4. The total includes $347.9 million spent to date, $288.5 million in projected expenditures (2003 - 2022) in 2003 dollars. The $288.5 million included the remaining cost to complete the required decommissioning activities ($121.1 million), contingency, long term spent fuel storage costs through 2022, and site restoration.

Trojan Nuclear Plant

Portland General Electric (PGE) reported that the decommissioning cost estimate in the initial Decommissioning Plan was based largely on a site-specific cost estimate performed for PGE by TLG Services, Inc. in May 1994.

In a March 8, 2005 meeting before the Oregon Public Utility Commission, PGE reported that radiological decommissioning was expected to be complete by June 2005 and that their overall radiological decommissioning cost performance was approximately 8% under budget

Decommissioning was completed and the plant's operating license terminated (ISFSI operations continue under a separate license) in May of 2005.

TLG Document No. P15-25-002, Rev. 1 18 August 1994 (excludes the cost of the large component removal project, i.e., disposition of the reactor vessel, steam generators, pressurizer)	$289.8 million ($1993)
PGE Decommissioning Plan and LTP, Rev. 16 27 March 2003	$429.7 million ($1997)[5]

PGE Decommissioning Plan and LTP, Rev. 21 31 March 2005	$421.9 million ($1997)[6]

Trojan Notes:

5. Total cost includes radiological, non-radiological, dry spent fuel management and financing costs
6. Total cost includes $211.7 million for radiological decommissioning activities, $40.2 million for non-radiological, $169.9 million for dry spent fuel management and $16 thousand for financing costs

Zion Nuclear Power Station

Commonwealth Edison Company (now Exelon Generation Company) submitted a PSDAR on February 14, 2000, following the permanent cessation of operations of the two nuclear units at the Zion Nuclear Power Station in 1998.

On January 25, 2008, Exelon and Zion Solutions, LLC (a wholly-owned subsidiary of EnergySolutions, LLC) submitted an Application for License Transfers to the NRC requesting that the NRC consent to the transfer of the plant to ZionSolutions. On March 18, 2008, ZionSolutions submitted an amended PSDAR stating their intention to accelerate the decommissioning schedule if the application for license transfers was approved.

The decommissioning cost estimate presented in the ZionSolutions PSDAR was based upon the plant commodities developed for an earlier TLG cost estimate completed in 2006 for Exelon.

Commonwealth Edison, PSDAR 14 February 2000	$904.3 million ($1996)
2006 TLG Estimate TLG Document No. E16-1555-004, Rev. 0	$1.043 billion ($2006)
ZionSolutions, Amended PSDAR 18 March 2008	$978.0 million ($2007)[7]
Report on Decommissioning Funding Status 30 March 2016 Letter to NRC (ZS-2015-0044)	$677.2 million ($2014)
Report on Decommissioning Funding Status 29 March 2016 Letter to NRC (ZS-2016-0036)	$667.3 million ($2015)[8]

Zion Notes:

7. The $978.0 million in 2007 dollars includes provisions for storage of spent fuel and GTCC wastes on the Zion site until 2018, as well as site restoration costs for all areas except the ISFSI.
8. Includes $486.8 million spent to date (through December 31, 2015), $158.9 million estimated costs to complete decommissioning and $21.6 million for managing irradiated fuel at the site until 2020 when the site is scheduled to transition back to Exelon.

Maine Yankee Atomic Power Station

Maine Yankee submitted its site-specific decommissioning cost estimate to the NRC on November 3, 1998. The accompanying report, "Decommissioning Cost Analysis for the Maine Yankee Atomic Power Station," prepared by TLG and dated October 1997, provided the detailed analysis of the projected costs for the decommissioning activities (radiological decontamination, spent fuel management and site remediation/restoration).

The License Termination Plan (Rev. 2), submitted by Maine Yankee and dated October 15, 2002, escalated the TLG 1997 cost to 2001 dollars for comparison with the costs spent to date.

On March 30, 2005, Maine Yankee provided a decommissioning funding status report to the NRC (MN-05-014). In that submittal, the company reported that the plant "is nearing completion of decommissioning" and that "as of December 31, 2004, $554 million has been expended for all decommissioning costs, of which $405 million has been estimated as the allocation of actual expenditures for decommissioning activities, as defined by the NRC expenditures for decommissioning activities, as defined by the NRC in 10 CFR 50.2."

Decommissioning was completed and the plant's operating license was amended (for continued ISFSI operations) in September of 2005.

TLG Document No. M01-1258-002, Rev. 1 28 October 1997	$508.2 million ($1997)[9]
License Termination Plan, Rev. 3 15 October 2002	$589.3 million ($2001)[10]
NRC Decommissioning Funding Status Report 30 March 2005	$554 million (YOE)[11]

Maine Yankee Notes:

9. Total cost for radiological decontamination, spent fuel management and site remediation/restoration
10. $508 million escalated to $2001
11. Total cost as of 31 December 2004 including $405 million of decommissioning costs, excluding Department of Energy contract settlement credits

Big Rock Point

Consumers Energy filed a revision to their PSDAR on March 26, 1998. The decommissioning costs reported in that document were based on a detailed, site-specific cost estimate was prepared by TLG. Pursuant to State of Michigan requirements to prepare and file decommissioning cost estimate updates with the Michigan Public Service Commission (MPSC) at three year intervals, an update was prepared by TLG in 2000 and filed in March 2001 as a follow-up to a site-specific decommissioning cost estimate filed with the MPSC in March 1998.

The 2000 estimate, updated with actual costs incurred through 2002 and the latest forecast costs, served as the cost basis for the License Termination Plan submitted in 2003. The $400.6 million estimated in 2001 was revised downward by Consumers Energy to $382.4 million in year 2000 constant dollars. The $18.2 million reduction was the result of a reduction in contingency dollars from $45.0 million to $13.0 million and an increase in projected spent fuel management costs from $50.9 million to $64.7 million.

Consumers Power noted in its LTP submittal that "entering the third year since the 2000 estimate was prepared, actual project cost performance has been on target and is expected to trend unchanged.

On March 31 2005, Consumers Power filed an update to the PSDAR (Rev. 4). The update included discussion on a revised cost estimate that had been presented to the MPSC in March 2004. The estimated cost to decommission the plant was based on the 2003 estimate study prepared by TLG. The estimate (in year of expenditure dollars) was $439.4 million.

Decommissioning was completed and the plant's operating license was amended (for continued ISFSI operations) in January of 2007.

1998 TLG Estimate $293.9 million ($1997)
TLG Document No. C07-1267-004, Rev. 0
26 March 1998

2001 TLG Estimate TLG Document No. C07-1388-003, Rev. 0 01 March 2001	$400.6 million ($200)[12]
BRP License Termination Plan, Rev. 0 01 April 2003	$382.4 million ($2000)[13]
2004 TLG Estimate TLG Document No. C07-1479-001, Rev. 0 22 March 2004	$430.8 million ($2003)
BRP PSDAR, Rev. 4 31 March 2005	$439.4 million (YOE)
BRP License Termination Plan, Rev. 2 27 September 2005	$439.4 million (YOE)[14]

Big Rock Point Notes:

12. $323.0 million Radiological Decommissioning, $50.9 million for Spent Fuel Management and $26.7 million for Site Restoration

13. $291.0 million Radiological Decommissioning, $64.7 million for Spent Fuel Management and $26.7 million for Site Restoration

14. $333.9 million of radiological decommissioning costs, $73.6 million of spent nuclear fuel storage costs, $30.3 million of site restoration and $1.6 million of post 9-11 incremental security costs. Consumers Energy has concluded that, based upon information currently available, that the estimate was adequate to complete the remaining decommissioning activities for the plant.

Schedule B

2020 Evergy Missouri Metro Funding Analysis

EVERGY METRO, INC. (f/k/a KANSAS CITY POWER & LIGHT COMPANY)

WOLF CREEK DECOMMISSIONING TRUST ANALYSIS

MISSOURI JURISDICTION - QUALIFIED TAXABLE TRUST

DECOMMISSIONING COST ASSUMPTIONS

2020 Decom Cost Est	$ 1,073,642,247
Cost Escalation Rate	3.48%
Metro Share	47.00%
Future Juris Allocation Factor	52.33%
Wtd Historical/Future Alloc Factor	54.30%

DECOMMISSIONING TRUST FUND EARNINGS ASSUMPTIONS

TRUST FUND MANAGEMENT FEE	
Missouri Avg Fund Balance	$ 269,654,663
Missouri Annual Fixed Trustee Fee	56,519
Fixed Trustee Fee %	0.0210%
FI Fee and Fixed Trustee Fee%	0.2310%
Equity Fee and Fixed Fee	0.1006%

DECOMMISSIONING TRUST FUND CASH FLOWS

NET AFTER-TAX MARKET VALUE		
June 30, 2020 Market Value	177,000,527	
2020 Remaining Deposits	640,632	
Market Value Incl Remaining Deposit		177,641,159
Unrealized Net Gain	60,608,395	
Effective Tax Rate	20.00%	
Tax on Unrealized Net Gain		12,121,679
Net After-Tax Market Value		165,519,479

Annual Accrual Escalation		0.00%
Contribution	$ 1,281,264.00	

Year	2020 Wolf Creek Decom Cost	Escalated Wolf Creek Decom Cost	Metro Missouri Decom Cost
2020	$ -	$ -	$ -
2021	$ -	$ -	$ -
2022	$ -	$ -	$ -
2023	$ -	$ -	$ -
2024	$ -	$ -	$ -
2025	$ -	$ -	$ -
2026	$ -	$ -	$ -
2027	$ -	$ -	$ -
2028	$ -	$ -	$ -
2029	$ -	$ -	$ -
2030	$ -	$ -	$ -
2031	$ -	$ -	$ -
2032	$ -	$ -	$ -
2033	$ -	$ -	$ -
2034	$ -	$ -	$ -
2035	$ -	$ -	$ -
2036	$ -	$ -	$ -
2037	$ -	$ -	$ -
2038	$ -	$ -	$ -
2039	$ -	$ -	$ -
2040	$ -	$ -	$ -
2041	$ -	$ -	$ -
2042	$ -	$ -	$ -
2043	$ -	$ -	$ -
2044	$ -	$ -	$ -
2045	$ 76,508,585	$ 191,590,565	$ 48,897,876
2046	$ 155,688,989	$ 382,278,684	$ 97,565,430
2047	$ 180,427,849	$ 450,278,203	$ 114,920,314
2048	$ 181,333,486	$ 469,677,136	$ 119,871,323
2049	$ 90,297,138	$ 249,745,286	$ 63,740,164
2050	$ 44,386,389	$ 131,487,802	$ 33,558,408
2051	$ 44,112,207	$ 129,182,554	$ 32,970,060
2052	$ 14,670,468	$ 44,947,873	$ 11,471,627
2053	$ 10,018,447	$ 32,120,498	$ 8,197,816
2054	$ 10,018,447	$ 33,284,200	$ 8,494,816
2055	$ 10,281,427	$ 35,296,456	$ 9,008,386
2056	$ 10,044,453	$ 35,834,694	$ 9,145,755
2057	$ 10,018,447	$ 37,037,995	$ 9,452,863
2058	$ 10,281,427	$ 39,270,121	$ 10,022,547
2059	$ 10,018,447	$ 39,776,047	$ 10,151,670
2060	$ 10,044,453	$ 41,328,790	$ 10,547,962
2061	$ 10,281,427	$ 43,697,477	$ 11,152,500
2062	$ 10,018,447	$ 44,272,521	$ 11,299,263
2063	$ 10,018,447	$ 45,883,028	$ 11,710,298
2064	$ 10,307,434	$ 48,755,332	$ 12,443,369
2065	$ 10,018,447	$ 49,284,230	$ 12,578,355
2066	$ 10,018,447	$ 51,079,426	$ 13,036,526
2067	$ 10,281,427	$ 54,129,120	$ 13,814,871
2068	$ 10,044,453	$ 55,014,509	$ 14,040,841
2069	$ 10,281,427	$ 58,140,266	$ 14,838,599
2070	$ 9,492,485	$ 56,327,515	$ 14,375,947
2071	$ 9,492,485	$ 58,392,753	$ 14,903,039
2072	$ 9,518,492	$ 60,700,438	$ 15,492,008
2073	$ 9,492,485	$ 62,755,893	$ 16,016,602
2074	$ 9,492,485	$ 65,059,641	$ 16,604,566
2075	$ 9,492,485	$ 67,448,923	$ 17,214,361
2076	$ 9,518,492	$ 70,118,526	$ 17,895,699
2077	$ 9,492,485	$ 72,497,036	$ 18,502,744
2078	$ 27,540,910	$ 175,395,619	$ 44,764,591
2079	$ 10,688,827	$ 66,515,566	$ 16,976,149
	$ 1,073,642,247	$ 3,548,604,721	$ 905,677,346
Metro %	47.0%	47.0%	
Metro Share	$ 504,611,856	$ 1,667,844,219	
		54.3023%	
MO Jurisdictional Share --->		$ 905,677,346	

	US T-Bills	Fixed Income	Inter-national	Small Stocks	Lrg Corp Stocks	Weighted After-Tax Earnings
Pre-tax Returns	2.04%	2.43%	8.91%	8.75%	8.49%	
Effective Tax Rate	20.0%	20.0%	20.0%	20.0%	20.0%	
Earnings After Fees & Taxes	1.45%	1.76%	7.05%	6.92%	6.71%	
Year	Investment Mix					
2020	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2021	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2022	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2023	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2024	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2025	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2026	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2027	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2028	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2029	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2030	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2031	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2032	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2033	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2034	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2035	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2036	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2037	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2038	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2039	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2040	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2041	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2042	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2043	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2044	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2045	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2046	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2047	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2048	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2049	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2050	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2051	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2052	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2053	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2054	0.0%	35.0%	15.0%	18.0%	32.0%	5.07%
2055	2.9%	35.9%	14.1%	16.9%	30.1%	4.86%
2056	5.9%	36.8%	13.2%	15.9%	28.2%	4.66%
2057	8.8%	37.6%	12.4%	14.8%	26.4%	4.45%
2058	11.8%	38.5%	11.5%	13.8%	24.5%	4.25%
2059	14.7%	39.4%	10.6%	12.7%	22.6%	4.05%
2060	17.6%	40.3%	9.7%	11.6%	20.7%	3.84%
2061	20.6%	41.2%	8.8%	10.6%	18.8%	3.64%
2062	23.5%	42.1%	7.9%	9.5%	16.9%	3.44%
2063	26.5%	42.9%	7.1%	8.5%	15.1%	3.23%
2064	29.4%	43.8%	6.2%	7.4%	13.2%	3.03%
2065	32.4%	44.7%	5.3%	6.4%	11.3%	2.83%
2066	35.3%	45.6%	4.4%	5.3%	9.4%	2.62%
2067	38.2%	46.5%	3.5%	4.2%	7.5%	2.42%
2068	41.2%	47.4%	2.6%	3.2%	5.6%	2.21%
2069	44.1%	48.2%	1.8%	2.1%	3.8%	2.01%
2070	47.1%	49.1%	0.9%	1.1%	1.9%	1.81%
2071	50.0%	50.0%	0.0%	0.0%	0.0%	1.60%
2072	56.3%	43.8%	0.0%	0.0%	0.0%	1.58%
2073	62.5%	37.5%	0.0%	0.0%	0.0%	1.56%
2074	68.8%	31.3%	0.0%	0.0%	0.0%	1.54%
2075	75.0%	25.0%	0.0%	0.0%	0.0%	1.53%
2076	81.3%	18.8%	0.0%	0.0%	0.0%	1.51%
2077	87.5%	12.5%	0.0%	0.0%	0.0%	1.49%
2078	93.8%	6.3%	0.0%	0.0%	0.0%	1.47%
2079	100.0%	0.0%	0.0%	0.0%	0.0%	1.45%
2054	0.00%	35.00%	15.00%	18.00%	32.00%	100%
	-2.94%	-0.88%	0.88%	1.06%	1.88%	
2071	50.00%	50.00%	0.00%	0.00%	0.00%	100%
	-6.25%	6.25%	0.00%	0.00%	0.00%	
2079	100.00%	0.00%	0.00%	0.00%	0.00%	100%

Year	Trust Fund Contribution	Trust Fund Expenditure	Earnings After Fees & Taxes	Trust Fund Balance
2020		$ -		$ 165,519,479
2021	$ 1,281,264	$ -	$ 8,409,637	$ 175,210,381
2022	$ 1,281,264	$ -	$ 8,900,583	$ 185,392,228
2023	$ 1,281,264	$ -	$ 9,416,400	$ 196,089,892
2024	$ 1,281,264	$ -	$ 9,958,349	$ 207,329,505
2025	$ 1,281,264	$ -	$ 10,527,753	$ 219,138,523
2026	$ 1,281,264	$ -	$ 11,126,004	$ 231,545,790
2027	$ 1,281,264	$ -	$ 11,754,562	$ 244,581,616
2028	$ 1,281,264	$ -	$ 12,414,963	$ 258,277,843
2029	$ 1,281,264	$ -	$ 13,108,821	$ 272,667,928
2030	$ 1,281,264	$ -	$ 13,837,829	$ 287,787,021
2031	$ 1,281,264	$ -	$ 14,603,770	$ 303,672,055
2032	$ 1,281,264	$ -	$ 15,408,513	$ 320,361,832
2033	$ 1,281,264	$ -	$ 16,254,025	$ 337,897,121
2034	$ 1,281,264	$ -	$ 17,142,371	$ 356,320,756
2035	$ 1,281,264	$ -	$ 18,075,722	$ 375,677,742
2036	$ 1,281,264	$ -	$ 19,056,356	$ 396,015,362
2037	$ 1,281,264	$ -	$ 20,086,669	$ 417,383,295
2038	$ 1,281,264	$ -	$ 21,169,179	$ 439,833,738
2039	$ 1,281,264	$ -	$ 22,306,529	$ 463,421,532
2040	$ 1,281,264	$ -	$ 23,501,498	$ 488,204,294
2041	$ 1,281,264	$ -	$ 24,757,005	$ 514,242,563
2042	$ 1,281,264	$ -	$ 26,076,116	$ 541,599,943
2043	$ 1,281,264	$ -	$ 27,462,054	$ 570,343,261
2044	$ 1,281,264	$ -	$ 28,918,204	$ 600,542,730
2045	$ 320,316	$ (48,897,876)	$ 29,500,922	$ 581,466,091
2046	$ -	$ (97,565,430)	$ 27,603,834	$ 511,504,496
2047	$ -	$ (114,920,314)	$ 23,729,844	$ 420,314,026
2048	$ -	$ (119,871,323)	$ 19,016,033	$ 319,458,737
2049	$ -	$ (63,740,164)	$ 14,973,018	$ 270,691,590
2050	$ -	$ (33,558,408)	$ 13,075,834	$ 250,209,017
2051	$ -	$ (32,970,060)	$ 12,049,354	$ 229,288,310
2052	$ -	$ (11,471,627)	$ 11,397,922	$ 229,214,605
2053	$ -	$ (8,197,816)	$ 11,456,382	$ 232,473,172
2054	$ -	$ (8,494,816)	$ 11,615,821	$ 235,594,176
2055	$ -	$ (9,008,386)	$ 11,291,159	$ 237,876,948
2056	$ -	$ (9,145,755)	$ 10,922,088	$ 239,653,281
2057	$ -	$ (9,452,863)	$ 10,518,531	$ 240,718,950
2058	$ -	$ (10,022,547)	$ 10,073,807	$ 240,770,209
2059	$ -	$ (10,151,670)	$ 9,591,241	$ 240,209,780
2060	$ -	$ (10,547,962)	$ 9,081,299	$ 238,743,117
2061	$ -	$ (11,152,500)	$ 8,538,415	$ 236,129,032
2062	$ -	$ (11,299,263)	$ 7,968,898	$ 232,798,667
2063	$ -	$ (11,710,298)	$ 7,383,895	$ 228,472,264
2064	$ -	$ (12,443,369)	$ 6,779,260	$ 222,808,154
2065	$ -	$ (12,578,355)	$ 6,161,911	$ 216,391,710
2066	$ -	$ (13,036,526)	$ 5,544,942	$ 208,900,126
2067	$ -	$ (13,814,871)	$ 4,925,914	$ 200,011,168
2068	$ -	$ (14,040,841)	$ 4,312,240	$ 190,282,567
2069	$ -	$ (14,838,599)	$ 3,713,931	$ 179,157,899
2070	$ -	$ (14,375,947)	$ 3,139,789	$ 167,921,741
2071	$ -	$ (14,903,039)	$ 2,602,524	$ 155,621,226
2072	$ -	$ (15,492,008)	$ 2,372,568	$ 142,501,787
2073	$ -	$ (16,016,602)	$ 2,135,064	$ 128,620,248
2074	$ -	$ (16,604,566)	$ 1,890,613	$ 113,906,295
2075	$ -	$ (17,214,361)	$ 1,638,841	$ 98,330,775
2076	$ -	$ (17,895,699)	$ 1,379,521	$ 81,814,597
2077	$ -	$ (18,502,744)	$ 1,112,808	$ 64,424,662
2078	$ -	$ (44,764,591)	$ 698,706	$ 20,358,777
2079	$ -	$ (16,976,149)	$ 202,503	$ 3,585,131
			Surplus/(Deficit)	0.40%