Nuclear Management Company, LLC

October 10, 2006

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

Palisades Nuclear Plant
Docket No. 50-255
License No. DPR-20

Response to Request for Additional Information for Palisades Supplement to Irradiated Fuel Management Plan and Preliminary Decommissioning Cost Estimates for the Palisades Nuclear Plant

Reference: 1) Nuclear Management Company, LLC (NMC) letter to the U.S. Nuclear Regulatory Commission (NRC), "Irradiated Fuel Management Plan and Preliminary Decommissioning Cost Estimates for Palisades Nuclear Plant," (L-HU-06-16) dated April 21, 2006, (ADAMS Accession No. ML061140185, TAC No. MD1699).

As holder of the plant operating license, Nuclear Management Company, LLC (NMC) is submitting this letter on behalf of the plant owner, Consumers Energy. On April 21, 2006, we provided information concerning the Irradiated Fuel Management Plan and Preliminary Decommissioning Cost Estimates for the Palisades Nuclear Plant (Palisades) (Reference 1). Enclosure 1 provides supplemental information in response to NRC staff questions. Enclosure 2 provides a copy of "Decommissioning Cost Analysis for the Palisades Nuclear Plant," dated March 2004, performed by TLG Services, Inc. for plant owner, Consumers Energy.

This letter contains no new commitments and no revisions to existing commitments.

Edward J. Weinkam
Director, Nuclear Licensing & Regulatory Services
Nuclear Management Company, LLC

700 First Street
Hudson, Wisconsin 54016

Enclosures (2)

cc: Regional Administrator, USNRC, Region III
NRR Project Manager, Palisades Nuclear Plant, USNRC
NRC Resident Inspector, Palisades Nuclear Plant, USNRC
Consumers Energy:
Manager of Depreciation and Decommissioning, Jan Anderson
Asset Manager, Steve Wawro

ENCLOSURE 1

Supplement to Irradiated Fuel Management Plan and Preliminary Decommissioning Cost Estimate

On April 21, 2006, Nuclear Management Company, LLC (NMC) provided information describing the present Irradiated Fuel Management Plan and Preliminary Decommissioning Cost Estimates for the Palisades Nuclear Plant (Palisades) (Reference 1). This enclosure supplements Reference 1 in providing additional information in response to NRC staff inquiries. The information provided herein is drawn primarily from a study prepared by TLG Services, Inc. entitled, "Decommissioning Cost Analysis for Palisades Nuclear Plant, March 2004," included as Enclosure 2. NMC is submitting this information on behalf of the plant owner, Consumers Energy.

The NRC staff's questions are restated below, with the NMC response immediately following.

NRC Question 1:

Nuclear Management Company, LLC (NMC) April 21, 2006, submittal, "Irradiated Fuel Management Plan and Preliminary Decommissioning Cost Estimate" for Palisades Nuclear Plant states that NMC cost estimate is based on a March 2004 TLG Services "Decommissioning Cost Study for Palisades Nuclear Plant" cost study. NMC referenced figures and tables from this cost study, but did not provide the supporting document for NRC to substantiate the information. Please send us this document, as we need to review the supporting basis for TLG's $960.3 million estimate. The validity of the supporting assumptions is a key factor in determining if the cost estimate is valid. We might have additional questions once we review the detailed TLG cost estimate.

> The supporting document is provided as Enclosure 2 in the attached TLG "Decommissioning Cost Study for the Palisades Nuclear Plant".

NRC Question 2:

The staff requests NMC to provide a detailed description of its plan for funding the costs of the SAFSTOR for Palisades. NMC stated that as of December 31, 2005, the Palisades Decommissioning Trust Fund had a balance of $554.1 million, with future annual contributions of $5.5 million for 6 years, and a real rate-of-return of about 1.86 percent. Assuming a real rate of return of 2 percent, incorporating the additional $ 5.5 million annual contributions for the remaining period, and deducting the expenses identified in Table 1, "PNP Schedule of Annual Expenditures: SAFSTOR Scenario," the resulting analysis indicates that the funds will be expended in 2031. This means NMC will need an additional $150 million to complete

decommissioning and to cover the cost of spent fuel storage until 2049. NMC submittal says it will be responsible for the additional costs beyond the trust fund monies to cover the cost of maintaining the spent fuel, and that operating revenue will be used to cover additional costs. However, because of the significant shortfall, and possible uncertainties, NMC spent fuel management plan needs to address the additional cost of spent fuel management from 2031 until 2049.

Decommissioning funding practices approved by the Michigan Public Service Commission (MPSC) require Consumers Energy to file reports on the adequacy of funds for decommissioning at three-year intervals. The next report is currently scheduled for 2007. If the report shows that Palisades decommissioning funding is inadequate, then Consumers Energy will likely seek an adjustment of decommissioning surcharges. The current MPSC-jurisdictional funding ($5.5 million/yr through year 2011) was adopted in MPSC Case No. U-14150 due to uncertainty related to license renewal. The settlement agreement (MPSC Case U-14150) addresses the rationale and includes provisions to evaluate extending funding beyond year 2011.

To the extent that the trust fund balance exceeds costs required for radiological decommissioning, trust fund monies, in conjunction with Consumers Energy operating revenues, will be used to pay for spent fuel management, if funding is not obtained from alternative sources.

NRC Question 3:

Table 1 in NMC submittal identified the expenditures for the SAFSTOR option from 2011 through 2049. However, Table 1 does not distinguish between the annual spent fuel storage costs and decommissioning costs for the period beginning in 2011 and ending in 2032 when the decommissioning is estimated to be completed. Since the Trust Funds are established to address the cost of radiological decommissioning, the annual expenditures need to be separated. This is especially significant since the total expenditures listed will deplete the Trust Fund before radiological decommissioning is completed in 2032. The NRC recognizes that Table 2, "PNP Summary of SAFSTOR Cost Estimate by Period Cost and Activity Cost," separates the total SAFSTOR and decommissioning expenditures. However, to assure funding is available to complete radiological decommissioning, please break out the annual spent fuel storage costs and the annual radiological decommissioning expenditures identified in Table 1.

See 2004 TLG Decommissioning Cost Study, Table 3.2 for Schedule of Annual Expenditures, License Termination and Table 3.3 for Schedule of Annual Expenditures, Spent Fuel Management.

NRC Question 4:

Provide an organizational structure chart that defines the organizational structure and shows how NMC and Consumers Energy, the plant owner, are related.

Palisades Nuclear Plant is owned by Consumers Energy Company (Consumers Energy), a subsidiary of CMS Energy Corporation. Nuclear Management Company, LLC (NMC) operates Palisades on behalf of Consumers Energy. With respect to the Palisades operating license, Consumers Energy is the owner licensee and NMC is the licensed operator of the facility.

Consumers Energy as owner licensee retains responsibility for accruing and maintaining the Decommissioning Trust Funds. NMC is assigned responsibility for assembling and reporting information for the Decommissioning Fund Status reports.

NRC Question 5:

Provide a detailed description of Consumers Energy plan for funding the costs of storing the spent fuel for Palisades from 2011 to 2033. This cost is about $200 million based on Table 3.3, "Schedule of Annual Expenditures Spent Fuel Management." Because the trust fund is established to address the cost of radiological decommissioning, access to funds would not be available to cover the cost of spent fuel storage until decommissioning is complete in 2033. NMC's submittal stated Consumers Energy would use operating revenue to cover the cost of maintaining the spent fuel. Accordingly, please address in detail where the money to support the spent fuel storage from 2011 to 2033 will come from. If the Public Service Commission will authorize additional collections (not withstanding the amounts in the trust fund), or Consumers Energy can cover additional costs and still project positive net income, then explain this.

We are not concerned about funding the costs of storing the spent fuel at Palisades beyond 2033, as explained next. NMC stated that as of December 31, 2005, the Palisades Decommissioning Trust Fund had a balance of $554.1 million.

NMC would continue to make future, annual contributions of $5.5 million for 6 years. Additional earnings would be generated on a real rate-of-return of about 1.86 percent. However, assuming an NRC-estimated rate-of-return of 2 percent, $5.5 million annual contributions for the remaining period, and then deducting the expenses identified in Table 3.2, "Schedule of Annual Expenditures for License Termination," the resulting analysis indicates that more than sufficient funds will be available to cover the cost of radiological decommissioning the facility. More specifically, about $300 million excess funds will be available to address spent fuel storage costs after decommissioning is complete in 2033.

The following response assumes a termination date of March 2011 with no license extension. We are expecting a decision from the NRC regarding the renewal of the Palisades license some time in 2007.

There are 3 alternatives for funding the costs of storing spent nuclear fuel for Palisades from 2011 to 2033, any combination of which could be utilized by the company. First, the company could absorb the expenses for storing spent nuclear fuel through existing operating revenues. The company would pay the expenses under the assumption that any subsequent recoveries from the pending DOE litigation would be used to offset those expenditures. Second, in the event that the current litigation is settled with the DOE prior to 2033, any funds received by the company would be used to cover any future expenditure related to the storing of Palisades' spent nuclear fuel or as a recovery of amounts previously expended. The company has indicated in SEC filings that if litigation against the DOE for failure to take delivery of spent nuclear fuel is successful, the company plans to use any recoveries to pay for spent fuel storage until the DOE takes possession as required by law.

Thirdly, the MPSC's definition of decommissioning for purposes of determining funding levels is not limited to radiological decommissioning. The surcharges currently being collected from customers and being placed into trust are not limited to expenses only for radiological decommissioning. For purposes of reviewing fund adequacy, the implicit assumption has been that the trust fund amounts that were above levels needed to meet NRC requirements could be used for non-radiological decommissioning before 2033.

If the company continues to own the Palisades plant and projected trust fund levels (including earnings) along with any amounts recovered from the DOE in the spent fuel litigation are not adequate for decommissioning costs, then the company will likely seek additional funding from the MPSC either through an increase in the annual surcharge recovery amount, an extension of the collection period beyond 2011, or both.

REFERENCE

1. Nuclear Management Company, LLC (NMC) letter to the U.S. Nuclear Regulatory Commission (NRC), "Irradiated Fuel Management Plan and Preliminary Decommissioning Cost Estimates for Palisades Nuclear Plant," (L-HU-06-16) dated April 21, 2006, (ADAMS Accession No. ML061140185).

ENCLOSURE 2

DECOMMISSIONING COST STUDY FOR THE PALISADES NUCLEAR PLANT

PREPARED BY

TLG SERVICES, INC.

March 2004

Document N30-1440-004, Rev. 0

DECOMMISSIONING COST STUDY

for the

PALISADES NUCLEAR PLANT

prepared for

Consumers Energy

prepared by

TLG Services, Inc.
Bridgewater, Connecticut

March 2004

APPROVALS

President/ Quality Assurance Manager	Thomas S. LaGuardia **Thomas S. LaGuardia**	3/17/04 **Date**
Project Manager	Geoffrey M. Griffiths **Geoffrey M. Griffiths**	3.17.04 **Date**
Project Engineer	Benjamin J. Stochmal **Benjamin J. Stochmal**	3/17/04 **Date**
Technical Manager	Francis W. Seymore **Francis W. Seymore**	3/17/04 **Date**

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No.	CRA No.	Date	Item Revised	Reason for Revision
0		03-17-04		Original Issue

EXECUTIVE SUMMARY

This report presents an estimate of the cost to decommission the Palisades Nuclear Plant (Palisades) for the selected decommissioning scenario following the scheduled cessation of plant operations. The projected cost to decommission the nuclear unit for the deferred dismantling alternative (SAFSTOR), in year 2003 dollars, is estimated at approximately $960.3 million, including contingency. The analysis relies upon site-specific, technical information, originally developed in an evaluation prepared in 1997-98,[1] revised in 2000-01,[2] and updated to reflect current assumptions pertaining to the disposition of the nuclear unit and relevant industry experience in undertaking such projects. The updated estimate is designed to provide Consumers Energy with sufficient information to assess their financial obligations, as they pertain to the eventual decommissioning of the nuclear unit.

The primary goal of the decommissioning is the removal and disposal of the contaminated systems and structures so that the plant's operating license can be terminated. The analysis recognizes that spent fuel will be stored at the site in the plant's storage pool and/or in an independent spent fuel storage installation (ISFSI) until such time that it can be transferred to a U.S. Department of Energy (DOE) facility. Consequently, the estimate also includes those costs to manage and subsequently decommission these storage facilities.

The estimate is 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 estimate incorporates a minimum cooling period of approximately eight years for the spent fuel that resides in the storage pool when operations cease. The estimate also includes the dismantling of non-essential structures and limited restoration of the site.

<u>Alternatives and Regulations</u>

The Nuclear Regulatory Commission (NRC or Commission) provided initial decommissioning requirements in its rule adopted on June 27, 1988.[3] In this rule, the NRC set forth financial criteria for decommissioning licensed nuclear power facilities.

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1 "Decommissioning Cost Study for the Palisades Nuclear Plant," Document No. C07-1267-003, TLG Services, Inc., March 1998.

2 "Decommissioning Cost Study for the Palisades Nuclear Plant," Document No. C07-1388-002, TLG Services, Inc., March 2001.

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.

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. The NRC also recognizes that some combination of the first two alternatives would be acceptable in some cases.

> 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 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.

The 60-year restriction has limited the practicality of 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 1996, the NRC published revisions to the general requirements for decommissioning nuclear power plants to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the

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

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, further described the methods and procedures acceptable to the NRC staff for implementing the requirements of the 1996 revised rule relating to the initial activities and major phases of the decommissioning process. The costs and schedule presented in this analysis follow the general guidance and processes described in the amended regulations.

Methodology

The methodology used to develop the estimate described within this document follows the basic approach originally presented in the cost estimating guidelines[8] developed by the Atomic Industrial Forum (now Nuclear Energy Institute). This reference describes a unit factor method for determining decommissioning activity costs. The unit factors used in this analysis incorporate site-specific costs and the latest available information on worker productivity in decommissioning.

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 cost estimate.

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."[9] The cost elements in the estimates are based on ideal conditions; therefore, the types of unforeseeable events that are almost certain to occur in decommissioning, based on industry experience, are addressed through a percentage contingency applied on a line-item basis. This contingency factor is a nearly universal element in all large-scale construction and demolition projects. It should be noted that contingency, as used in

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

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

this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

The use and role of contingency within decommissioning estimates is not a safety factor issue. Safety factors provide additional security and address situations that may never occur. Contingency funds, by contrast, are expected to be fully expended throughout the program. Inclusion of contingency is necessary to provide assurance that sufficient funding will be available to accomplish the intended tasks.

Low-Level Radioactive Waste Disposal

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. With the passage of the "Low-Level Radioactive Waste Policy Act" in 1980,[10] and its Amendments of 1985,[11] the states became ultimately responsible for the disposition of low-level radioactive waste generated within their own borders.

Palisades is currently able to access the disposal facility in Barnwell, South Carolina. However, in June 2000, South Carolina formally joined with Connecticut and New Jersey to form the Atlantic Compact. The legislation allows South Carolina to gradually limit access to the Barnwell facility, with only Atlantic Compact members having access to the facility after mid-year 2008. It is reasonable to assume that additional disposal capacity will be available to support reactor decommissioning, particularly for the isolation of the more highly radioactive material that is not suitable for disposal elsewhere. However, for estimating purposes, and as a proxy for future disposal facilities, waste disposal costs are generated using available pricing schedules for the currently operating facilities, i.e., at Barnwell and the Envirocare facility in Utah.

High-Level Radioactive Waste Management

Congress passed the "Nuclear Waste Policy Act"[12] (NWPA) in 1982, assigning the responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the DOE. Two permanent disposal facilities were envisioned, as well as an interim storage facility. To recover the cost, the legislation created a Nuclear Waste Fund through which money is collected from the sale of electricity generated by the power plants. The NWPA, along with the individual disposal

10 "Low-Level Radioactive Waste Policy Act," Public Law 96-573, 1980.
11 "Low-Level Radioactive Waste Policy Amendments Act of 1985," Public Law 99-240, 1986.
12 "Nuclear Waste Policy Act of 1982 and Amendments," U.S. Department of Energy's Office of Civilian Radioactive Management, 1982.

contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

Since the original legislation, the DOE has announced several delays in the program schedule. By January 1998, the DOE had failed to initiate the disposal of spent nuclear fuel and high level waste, as required by the NWPA and the utility contracts. As a result, utilities have initiated legal action against the DOE. While legal actions continue, the DOE has no plans to receive spent fuel prior to completing the construction of its geologic repository.

Despite unfavorable rulings in the courts, the DOE has continued to link initial acceptance of commercial spent fuel to the schedule for a geologic repository, which it currently projects to begin operating in 2010 at the earliest. However, the DOE has failed to communicate to utilities a revised schedule for acceptance of spent fuel. Thus, spent fuel logistics supporting this cost update are based on available information and projections related to the DOE's initial performance, acceptance rates and use of spent fuel acceptance allocations assigned to Consumers Energy. These projections indicate that fuel from Palisades will not begin to be accepted by the DOE until 2013.

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.[13] Interim storage of the fuel, until the DOE has completed the transfer, will be in the storage pool and/or an ISFSI located on the Palisades site. The ISFSI, which is independently licensed and operated, will accommodate the inventory of spent fuel residing in the plant's storage pool at the conclusion of the required cooling period. Once emptied, the auxiliary building can be prepared for long-term storage.

The DOE's generator allocation/receipt schedules are based upon the oldest fuel receiving the highest priority. Given this scenario and an anticipated rate of transfer, spent fuel is projected to remain at the site for approximately 37 years after the cessation of operations. Consequently, costs are included within the estimate for the long-term caretaking of the spent fuel at the Palisades site until the year 2048.

<u>Site Restoration</u>

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 will substantially damage power block structures, potentially weakening the footings and structural supports. Prompt demolition once

[13] "Domestic Licensing of Production and Utilization Facilities," U.S. Code of Federal Regulations, Title 10, Part 50.54 (bb).

the license is terminated is clearly the most appropriate and cost-effective option. It is unreasonable to anticipate that these structures would be repaired and preserved after the radiological contamination is removed. The cost to dismantle site structures with a work force already mobilized is more efficient and less costly than if the process were deferred. Experience at shutdown generating stations has shown that plant facilities quickly degrade without maintenance, adding additional expense and creating potential hazards to the public and the demolition work force. Consequently, this analysis assumes that non-essential site structures within the restricted access area are removed to a nominal depth of three feet below the local grade level wherever possible. The site is then backfilled, graded and stabilized.

Financial Risk

It has been TLG's experience that the results of a risk analysis, when compared with the base case estimate for decommissioning, indicate that the chances of the base decommissioning estimate's being too high is a low probability, and the chances that the estimate is too low is a higher probability. This is mostly due to the pricing uncertainty for low-level radioactive waste burial, and to a lesser extent due to schedule increases from changes in plant conditions and to pricing variations in the cost of labor (both craft and staff). TLG did not perform a risk analysis for this study and therefore the estimates in this report do not include any additional costs to address the perceived financial risk.

Summary

The cost to decommission Palisades is evaluated for the SAFSTOR decommissioning alternative. The estimate assumes the eventual removal of all the contaminated and activated plant components and structural materials, such that the facility operator may then have unrestricted use of the site with no further requirement for an operating license. Delayed 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 can be completed. Once the transfer is complete, the storage facilities are also decommissioned.

The scenario analyzed for the purpose of generating the estimate is 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 Appendix C. A cost summary is provided at the end of this section for the major cost components.

COST AND SCHEDULE ESTIMATE SUMMARY

	Costs 2003$ (thousands)	Schedule (months)
SAFSTOR Preparations (includes pre-shutdown costs)	105,021	18.0
12.5 year Dormancy Maintenance	229,730	150.0
Decommissioning Preparations	110,217	18.1
Delayed Decommissioning	312,938	49.0
Site Restoration	78,794	19.5
Post Decommissioning ISFSI Operations	115,413	198.9
ISFSI Decontamination and Decommissioning	8,212	6.0
Total [1]	960,325	459.6

[1] Columns may not add due to rounding

SUMMARY OF DECOMMISSIONING COST ELEMENTS
(Thousands of 2003 Dollars)

Activity	Total
Decontamination	10,605
Removal	99,525
Packaging	12,377
Shipping	4,424
Low-Level Radioactive Waste Disposal	61,281
Staffing	280,309
Taxes	65,011
Engineering	16,569
Energy	11,857
Waste Recycling	64,480
Insurance	21,211
ISFSI Expenditures	194,931
Spent Fuel Pool Isolation	9,607
NRC and EP Fees	12,273
Site Characterization	1,707
License Termination Survey	5,540
Miscellaneous Support Equipment & Supplies	23,167
Separation Program	9,141
Fixed Indirect Overhead	36,848
Site Security	10,284
Spent Fuel Pool O&M	9,177
Total [1]	960,325
NRC License Termination	584,064
Spent Fuel Management	297,948
Site Restoration	78,313

[1] Columns may not add due to rounding

1. INTRODUCTION

This report presents an estimate of the cost to decommission the Palisades Nuclear Plant (Palisades) for the scenario described in Section 2, following a scheduled cessation of plant operations. The analysis is designed to provide Consumers Energy with sufficient information to assess its financial obligations, as they pertain to the eventual decommissioning of the nuclear unit. It is not a detailed engineering document, but a financial analysis prepared in advance of the detailed engineering that will be required to carry out the decommissioning.

1.1 OBJECTIVES OF STUDY

The objectives of this study are to prepare a comprehensive estimate of the cost to decommission Palisades, to provide a sequence or schedule for the associated activities, and to develop waste stream projections from the decontamination and dismantling activities. For the purposes of this study, the shutdown date was taken as March 14, 2011.

1.2 SITE DESCRIPTION

Palisades is a single unit, pressurized water reactor located on the eastern shore of Lake Michigan, in Covert Township, approximately four and one-half miles south of South Haven, Michigan. The plant is owned by Consumers Energy. In late 2000, Consumers Energy signed an agreement to transfer responsibility for operation of the Palisades Plant to Nuclear Management Company (NMC).

The nuclear steam supply system (NSSS) consists of a pressurized water reactor and a two-loop reactor coolant system. Combustion Engineering was the supplier. The generating unit has a licensed thermal power rating of 2530 Megawatts thermal (MWt), with a corresponding electrical rating of 730 net Megawatts electric (MWe) with the reactor at rated power. The balance of plant was designed and constructed by Bechtel Power Corporation as architect-engineer and constructor.

The reactor coolant system is comprised of the reactor vessel, a vertical cylinder with a removable hemispherical dome, and two heat transfer loops, each containing a vertical shell and U-tube steam generator, and two vertical, single-suction, centrifugal reactor coolant pumps. In addition, the system includes an electrically heated pressurizer, pressurizer relief tank, and interconnected piping. The system is housed within the reactor building, a prestressed, posttensioned, concrete cylinder with a hemispherical dome connected to a conventionally reinforced concrete slab. A steel liner is anchored to the interior of the building forming a leaktight boundary. The building housing the NSSS is designed to provide biological shielding as well as missile protection for the steel containment shell.

Heat produced in the reactor is converted to electrical energy by the steam and power conversion system. A turbine-generator system converts the thermal energy of steam produced in the generators into mechanical shaft power and then into electrical energy. The turbine-generator consists of a tandem (single shaft) arrangement of a double-flow high-pressure turbine, and two identical, double-flow, low-pressure turbine sections driving a direct-coupled generator. The turbine is operated in a closed feedwater cycle that condenses the steam, and the heated feedwater is returned to the steam generators. Heat rejected in the main condenser is removed by the circulating water system. This system is the heat sink for Palisades. Rejected heat from the main and the feedwater pump turbine condensers is dissipated to the ambient surroundings in a closed cycle system using two multi-cell, straight, mechanical draft cooling towers.

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.[1]* 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,"[2] 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, the option evaluated for this analysis, assumes that any contaminated or

* Annotated references for citations in Sections 1-6 are provided in Section 7.

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

The ENTOMB alternative has not been viewed as a viable option for power reactors due to the significant time required to isolate the long-lived radionuclides for decay to permissible levels. However, with recent rulemaking permitting the controlled release of a site, the NRC has re-evaluated this alternative.[3] The resulting feasibility study, based upon an assessment by Pacific Northwest National Laboratory, concluded that the method did have conditional merit for some, if not most, reactors. However, the staff also found that additional rulemaking would be needed before this option could be treated as a generic alternative. The NRC had considered rulemaking to alter the 60-year time for completing decommissioning and to clarify the use of engineered barriers for reactor entombments.[4] However, the staff has recently 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 has concurred with the staff's recommendation.

The NRC published revisions to the general requirements for decommissioning nuclear power plants in 1996.[5] When the 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 new amendments allow for greater public participation and better define the transition process from operations to decommissioning.

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

1.3.1 Nuclear Waste Policy Act

Congress passed the Nuclear Waste Policy Act[6] (NWPA) in 1982, assigning the responsibility for disposal of the spent nuclear fuel created by the commercial nuclear generating plants to the U.S. Department of Energy (DOE). Two permanent disposal facilities and an interim storage facility were envisioned. To recover the cost, the legislation created a Nuclear Waste Fund through which money is collected from the sale of electricity generated by the power plants. The NWPA, along with the individual disposal contracts with the utilities, specified that the DOE was to begin accepting spent fuel by January 31, 1998.

After pursuing a national site selection process, the NWPA was amended in 1987 to designate Yucca Mountain, Nevada, as the only site to be evaluated for geologic disposal of high-level waste. Also in 1987, the DOE announced a five-year delay (1998 to 2003) in the opening date for the repository. Two years later, in 1989, an additional seven-year delay was announced, primarily due to problems in obtaining the permits necessary from the state of Nevada to perform the required characterization of the site.

Generators have responded to this impasse by initiating legal action and constructing supplemental storage as a means of maintaining necessary operating margins. In an August 2000 ruling,[7] the U.S. Court of Appeals for the Federal Circuit reaffirmed the utility position that DOE had breached its contractual obligation. Legal actions with the DOE continue; however, the DOE's position has remained unchanged. The agency continues to maintain that its delayed performance is unavoidable because it does not have an operational repository and does not have authority to provide storage in the interim. Consequently the DOE has no plans to receive spent fuel from the commercial reactors until the repository is operational.

The NRC requires that licensees establish a program to manage and provide funding for the management of all irradiated fuel at the reactor until title of the fuel is transferred to the Secretary of Energy, pursuant to Title 10 of the Code of Federal Regulations (10 CFR), §50.54 (bb).[8] This funding requirement is fulfilled through inclusion of certain high-level waste cost elements in the decommissioning estimate, as identified in Section 3.

A supplemental spent fuel storage facility currently exists on the Palisades site that can accommodate the residual inventory in wet storage. Once the pool is emptied, the Auxiliary Building can be prepared for long-term storage.

For estimating purposes, the DOE is assumed to initiate operations of its geologic repository in 2010 and the pickup of Palisade's spent fuel beginning in the year 2013. The DOE's generator allocation/receipt schedules are based upon the oldest fuel receiving the highest priority. Given this scenario and an anticipated rate of transfer, spent fuel is projected to remain at the site for approximately 37 years after the cessation of operations. Consequently, costs are included within the analysis for the continued operation of the storage pool and the expansion of the ISFSI, as required, and for the long-term caretaking of the spent fuel at the site until the year 2048.

[This evaluation is prepared without prejudice to the rights of Consumers Energy to pursue legal and contractual remedies from the DOE in light of recent court decisions.]

1.3.2 Low-Level Radioactive Waste Acts

The contaminated and activated material generated in the decontamination and dismantling of a commercial nuclear reactor is classified as low-level (radioactive) waste, although not all of the material is suitable for "shallow-land" disposal. Congress passed the "Low-Level Radioactive Waste Policy Act" in 1980,[9] declaring the states as being ultimately responsible for the disposition of low-level radioactive waste generated within their own borders. The federal law encouraged the formation of regional groups or compacts to implement this objective safely, efficiently, and economically, and set a target date of 1986 for implementation. After little progress, the "Low-Level Radioactive Waste Policy Amendments Act of 1985,"[10] extended the implementation schedule, with specific milestones and stiff sanctions for non-compliance. However, to date, no new compact facilities have been successfully sited, licensed, and constructed.

Palisades is currently able to access the disposal facility in Barnwell, South Carolina. However, in June 2000, South Carolina formally joined with Connecticut and New Jersey to form the Atlantic Compact. The legislation allows South Carolina to gradually limit access to the Barnwell facility, with only Atlantic Compact members having access to the facility after mid-year 2008. It is reasonable to assume that additional disposal capacity will be available to support reactor decommissioning, particularly for the isolation of the more highly radioactive material that is not suitable for disposal elsewhere. However, for estimating purposes, and as a proxy for future disposal facilities, waste disposal costs are generated using available pricing schedules for the currently operating facilities, i.e., at Barnwell and the Envirocare facility in Utah.

1.3.3 Radiological Criteria for License Termination

In 1997, the NRC published Subpart E, "Radiological Criteria for License Termination,"[11] amending 10 CFR §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 for Palisades assume that the 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).[12] An additional limit of 4 millirem per year, as defined in 40 CFR §141.16, is applied to drinking water.[13]

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) [14] 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. SAFSTOR DECOMMISSIONING ALTERNATIVE

The following sections describe the basic activities associated with the SAFSTOR decommissioning 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 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 not required to operate in support of the spent fuel pool or site surveillance and security are drained, de-energized, and secured. Minimal cleaning/removal of loose contamination and/or fixation and sealing of remaining contamination is performed. Access to contaminated areas is secured to provide controlled access for inspection and maintenance. 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.

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 would then be 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 estimate developed for Palisades is 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 PERIOD 1 – PREPARATIONS FOR SAFE-STORAGE

In anticipation of the cessation of plant operations, detailed preparations are undertaken to provide a smooth transition from plant operations to its intended safe-storage configuration. Through implementation of a staffing transition plan, the organization required to manage the intended preparation 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.

2.1.1 Engineering and Planning

The PSDAR, required within two years of the notice to cease operations, provides a description of the licensee's planned decommissioning activities, a timetable, and the associated financial requirements of the intended decommissioning program. Upon receipt of the PSDAR, the NRC will make the document available to the public for comment in a local hearing to be held in the vicinity of the reactor site. Ninety days following submittal and NRC receipt of the PSDAR, the licensee may begin to perform major decommissioning activities under a modified 10 CFR §50.59 procedure, i.e., without specific NRC approval. Major activities are defined as any activity that results in permanent removal of major radioactive components, permanently modifies the structure of the containment, or results in dismantling components (for shipment) containing GTCC, as defined by 10 CFR §61. Major components are further defined as comprising the reactor vessel and internals, large bore reactor recirculation 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 safe-storage period. 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.

2.1.2 Site Preparations

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

- 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.

- The transfer of spent fuel from the storage pool to the ISFSI.

- 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.

- 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.

- Decontamination of the reactor coolant system.

- Draining of the reactor vessel, with the internals left in place and the vessel head secured.

- Draining and de-energizing non-essential, contaminated systems with decontamination as required for future maintenance and inspection.

- Preparing lighting and alarm systems whose continued use is required; de-energizing portions of fire protection, electric power, and HVAC systems whose continued use is not required.

- Cleaning of the loose surface contamination from building access pathways.

- Performing an interim radiation survey of plant, posting warning signs where appropriate.

- Erecting physical barriers and/or securing all access to radioactive or contaminated areas, except as required for inspection and maintenance.

- Installing security and surveillance monitoring equipment and relocating security fence around secured structures, as required.

2.2 PERIOD 2 - DORMANCY

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

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

The environmental surveillance program constitutes an abbreviated version of the program in effect during normal plant operations.

Security during the dormancy period is conducted primarily to prevent unauthorized entry and to protect the public from the consequences of its own actions. The security fence, sensors, alarms, and other surveillance equipment provide security. Fire and radiation alarms are also monitored and maintained. While remote surveillance is an option, it does not offer the immediate response time of a physical presence.

Spent fuel is transferred from the ISFSI to a DOE facility throughout this period.

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

2.3 PERIOD 3 – PREPARATIONS FOR DECOMMISSIONING

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

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

The delay in decommissioning also yields lower working area radiation levels. As such, the estimates for the delayed scenarios incorporate reduced ALARA controls for the SAFSTOR's lower occupational exposure potential. Although the initial radiation levels due to ^{60}Co will decrease during the dormancy period, the internal components of the reactor vessel will still exhibit sufficiently high radiation dose rates to require remote sectioning under water due to the presence of long-lived radionuclides such as ^{94}Nb, ^{59}Ni, and ^{63}Ni. 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). 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. As such, the controls used in the decontamination and dismantling of the nuclear unit will be similar to those employed in a more immediate decommissioning scenario.

The LTP, submitted as a supplement to the FSAR or its equivalent, 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.

Significant decommissioning activities in this phase include:

- 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.

- 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.

2.4 PERIOD 4 – DECOMMISSIONING OPERATIONS

This period includes the physical decommissioning activities associated with the removal and disposal of contaminated and activated components and structures, including the successful termination of the 10 CFR §50 operating license. Significant decommissioning activities in this phase include:

- Construction of temporary facilities and/or modification of existing facilities to support dismantling activities. This may include a centralized processing area to facilitate equipment removal and component preparations for off-site disposal.

- Reconfiguration and modification of site structures and facilities as needed to support decommissioning operations. This may include the upgrading of roads (on- and off-site) to facilitate hauling and transport. Modifications may be required to the containment structure to facilitate access of large/heavy equipment. Modifications may also be required to the refueling area of the building to support the segmentation of the reactor vessel internals and component extraction.

- Design and fabrication of temporary and permanent shielding to support removal and transportation activities, construction of contamination control envelopes, and the procurement of specialty tooling.

- Procurement (lease or purchase) of shipping canisters, cask liners, and industrial packages.

- 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 former and lower core support assembly. Some material is expected to exceed Class C disposal requirements. As such, the segments will be packaged in modified fuel storage canisters for geologic disposal.

- Segmentation of the reactor vessel. A shielded platform is installed for segmentation as cutting operations are performed in-air using remotely operated equipment within a contamination control envelope. The water level is maintained just below the cut to minimize the working area dose rates. Segments are transferred in-air to containers that are stored under water, for example, in an isolated area of the refueling canal.

- Removal of the activated portions of the concrete biological shield and accessible contaminated concrete surfaces. If dictated by the steam generator and pressurizer removal scenarios, those portions of the associated cubicles necessary for access and component extraction are removed.

- Removal of the steam generators and pressurizer for material recovery and controlled disposal. 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.

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

- Removal of the steel liners from refueling canal, disposing of the activated and contaminated sections as radioactive waste. Removal of any activated/ contaminated concrete.

- Surveys of the decontaminated areas of the containment structure.

- Remediation and removal of the contaminated equipment and material from the auxiliary, condensate demineralizer and radwaste storage 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)."[15] This document incorporates the statistical approaches to survey design and data interpretation used by the EPA. It also identifies state-of-the-art, commercially available instrumentation and procedures for conducting radiological surveys. Use of this guidance ensures that the surveys are conducted in a manner that provides a high degree of confidence that applicable NRC criteria are satisfied. Once the survey is complete, the results are provided to the NRC in a format that can be verified. The NRC then reviews and evaluates the information, performs an independent confirmation of radiological site conditions, and makes a determination on final termination of the license.

The NRC will terminate the operating license if it determines that site remediation has been performed in accordance with the LTP, and that the terminal radiation survey and associated documentation demonstrate that the facility is suitable for release.

2.5 PERIOD 5 – SITE RESTORATION

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

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

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

Concrete rubble produced by the demolition of the reactor building is sent to a waste processing facility for disposal. Rubble produced by the demolition of the remaining structures is processed to remove rebar and miscellaneous embedments. Processed material from the remaining structures is trucked to an off-site area for disposal as construction debris.

2.6 ISFSI OPERATIONS AND DECOMMISSIONING

The ISFSI will continue to operate under a separate and independent license (10 CFR §72) following the termination of the §50 operating license. Assuming the DOE starts accepting fuel in 2010, transfer of spent fuel from Palisades is anticipated to start in the year 2013 and is assumed to continue with the final spent fuel shipment presumed to occur in the year 2048.

At the conclusion of the spent fuel transfer process, the ISFSI will be decommissioned. The Commission will terminate the §72 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 assumed design for the ISFSI is based upon the use of a multi-purpose canister and a concrete overpack for pad storage. For purposes of this cost analysis, it is assumed that once the inner canisters containing the spent fuel assemblies have been removed, any required decontamination performed, 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 will then be removed, and the area graded and landscaped to conform to the surrounding environment.

3. COST ESTIMATE

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

3.1 BASIS OF ESTIMATE

The estimate was developed with site-specific, technical information originally developed in an evaluation prepared in 1998[16] and revised in 2000.[17] The information was reviewed for the current analysis and updated as deemed appropriate. The site-specific considerations and assumptions used in the previous evaluation were also revisited. Modifications were incorporated where new information was available or experience from ongoing decommissioning programs provided viable alternatives or improved processes.

3.2 METHODOLOGY

The methodology used to develop the estimates follows the basic approach originally presented in the AIF/NESP-036 study report, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates,"[18] and the DOE "Decommissioning Handbook."[19] These documents present a unit factor method for estimating decommissioning activity costs, which simplifies the estimating calculations. Unit factors for concrete removal ($/cubic yard), steel removal ($/ton), and cutting costs ($/inch) were developed using local labor rates. The activity-dependent costs were 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 relied upon information available in the industry publication, "Building Construction Cost Data," published by R.S. Means.[20]

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

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.

Work Difficulty Factors

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

Access Factor	10% to 20%
Respiratory Protection Factor	10% to 50%
Radiation/ALARA Factor	10% to 17.5%
Protective Clothing Factor	10% to 30%
Work Break Factor	8.33%

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

Scheduling Program Durations

The unit factors, adjusted by the WDFs as described above, are applied against the inventory of materials to be removed in the radiologically controlled areas. The resulting man-hours, or crew-hours, are used in the development of the decommissioning program schedule, using resource loading and event sequencing considerations. The scheduling of conventional removal and dismantling activities are based upon productivity information available from the "Building Construction Cost Data" publication.

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

3.3 FINANCIAL COMPONENTS OF THE COST MODEL

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

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

3.3.1 Contingency

The activity- and period-dependent costs are combined to develop the total decommissioning cost. A contingency is then applied on a line-item basis, using one or more of the contingency types listed in the AIF/NESP-036 study. "Contingencies" are defined in the American Association of Cost Engineers "Project and Cost Engineers' Handbook"[21] as "specific provision for unforeseeable elements of cost within the defined project scope; particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur." The cost elements in this analysis are based upon ideal conditions and maximum efficiency; therefore, consistent with industry practice, a contingency factor has been applied. In the AIF/NESP-036 study, the types of unforeseeable events that are likely to occur in decommissioning are discussed and guidelines are provided for percentage contingency in each category. It should be noted that contingency, as used in this analysis, does not account for price escalation and inflation in the cost of decommissioning over the remaining operating life of the station.

The use and role of contingency within decommissioning estimates is not a "safety factor issue." Safety factors provide additional security and address situations that may never occur. Contingency funds are expected to be fully expended throughout the program. They also provide assurance that sufficient funding is available to accomplish the intended tasks. An estimate without contingency, or from which contingency has been removed, can disrupt the orderly progression of events and jeopardize a successful conclusion to the decommissioning process.

For example, the most technologically challenging task in decommissioning a commercial nuclear station is the disposition of the reactor vessel and internal components, now highly radioactive after a lifetime of exposure to core activity. The disposition of these components forms the basis of the critical path (schedule) for decommissioning operations. Cost and schedule are interdependent, and any deviation in schedule has a significant impact on cost for performing a specific activity.

Disposition of the reactor vessel internals involves the underwater cutting of complex components that are highly radioactive. Costs are based upon optimum segmentation, handling, and packaging scenarios. The schedule is primarily dependent upon the turnaround time for the heavily shielded shipping casks, including preparation, loading, and decontamination of the containers for transport. The number of casks required is a function of the pieces generated in the segmentation activity, a value calculated on optimum performance of the tooling employed in cutting the various subassemblies. The expected optimization, however, may not be achieved, resulting in delays and additional program costs. For this reason, contingency must be included to mitigate the consequences of the expected inefficiencies inherent in this complex activity, along with related concerns associated with the operation of highly specialized tooling, field conditions, and water clarity.

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.

The following list is a composite of some of the activities, assembled from past decommissioning programs, in which contingency dollars were needed to respond to, compensate for, and/or provide adequate funding of decontamination and dismantling tasks:

Incomplete or Changed Conditions:

- Unavailable/incomplete operational history that led to a recontamination of a work area because a sealed cubicle (incorrectly identified as being non-contaminated) was breached without controls.

- Surface coatings covering contamination that, due to an incomplete characterization, required additional cost and time to remediate.

- Additional decontamination, controlled removal, and disposition of previously undetected (although at some sites, suspected) contamination due to access gained to formerly inaccessible areas and components.

Adverse Working Conditions:

- Lower than expected productivity due to high temperature environments, resulting in a change in the working hours (shifting to cooler periods of the day) and additional manpower.

- Confined space, low-oxygen environments where supplied air was necessary and additional safety precautions prolonged the time required to perform required tasks.

Maintenance, Repairs and Modifications:

- Facility refurbishment required to support site operations, including those needed to provide new site services, as well as to maintain the integrity of existing structures.

- Damage control, repair, and maintenance from bird nestings and their fouling of equipment and controls.

- Building modification, i.e., re-supporting of floors to enhance loading capacity for heavily shielded casks.

- Roadway upgrades on site to handle heavier and wider loads; roadway rerouting, excavation, and reconstruction.

- Requests for additional safety margins by a vendor.

- Requests to analyze accident scenarios beyond those defined by the removal scenario (requested by the NRC to comply with "total scope of regulation").

- Additional collection of site runoff and processing of such due to disturbance of natural site contours and drainage.

- Concrete coring for removal of embedments and internal conduit, piping, and other potentially contaminated material not originally identified as being contaminated.

- Modifications required to respond to higher than expected worker exposure, water clarity, water disassociation, and hydrogen generation from high temperature cutting operations.

- Additional waste containers needed to accommodate cutting particulates (fines), inefficient waste geometries, and excess material.

Labor:

- Turnover of personnel, e.g., craft and health physics. Replacement of labor is costly, involving additional training, badging, medical exams, and associated processing procedures. Recruitment costs are incurred for more experienced personnel and can include relocation and living expense compensation.

- Additional personnel required to comply with NRC mandates and requests.

- Replacement of personnel due to non-qualification and/or incomplete certification (e.g., welders).

Schedule:

- Schedule slippage due to a conflict in required resources, i.e., the licensee was forced into a delay until prior (non-licensee) commitments of outside resources were resolved.

- Rejection of material by NRC inspectors, requiring refabrication and causing program delays in activities required to be completed prior to decommissioning operations.

Weather:

- Weather-related delays in the construction of facilities required to support site operations (with compensation for delayed mobilization made to vendor).

The cost model incorporates considerations for items such as those described above, generating contingency dollars (at varying percentages of total line-item cost) with every activity. The purpose of the contingency is to allow for the costs of high probability program problems occurring in the field where the occurrence, duration, and severity cannot be accurately predicted, and so their associated costs have not been included in the basic estimate. Past decommissioning experience has shown that unforeseeable elements of cost are almost certain to occur in the field and may have a cumulative impact. For this study, TLG examined the major activity-related problems (decontamination, segmentation, equipment handling, packaging, transport, and waste disposal) that necessitate a contingency. Individual activity contingencies ranged from 10% to 75%, depending on the degree of difficulty judged to be appropriate from TLG's actual decommissioning experience. The contingency values used in this study are as follows:

Decontamination	50%
Contaminated Component Removal	25%
Contaminated Component Packaging	10%
Contaminated Component Transport	15%
Low-Level Radioactive Waste Disposal	25%
Reactor Segmentation	75%
NSSS Component Removal	25%
Reactor Waste Packaging	25%
Reactor Waste Transport	25%
Reactor Vessel Component Disposal	50%
GTCC Disposal	15%
Non-Radioactive Component Removal	15%
Heavy Equipment and Tooling	15%
Supplies	25%
Engineering	15%

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

The contingency values are applied to the appropriate components of the estimates on a line item basis. A composite value is then reported at the end of each estimate. For example, the composite contingency value reported for the SAFSTOR alternative is 20.37%, as delineated within the detailed cost table in Appendix C.

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, e.g., 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, e.g., the start and rate of acceptance of spent fuel by the DOE.

- Pricing changes for basic inputs, such as labor, energy, materials, and burial. Some of these inputs may vary slightly, e.g. -10% to +20%; burial could vary from -50% to +200% or more.

It has been TLG's experience that the results of a risk analysis, when compared with the base case estimate for decommissioning, indicate that the chances of the base decommissioning estimate's being too high is a low probability, and the chances that the estimate is too low is a higher probability. This is mostly due to the pricing uncertainty for low-level radioactive waste burial, and to a lesser extent due to schedule increases from changes in plant conditions and to pricing variations in the cost of labor (both craft and staff). This cost study, however, does not add any additional costs to the estimate for financial risk since there is insufficient historical data from which to project future liabilities. Consequently, the areas of uncertainty or risk are revisited periodically and addressed through repeated revisions or updates of the base estimate.

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 of spent fuel generated from plant operations is not reflected within the estimate to decommission the Palisades site. Ultimate disposition of the spent fuel is within the province of the DOE's Waste Management System, as defined by the NWPA. As such, the disposal cost is financed by a 1 mill/kWhr surcharge paid into the DOE's waste fund during operations. However, the NRC requires licensees to establish a program to manage and provide funding for the management of all irradiated fuel at the reactors until title of the fuel is transferred to the Secretary of Energy. This funding requirement is fulfilled through inclusion of certain high-level waste cost elements within the estimate, as described below.

The total inventory of assemblies that will require handling during decommissioning is based upon several assumptions. The pickup of commercial fuel is assumed to begin in the year 2010 and will proceed on an oldest fuel first basis. Any delay in the startup of the repository or decrease in the rate of acceptance will correspondingly prolong the transfer process and result in the fuel remaining at the site longer.

An ISFSI will be used for supplemental storage until such time that the transfer of spent fuel to the DOE can be completed. Assuming that the DOE commences repository operation in 2010, fuel is projected to be removed from the Palisades site beginning in the year 2013 with the transfer completed by the year 2048.

Operation and maintenance costs for the storage facilities are included within the estimates and address the cost for staffing the facilities, as well as security, insurance, and licensing fees. The estimates include the costs to purchase, load, and transfer the fuel storage canisters. Costs are also provided for the final disposition of the facilities once the transfer is complete.

Repository Startup

Operation of the DOE’s yet-to-be constructed geologic repository is contingent upon the review and approval of the facility’s license application by the NRC, the successful resolution of pending litigation, and the development of a national transportation system. For estimating purposes, the spent fuel management plan described in this section is predicated upon the DOE initiating the pickup of commercial fuel in the year 2010.

Spent Fuel Management Model

The DOE's repository program assumes that spent fuel will be accepted for disposal from the nation's commercial nuclear plants in the order (the "queue") in which it was removed from service ("oldest fuel first").[22]

Canister Design

A multi-purpose storage canister with a 24-fuel assembly capacity, is assumed for future cask acquisitions after plant shutdown. A unit cost of $495,000 is used for pricing the internal multi-purpose canister (MPC), with an additional cost of $164,000 for the concrete overpack.

Canister Loading and Transfer

An average cost of $250,000 is used for the labor to load/transport the spent fuel from the pool to the ISFSI pad, based upon industry experience. An average cost of $200,000 is used to estimate the cost to transfer the fuel from the ISFSI to the DOE.

Operations and Maintenance

Annual costs (excluding labor) of approximately $977,000 and $60,000 are used for operation and maintenance of the spent fuel pool and the ISFSI, respectively.

ISFSI Design Considerations

The capacity of the ISFSI is based upon a vertical spent fuel storage system, utilizing the MPC design. The ISFSI is assumed to have the capacity to store the residual inventory present in the spent fuel pool at the cessation of operations. Fifty-five casks are projected to be required for the storage of spent fuel in support of decommissioning, based upon a loading of 24 assemblies per cask. Three casks will be required for the storage of GTCC material generated in the segmentation of the reactor vessel internals. Consumers Energy provides the spent fuel storage canisters and concrete overpacks for both the spent fuel and GTCC casks. The ISFSI storage pad is sized to accommodate the casks required for decommissioning as well as the transfer of current dry fuel storage inventory to MPC's.

Approximately 50% of the overpacks are assumed to have some level of neutron-induced activation as a result of the long-term storage of the fuel, i.e., to levels exceeding free-release limits. Approximately 10% of the concrete and steel is assumed to be removed from the overpacks for controlled disposal. The cost to dispose of this material, as well as the demolition of the ISFSI facility, is included in the estimates.

3.4.2 Reactor Vessel and Internal Components

The NSSS (reactor vessel and reactor coolant system components) will be decontaminated using chemical agents prior to placing the unit into safe storage. A decontamination factor (average reduction) of 10 is assumed for the process.

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 will dictate segmentation and packaging methodology. The number of cask shipments out of the reactor building is expected to average three every two weeks. Non-cask shipments will be limited to ten per week.

The dismantling of the reactor internals will generate radioactive waste considered unsuitable for shallow land disposal, i.e., GTCC. Although the material is not classified as high-level waste, the DOE has indicated it will accept this waste for disposal at the future high-level waste repository.[23] However, the DOE has not been forthcoming with an acceptance criteria or disposition schedule for this material, and numerous questions remain as to the ultimate disposal cost and waste form requirements. As such, for purposes of this study, the GTCC has been packaged and disposed of as high-level waste, at a cost equivalent to that envisioned for the spent fuel. It is not anticipated that the DOE would 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 Palisades site.

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. 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 Palisades ceases operation. Future viability of this option will depend upon the ultimate location of the disposal site, as well as the disposal site licensee's ability to accept highly radioactive packages and effectively isolate them from the environment. Consequently, the study assumes the reactor vessel will require segmentation, as a bounding condition.

3.4.3 Primary System Components

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 will be 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, will be removed to create sufficient laydown space for processing these large components.

The generators will be rigged for removal, disconnected from the surrounding piping and supports, and maneuvered into the open area where they will be lowered onto a down-ending cradle. Once each steam generator has been placed in the horizontal position, nozzles and other openings will be welded closed. The lower shell will have a carbon steel membrane welded to its outside surface for shielding, if required, during transport. The interior volume will be filled with low-density cellular concrete for stabilization of the internal contamination and to satisfy burial ground packaging requirements. When this stage has been completed, each generator will be moved out of containment and lowered onto a multi-wheeled transporter to be staged at an on-site storage area and await transport to the disposal facility. The pressurizer will be removed using the same technique. Each component will then be loaded onto a railcar 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 disposal.

3.4.4 Main Turbine and Condenser

The main turbine will be dismantled using conventional maintenance procedures. The turbine rotors and shafts will be removed to a laydown area. The lower turbine casings will be removed from their anchors by controlled demolition. The main condensers will also be disassembled and moved to a laydown area. Material is then prepared for transportation to an off-site recycling facility where it will be surveyed and designated for either decontamination or volume reduction, conventional disposal, or controlled disposal. Components will be packaged and readied for transport in accordance with the intended disposition.

3.4.5 Transportation Methods

Contaminated piping, components, and structural material other than the highly activated reactor vessel and internal components will qualify as LSA-I, II or III or Surface Contaminated Object, SCO-I or II, as described in Title 49.[24] The contaminated material will be packaged in Industrial Packages (IP I, II, or III, as defined in subpart 173.411) for transport unless demonstrated to qualify as their own shipping containers. The reactor vessel and internal components are expected to be transported in accordance with §71, as Type B. It is conceivable that the reactor, due to its limited specific activity, could qualify as LSA II or

III. However, the high radiation levels on the outer surface would require that additional shielding be incorporated within the packaging so as to attenuate the dose to levels acceptable for transport.

Truck transport assumes a maximum normal road weight limit of 80,000 pounds for all shipments, with the exception of the overweight shielded casks. 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., steam generators, large heat exchangers and other oversized components, will be by a combination of truck, rail, and/or multi-wheeled transporter.

The low-level radioactive waste requiring controlled disposal will be sent to one of two currently available burial facilities. Transportation costs are based upon the mileage to either the Envirocare facility in Clive, Utah, or the Barnwell facility in South Carolina. A regional site is assumed as the destination for off-site processing. Transportation costs are estimated using published tariffs from Tri-State Motor Transit.[25]

3.4.6 Low-Level Radioactive Waste Disposal

To the greatest extent practical, metallic material generated in the decontamination and dismantling processes is treated to reduce the total volume requiring controlled disposal. The treated material, meeting the regulatory and/or site release criterion, is released as scrap, requiring no further cost consideration. Conditioning and recovery of the waste stream is performed off site at a licensed processing center.

Material requiring controlled disposal is packaged and transported to one of two currently available burial facilities. Very low-level radioactive material, e.g., structural steel and contaminated concrete, is sent to Envirocare. More highly contaminated and activated material is sent to Barnwell. Disposal fees are based upon current charges for operating waste, with surcharges added for the highly activated components, e.g., generated in the segmentation of the reactor vessel.

3.4.7 Site Conditions Following Decommissioning

The NRC will terminate (or amend) the site licenses 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 the owner's own future plans for the site.

Non-essential structures or buildings severely damaged in decontamination process are removed to a nominal depth of three feet below grade. Structures and buried piping will be completely removed from the site. Concrete rubble will be trucked to a waste processing facility for disposal. Structural scrap steel will be disposed of at a local landfill. Subsurface voids will be backfilled with imported clean fill and capped with topsoil. The site will be graded such that the site will have a final contour consistent with adjacent surroundings.

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

3.5 ASSUMPTIONS

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

3.5.1 Estimating Basis

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

3.5.2 Labor Costs

Utility staffing requirements will vary with the level of effort associated with the various phases of the project. Once the decommissioning program commences, the operations staff will be reduced to only those staff positions necessary to support the decommissioning program.

The staffing levels assumed in this estimate, as provided by Consumers Energy, reflect the management provisions experienced at other decommissioning projects recently completed and currently underway. Costs for site administration, operations, construction, and maintenance personnel are based upon average salary information provided by NMC or from comparable industry information.

Consumers Energy will hire a Decommissioning Operations Contractor (DOC) to manage the decommissioning. The owner will provide site security, radiological health and safety, quality assurance and overall site administration during the decommissioning and demolition phases. Contract personnel will provide engineering services, e.g., for preparing the activity specifications, work procedures, activation, and structural analyses, under the direction of Consumers Energy.

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

3.5.3 Design Conditions

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

The curie contents of the vessel and internals at final shutdown are derived from those listed in NUREG/CR-3474.[26] Actual estimates are derived from the curie/gram values contained therein and adjusted for the different mass of the Palisades components, projected operating life, and different periods of decay. Additional short-lived isotopes were derived from CR-0130[27] and CR-0672,[28] and benchmarked to the long-lived values from CR-3474.

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

Since the top of the reactor vessel contains minimal shielding it is assumed that the entire containment roof as well as the upper half of the walls are considered activated, and will be disposed of as radioactive material. The reactor building crane will be sent to a waste processing facility for disposal.

3.5.4 General

Transition Activities

Existing warehouses will be cleared of non-essential material and remain for use by Consumers Energy and its subcontractors. The plant's operating staff will perform 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. Consumers Energy 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, and that scrap may represent a liability (incur a cost to dispose of this material). 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. Therefore, as an explicit recognition of scrap as a potential liability, an allowance for the disposal of clean metallic waste has been included.

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

Energy

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

Insurance

Costs for continuing coverage (nuclear liability and property insurance) following cessation of plant operations and during decommissioning are included and based upon current operating premiums. Reductions in premiums, throughout the decommissioning process, are based upon the guidance and the limits for coverage defined in the NRC's proposed rulemaking "Financial Protection Requirements for Permanently Shutdown Nuclear Power Reactors."[29] The NRC's financial protection requirements are based on various reactor (and spent fuel) configurations.

Taxes

Property taxes on existing plant structures and equipment are reduced over the phase in which they are removed throughout the decommissioning schedule and plant site restoration, terminating upon ISFSI.

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 expenditure are provided in Tables 3.1 through 3.5. Decommissioning costs are reported in the year of projected expenditure; however, the values are provided in thousands of 2003 dollars. Costs are not inflated, escalated, or discounted over the period of expenditure. The annual expenditures are based upon the detailed activity costs reported in Appendix C along with the schedule discussed in Section 4.

TABLE 3.1
SCHEDULE OF ANNUAL EXPENDITURES
TOTAL DECOMMISSIONING COST
(thousands, 2003 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2008	0	0	0	0	8,698	8,698
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	31,770	4,089	951	1,395	14,531	52,736
2012	31,337	5,504	1,103	1,253	12,854	52,051
2013	11,754	67	905	29	15,330	28,086
2014	11,754	67	905	29	15,330	28,086
2015	11,754	67	905	29	15,330	28,086
2016	11,786	67	908	29	15,372	28,163
2017	11,754	67	905	29	15,330	28,086
2018	11,754	67	905	29	15,330	28,086
2019	6,037	67	439	29	8,280	14,852
2020	2,767	67	172	29	4,251	7,286
2021	2,760	67	171	29	4,239	7,266
2022	2,760	67	171	29	4,239	7,266
2023	2,760	67	171	29	4,239	7,266
2024	2,767	67	172	29	4,251	7,286
2025	33,132	460	751	29	8,467	42,840
2026	47,846	19,175	896	13,849	17,353	99,119
2027	48,137	18,246	873	25,880	8,247	101,384
2028	45,222	4,710	686	20,784	6,547	77,950
2029	45,099	4,697	684	20,727	6,530	77,737
2030	18,915	2,255	282	1,157	12,902	35,512
2031	23,616	7,190	171	0	17,358	48,336
2032	10,958	3,053	107	0	9,858	23,977
2033	1,608	0	60	0	4,301	5,969
2034	1,608	0	60	0	4,301	5,969
2035	1,608	0	60	0	4,301	5,969
2036	1,612	0	60	0	4,313	5,985
2037	1,608	0	60	0	4,301	5,969
2038	1,608	0	60	0	4,301	5,969
2039	1,608	0	60	0	4,301	5,969
2040	1,612	0	60	0	4,313	5,985
2041	1,608	0	60	0	4,301	5,969
2042	1,608	0	60	0	4,301	5,969
2043	1,608	0	60	0	4,301	5,969
2044	1,612	0	60	0	4,313	5,985
2045	1,608	0	60	0	4,301	5,969
2046	1,608	0	60	0	4,301	5,969
2047	1,608	0	60	0	4,301	5,969
2048	1,624	705	60	22	20,023	22,434
2049	2,490	1,027	0	2,590	2,048	8,155
	454,688	71,920	14,198	88,027	331,491	960,325

TABLE 3.2
SCHEDULE OF ANNUAL EXPENDITURES
LICENSE TERMINATION
(thousands, 2003 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	30,397	4,089	895	1,395	13,541	50,318
2012	26,975	3,185	816	1,245	8,802	41,022
2013	1,261	7	112	3	4,755	6,138
2014	1,261	7	112	3	4,755	6,138
2015	1,261	7	112	3	4,755	6,138
2016	1,265	7	112	3	4,768	6,155
2017	1,261	7	112	3	4,755	6,138
2018	1,261	7	112	3	4,755	6,138
2019	1,269	45	112	19	3,882	5,327
2020	1,277	67	112	29	3,391	4,875
2021	1,273	67	112	29	3,381	4,862
2022	1,273	67	112	29	3,381	4,862
2023	1,273	67	112	29	3,381	4,862
2024	1,277	67	112	29	3,391	4,875
2025	31,308	460	691	29	8,013	40,502
2026	45,249	19,168	836	13,849	16,812	95,914
2027	45,067	18,223	813	25,880	7,672	97,655
2028	42,514	4,700	626	20,784	6,100	74,723
2029	42,398	4,687	625	20,727	6,083	74,519
2030	13,101	829	199	1,157	8,744	24,030
2031	1,391	252	0	0	0	1,643
2032	591	107	0	0	0	698
2033	0	0	0	0	0	0
2034	0	0	0	0	0	0
2035	0	0	0	0	0	0
2036	0	0	0	0	0	0
2037	0	0	0	0	0	0
2038	0	0	0	0	0	0
2039	0	0	0	0	0	0
2040	0	0	0	0	0	0
2041	0	0	0	0	0	0
2042	0	0	0	0	0	0
2043	0	0	0	0	0	0
2044	0	0	0	0	0	0
2045	0	0	0	0	0	0
2046	0	0	0	0	0	0
2047	0	0	0	0	0	0
2048	0	701	0	0	15,831	16,531
2049	0	0	0	0	0	0
	294,204	56,826	6,841	85,246	140,948	584,064

TABLE 3.3
SCHEDULE OF ANNUAL EXPENDITURES
SPENT FUEL MANAGEMENT
(thousands, 2003 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2008	0	0	0	0	8,698	8,698
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	1,372	0	55	0	991	2,418
2012	4,361	2,320	288	8	4,053	11,029
2013	10,493	60	794	25	10,575	21,947
2014	10,493	60	794	25	10,575	21,947
2015	10,493	60	794	25	10,575	21,947
2016	10,522	60	796	25	10,604	22,008
2017	10,493	60	794	25	10,575	21,947
2018	10,493	60	794	25	10,575	21,947
2019	4,768	22	327	9	4,399	9,525
2020	1,491	0	60	0	860	2,411
2021	1,486	0	60	0	858	2,404
2022	1,486	0	60	0	858	2,404
2023	1,486	0	60	0	858	2,404
2024	1,491	0	60	0	860	2,411
2025	1,487	0	60	0	454	2,001
2026	1,487	0	60	0	461	2,008
2027	1,488	0	60	0	331	1,878
2028	1,491	0	60	0	448	1,999
2029	1,487	0	60	0	446	1,993
2030	1,487	0	60	0	741	2,287
2031	1,487	0	60	0	727	2,274
2032	1,561	0	60	0	2,795	4,416
2033	1,608	0	60	0	4,301	5,969
2034	1,608	0	60	0	4,301	5,969
2035	1,608	0	60	0	4,301	5,969
2036	1,612	0	60	0	4,313	5,985
2037	1,608	0	60	0	4,301	5,969
2038	1,608	0	60	0	4,301	5,969
2039	1,608	0	60	0	4,301	5,969
2040	1,612	0	60	0	4,313	5,985
2041	1,608	0	60	0	4,301	5,969
2042	1,608	0	60	0	4,301	5,969
2043	1,608	0	60	0	4,301	5,969
2044	1,612	0	60	0	4,313	5,985
2045	1,608	0	60	0	4,301	5,969
2046	1,608	0	60	0	4,301	5,969
2047	1,608	0	60	0	4,301	5,969
2048	1,624	4	60	22	4,193	5,902
2049	2,490	1,027	0	2,590	2,048	8,155
	121,151	3,732	7,175	2,781	163,108	297,948

TABLE 3.4
SCHEDULE OF ANNUAL EXPENDITURES
SITE RESTORATION
(thousands, 2003 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	0	0	0	0	0	0
2012	0	0	0	0	0	0
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
2015	0	0	0	0	0	0
2016	0	0	0	0	0	0
2017	0	0	0	0	0	0
2018	0	0	0	0	0	0
2019	0	0	0	0	0	0
2020	0	0	0	0	0	0
2021	0	0	0	0	0	0
2022	0	0	0	0	0	0
2023	0	0	0	0	0	0
2024	0	0	0	0	0	0
2025	337	0	0	0	0	337
2026	1,110	7	0	0	80	1,197
2027	1,583	23	0	0	245	1,850
2028	1,217	11	0	0	0	1,228
2029	1,214	11	0	0	0	1,225
2030	4,328	1,426	23	0	3,417	9,194
2031	20,738	6,938	112	0	16,631	44,419
2032	8,807	2,946	47	0	7,063	18,863
2033	0	0	0	0	0	0
2034	0	0	0	0	0	0
2035	0	0	0	0	0	0
2036	0	0	0	0	0	0
2037	0	0	0	0	0	0
2038	0	0	0	0	0	0
2039	0	0	0	0	0	0
2040	0	0	0	0	0	0
2041	0	0	0	0	0	0
2042	0	0	0	0	0	0
2043	0	0	0	0	0	0
2044	0	0	0	0	0	0
2045	0	0	0	0	0	0
2046	0	0	0	0	0	0
2047	0	0	0	0	0	0
2048	0	0	0	0	0	0
2049	0	0	0	0	0	0
	39,333	11,363	182	0	27,436	78,313

TABLE 3.5
SCHEDULE OF ANNUAL EXPENDITURES
PRELIMINARY INCREMENTAL SNF COST
(thousands, 2003 dollars)

Year	Labor	Equipment & Materials	Energy	Burial	Other	Total
2008	0	0	0	0	6,363	6,363
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	0	0	0	0	564	564
2012	0	0	0	0	1,444	1,444
2013	0	0	0	0	4,331	4,331
2014	0	0	0	0	4,331	4,331
2015	0	0	0	0	4,331	4,331
2016	0	0	0	0	4,343	4,343
2017	0	0	0	0	4,331	4,331
2018	0	0	0	0	4,331	4,331
2019	0	0	0	0	4,331	4,331
2020	1,491	0	60	0	0	1,551
2021	1,487	0	60	0	0	1,547
2022	1,487	0	60	0	0	1,547
2023	1,487	0	60	0	0	1,547
2024	1,491	0	60	0	0	1,551
2025	1,487	0	60	0	0	1,547
2026	1,487	0	60	0	0	1,547
2027	1,488	0	60	0	0	1,548
2028	1,491	0	60	0	0	1,551
2029	1,487	0	60	0	0	1,547
2030	1,487	0	60	0	66	1,612
2031	1,487	0	60	0	319	1,865
2032	1,561	0	60	0	320	1,941
2033	1,608	0	60	0	319	1,987
2034	1,608	0	60	0	319	1,987
2035	1,608	0	60	0	319	1,987
2036	1,612	0	60	0	320	1,992
2037	1,608	0	60	0	319	1,987
2038	1,608	0	60	0	319	1,987
2039	1,608	0	60	0	319	1,987
2040	1,612	0	60	0	320	1,992
2041	1,608	0	60	0	319	1,987
2042	1,608	0	60	0	319	1,987
2043	1,608	0	60	0	319	1,987
2044	1,612	0	60	0	320	1,992
2045	1,608	0	60	0	319	1,987
2046	1,608	0	60	0	319	1,987
2047	1,608	0	60	0	319	1,987
2048	1,612	0	60	0	320	1,992
2049	797	0	0	0	105	902
	45,962	0	1,740	0	44,610	92,311

4. SCHEDULE ESTIMATE

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

A schedule or sequence of activities is presented in Figure 4.1 for the SAFSTOR decommissioning alternative. The scheduling sequence assumes that fuel is removed from the spent fuel pool within the first eight years after operations cease. 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 2002" computer software.[30]

4.1 SCHEDULE ESTIMATE ASSUMPTIONS

The schedule reflects the results of a precedence network developed for the site decommissioning activities, i.e., a PERT (Program Evaluation and Review Technique) Software Package. The work activity durations used in the precedence network reflect the actual man-hour estimates from the cost tables, 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 Auxiliary Building is isolated until such time that all spent fuel has been discharged from the spent fuel pool to the DOE or to the ISFSI.

- All work (except vessel and internals removal) is performed during an 8-hour workday, 5 days per week, with no overtime. There are eleven paid holidays per year.

- Reactor and internals removal activities are performed by using separate crews for different activities working on different shifts, with a corresponding backshift charge for the second shift.

- Multiple crews work parallel activities to the maximum extent possible, consistent with optimum efficiency, adequate access for cutting, removal and laydown space, and with the stringent safety measures necessary during demolition of heavy components and structures.

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

4.2 PROJECT SCHEDULE

The period-dependent costs presented in the detailed cost table are based upon the durations developed in the schedule for decommissioning Palisades. 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 also shown for the spent fuel cooling period, which determines the release of the Auxiliary Building for final decontamination.

A project timeline is provided in Figures 4.2. Milestone dates are based on a shutdown date of March 14, 2011.

FIGURE 4.1

ACTIVITY SCHEDULE

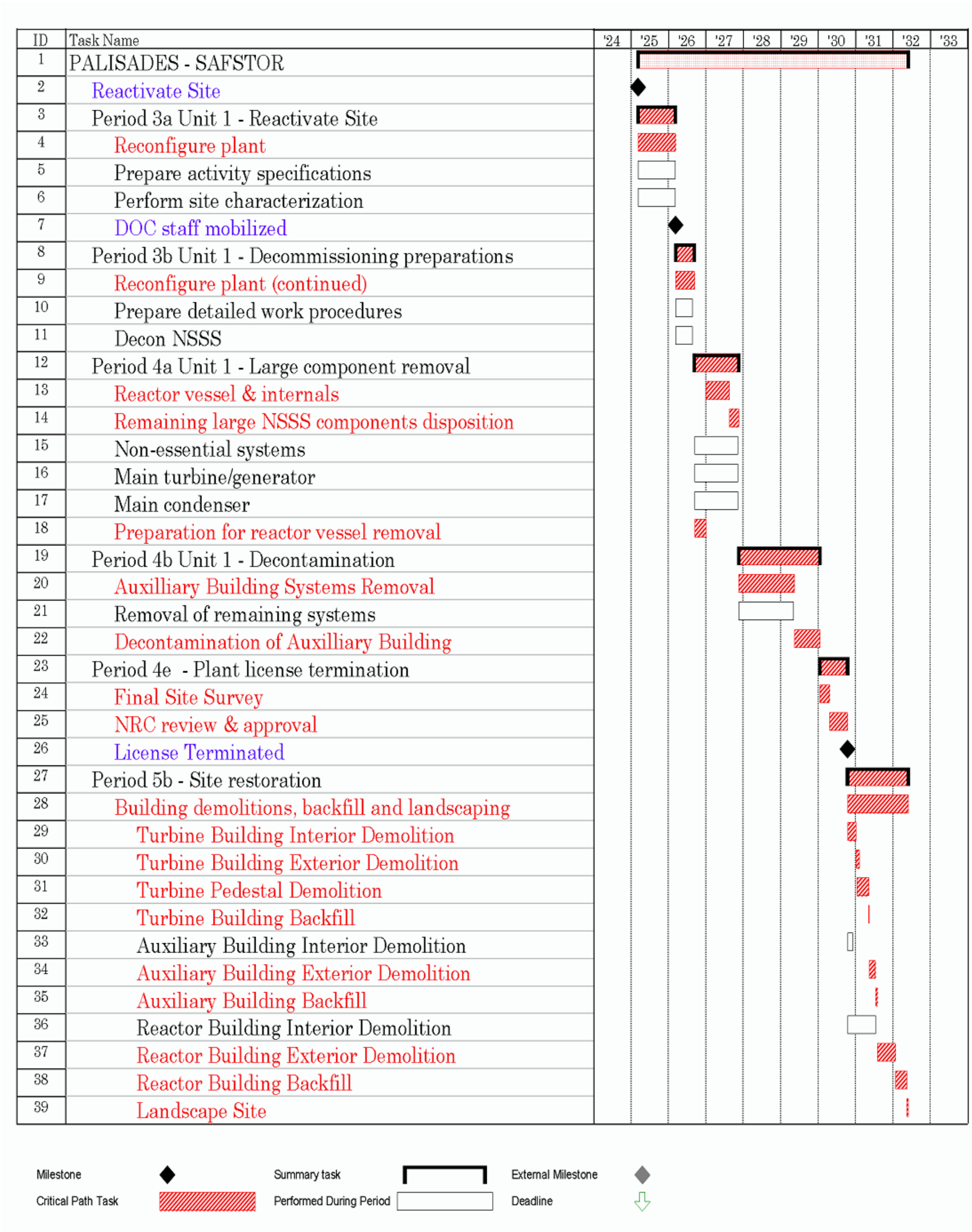
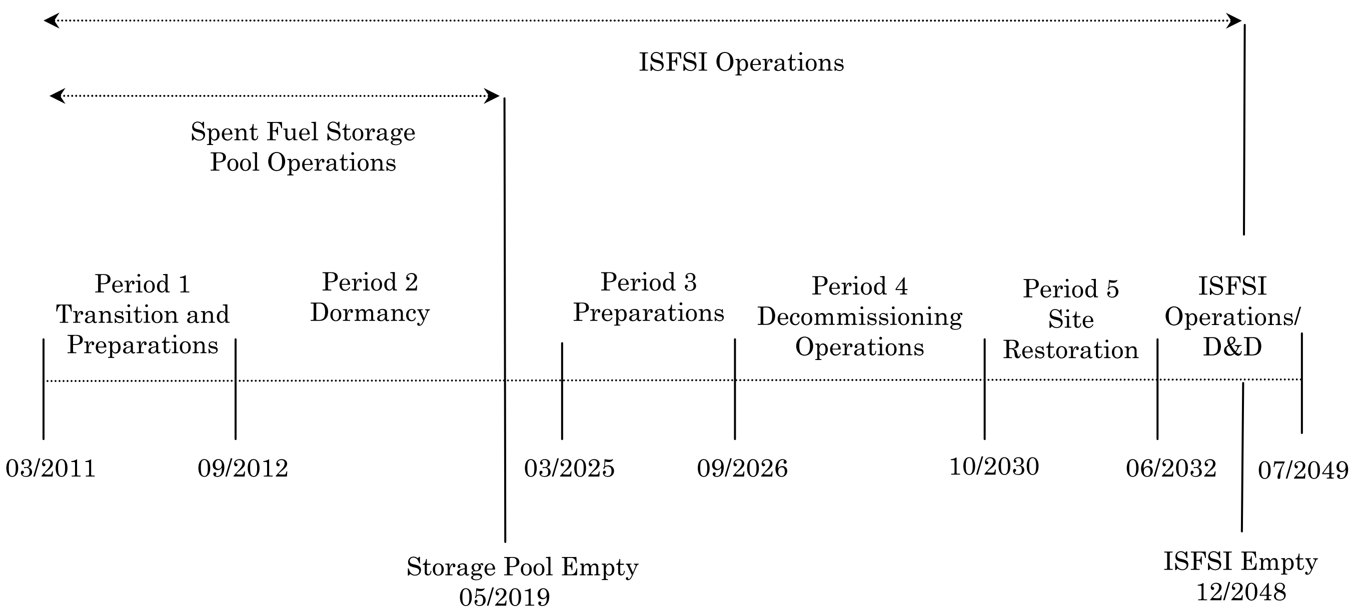


FIGURE 4.2
DECOMMISSIONING TIMELINE
(not to scale)

Shutdown: March 14, 2011



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(s). This currently requires the remediation of all radioactive material at the site in excess of applicable legal limits. Under the Atomic Energy Act,[31] the NRC is responsible for protecting the public from sources of ionizing radiation. Title 10 of the Code of Federal Regulations delineates the production, utilization, and disposal of radioactive materials and processes. In particular, §71 defines radioactive material and §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 §173-178. Shipping containers are required to be Industrial Packages (IP-1, IP-2 or IP-3, as defined in subpart 173.411). For this study, commercially available steel containers are presumed to be used for the disposal of piping, small components, and concrete. Larger components can serve as their own containers, with proper closure of all openings, access ways, and penetrations.

The volumes of radioactive waste generated during the various decommissioning activities at the site is shown on a line-item basis in Appendix C and summarized in Table 5.1. The quantified waste volume summaries shown in the table are consistent with §61 classifications. The volumes are calculated based on the exterior dimensions for containerized material and on the displaced volume of components serving as their own waste containers.

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

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

The waste material generated in the decontamination and dismantling of Palisades is primarily generated during Period 4 of the SAFSTOR alternative. Material that is considered potentially contaminated when removed from the radiologically controlled area is sent to off-site processing facilities for conditioning and disposal. Heavily contaminated components and activated materials are routed for controlled disposal. The disposal volumes reported in the table reflects the savings resulting from reprocessing and recycling.

For purposes of constructing the analysis, the rate schedule for the Barnwell facility was used as a proxy for the higher activity waste. This schedule was used to estimate the disposal fees for most plant components and all activated concrete unsuitable for processing or recovery. An average disposal rate of approximately $5.10 per pound was used, with additional surcharges for activity, dose rate, and/or handling added as appropriate for the particular package.

The remaining volume of contaminated metallic and concrete debris is processed and conditioned at an off-site facility. The contaminated metallic waste stream includes the lower activity components such as miscellaneous steel, metal siding, scaffolding, and structural steel. Metals are recycled at a unit rate of $2.85 per pound. Concrete, soil, asbestos and other bulk debris are disposed of at a rate of $0.50 per pound or approximately $50 per cubic foot. Dry active wastes, e.g., cloth, paper and plastics, are sent to the Envirocare facility for direct disposal from the site at $2.82 per pound or $56.40 per cubic foot, at an assumed density of 20 pounds per cubic foot.

TABLE 5.1
DECOMMISSIONING WASTE SUMMARY

	Waste Class[1]	Volume (cubic feet)	Weight (pounds)
Low-Level Radioactive Waste			
Barnwell, South Carolina (contaminated/activated metallic waste and concrete)			
	A	51,566	4,627,251
	B	3,767	489,870
	C	115	12,090
Envirocare, Utah (miscellaneous steel, contaminated/activated concrete)			
Containerized	A	11,973	1,036,674
Bulk	A	101,230	12,197,490
Geologic Repository (Greater-than Class C)			
	>C	495	85,300
Total [2]		169,147	18,448,675
Processed Waste (Off-Site)		325,836	25,703,560
Scrap Metal			68,498,029

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 Palisades relied upon the site-specific, technical information developed for a previous analysis prepared in 1998 and revised in 2000. While not an engineering study, the estimates provide Consumers Energy with sufficient information to assess its financial obligations, as they pertain to the eventual decommissioning of the nuclear station.

The estimate described in this report is 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 scenario assumes continued operation of the plant's spent fuel pool for a minimum of eight years following the cessation of operations for continued cooling of the assemblies. The existing ISFSI will accommodate the residual inventory of spent fuel assemblies following the cooling period and will operate throughout the decommissioning of the nuclear unit until such time that the DOE can complete the transfer of the assemblies to its repository.

The cost projected to decommission the Palisades nuclear unit is estimated to be $960.3 million. The majority of this cost (approximately 60.8%) is associated with the physical decontamination and dismantling of the nuclear unit so that the license can be terminated. Another 31.0% is associated with the management, interim storage, and eventual transfer of the spent fuel. The remaining 8.2% is for the demolition of the designated structures and limited restoration of the site.

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

As described in this report, the spent fuel pool will remain operational for a minimum of eight years following the cessation of operations. The pool will be isolated and an independent spent fuel island created. Over the eight-year period, the spent fuel will be packaged into transportable steel canisters for loading into a DOE-provided transport cask. The canisters will be stored in concrete overpacks at the ISFSI until the DOE is able to receive them. Dry storage of the fuel under a separate license provides additional flexibility in the event the DOE is not able to meet the current timetable for completing the transfer of assemblies to an off-site facility and minimizes the associated caretaking expenses.

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, disposal of the lower level material, including concrete and structural steel, is at the Envirocare facility. The more highly radioactive material is sent to the Barnwell facility, with the exception of selected reactor vessel components. Highly activated components, requiring additional isolation from the environment, 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 table for processing is all-inclusive, incorporating the ultimate disposition of the material.

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

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

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

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

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

TABLE 6.1
SUMMARY OF DECOMMISSIONING COST ELEMENTS
(thousands of 2003 dollars)

Work Category	Cost	%
Decontamination	10,605	1.1
Removal	99,525	10.4
Packaging	12,377	1.3
Shipping	4,424	0.5
Low-Level Radioactive Waste Disposal	61,281	6.4
Staffing	280,309	29.2
Taxes	65,011	6.8
Engineering	16,569	1.7
Energy	11,857	1.2
Waste Recycling	64,480	6.7
Insurance	21,211	2.2
ISFSI Expenditures	194,931	20.3
Spent Fuel Pool Isolation	9,607	1.0
NRC and EP Fees	12,273	1.3
Site Characterization	1,707	0.2
License Termination Survey	5,540	0.6
Miscellaneous Support Equipment & Supplies	23,167	2.4
Separation Program	9,141	1.0
Fixed Indirect Overhead	36,848	3.8
Site Security	10,284	1.1
Spent Fuel Pool O&M	9,177	1.0
Total [1]	960,325	100.0
NRC License Termination	584,064	60.8
Spent Fuel Management	297,948	31.0
Site Restoration	78,313	8.2

[1] Columns may not add due to rounding

7. REFERENCES

1. 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.

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

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

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

5. 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.

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

7. Maine Yankee Atomic Power Company, Connecticut Yankee Atomic Power Company, and Yankee Atomic Power Company v. United States, U.S. Court of Appeals for the Federal Circuit decision, Docket No. 99-5138, -5139, -5140, August 31, 2000.

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

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

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

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

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

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14. "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.

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16. "Decommissioning Cost Study for the Palisades Nuclear Plant," Document No. C07-1267-003, TLG Services, Inc., March 1999.

17. "Decommissioning Cost Study for the Palisades Nuclear Plant," Document No. C07-1388-002, TLG Services, Inc., March 2001.

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

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

20. "Building Construction Cost Data 2003," Robert Snow Means Company, Inc., Kingston, Massachusetts.

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

22. "Civilian Radioactive Waste Management System Total System Description," Revision 02 (TDR-CRW-SE-000002), DOE/RW-0500, September 2001.

7. REFERENCES
(continued)

23. "Strategy for Management and Disposal of Greater-Than-Class C Low-Level Radioactive Waste," Federal Register Volume 60, Number 48 (p 13424 et seq.), March 1995.

24. U.S. Department of Transportation, Title 49 of the Code of Federal Regulations, "Transportation," Parts 173 through 178, 1996.

25. Tri-State Motor Transit Company, published tariffs, Interstate Commerce Commission (ICC), Docket No. MC-109397 and Supplements, 2000.

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

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

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

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

30. "Microsoft Project 2002," Microsoft Corporation, Redmond, WA, 2002.

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

APPENDIX A

UNIT COST FACTOR DEVELOPMENT

APPENDIX A
UNIT COST FACTOR DEVELOPMENT

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

1. SCOPE

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

2. CALCULATIONS

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

Duration adjustment(s):

+ Respiratory protection adjustment (50% of critical duration)	128
+ Radiation/ALARA adjustment (17.5% of critical duration)	45
Adjusted work duration	428
+ Protective clothing adjustment (30% of adjusted duration)	128
Productive work duration	556
+ Work break adjustment (8.33 % of productive duration)	46
Total work duration (minutes)	602

***** Total duration = 10.033 hr *****

* alpha designators indicate activities that can be performed in parallel

APPENDIX A
(continued)

3. LABOR REQUIRED

Crew	Number	Duration (hours)	Rate ($/hr)	Cost
Laborers	3.00	10.033	$28.92	$870.46
Craftsmen	2.00	10.033	$41.36	$829.93
Foreman	1.00	10.033	$42.44	$425.80
General Foreman	0.25	10.033	$44.26	$111.02
Fire Watch	0.05	10.033	$28.92	$14.51
Health Physics Technician	1.00	10.033	$43.10	$432.42
Total labor cost				$2,684.14

4. EQUIPMENT & CONSUMABLES COSTS

Equipment Costs	none
Consumables/Materials Costs	
-Blotting paper 50 @ $0.38 sq ft {1}	$19.00
-Plastic sheets/bags 50 @ $0.09/sq ft {2}	$4.50
-Gas torch consumables 1 @ $3.79/hr x 1 hr {3}	$3.79
Subtotal cost of equipment and materials	$27.29
Overhead & profit on equipment and materials @ 16.000 %	$4.37
Total costs, equipment & material	$31.66

TOTAL COST:

Removal of contaminated heat exchanger <3000 pounds: $2,717.80

Total labor cost:	$2,684.14
Total equipment/material costs:	$31.66
Total craft labor man-hours required per unit:	73.241

5. NOTES AND REFERENCES

- Work difficulty factors were developed in conjunction with the AIF (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
  2. R.S. Means (2003) Section 01540-800-0200, page 17
  3. R.S. Means (2003) Section 01590-400-6360, page 25

- Material and consumable costs were adjusted using the regional indices for Kalamazoo, Michigan.

APPENDIX B

UNIT COST FACTOR LISTING
(SAFSTOR: 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	0.32
Removal of clean pipe 0.25 to 2 inches diameter, $/linear foot	3.41
Removal of clean pipe >2 to 4 inches diameter, $/linear foot	4.90
Removal of clean pipe >4 to 8 inches diameter, $/linear foot	9.80
Removal of clean pipe >8 to 14 inches diameter, $/linear foot	18.79
Removal of clean pipe >14 to 20 inches diameter, $/linear foot	24.34
Removal of clean pipe >20 to 36 inches diameter, $/linear foot	35.83
Removal of clean pipe >36 inches diameter, $/linear foot	42.62
Removal of clean valves >2 to 4 inches	64.17
Removal of clean valves >4 to 8 inches	98.00
Removal of clean valves >8 to 14 inches	187.94
Removal of clean valves >14 to 20 inches	243.40
Removal of clean valves >20 to 36 inches	358.33
Removal of clean valves >36 inches	426.18
Removal of clean pipe hangers for small bore piping	20.04
Removal of clean pipe hangers for large bore piping	73.62
Removal of clean pumps, <300 pound	163.24
Removal of clean pumps, 300-1000 pound	461.44
Removal of clean pumps, 1000-10,000 pound	1,826.60
Removal of clean pumps, >10,000 pound	3,525.26
Removal of clean pump motors, 300-1000 pound	195.25
Removal of clean pump motors, 1000-10,000 pound	762.49
Removal of clean pump motors, >10,000 poun d	1,715.60
Removal of clean turbine-driven pumps < 10,000 pounds	2,106.57
Removal of clean turbine-driven pumps > 10,000 pounds	4,725.01

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of clean PWR turbine generator	113,678.58
Removal of clean heat exchanger <3000 pound	976.86
Removal of clean heat exchanger >3000 pound	2,448.85
Removal of clean feedwater heater/deaerator	6,931.41
Removal of clean moisture separator/reheater	14,287.40
Removal of clear PWR main condenser	312,689.66
Removal of clean tanks, <300 gallons	210.22
Removal of clean tanks, 300-3000 gallons	666.87
Removal of clean tanks, >3000 gallons, $/square foot surface area	5.63
Removal of clean electrical equipment, <300 pound	90.31
Removal of clean electrical equipment, 300-1000 pound	317.90
Removal of clean electrical equipment, 1000-10,000 pound	635.79
Removal of clean electrical equipment, >10,000 pound	1,513.71
Removal of clean electrical transformers < 30 tons	1,051.25
Removal of clean electrical transformers > 30 tons	3,027.40
Removal of clean standby diesel-generator, <100 kW	1,073.76
Removal of clean standby diesel-generator, 100 kW to 1 MW	2,396.69
Removal of clean standby diesel-generator, >1 MW	4,961.66
Removal of clean electrical cable tray, $/linear foot	8.35
Removal of clean electrical conduit, $/linear foot	3.64
Removal of clean mechanical equipment, <300 pound	90.31
Removal of clean mechanical equipment, 300-1000 pound	317.90
Removal of clean mechanical equipment, 1000-10,000 pound	635.79
Removal of clean mechanical equipment, >10,000 pound	1,513.71
Removal of clean HVAC equipment, <300 pound	90.31

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of clean HVAC equipment, 300-1000 pound	317.90
Removal of clean HVAC equipment, 1000-10,000 pound	635.79
Removal of clean HVAC equipment, >10,000 pound	1,513.71
Removal of clean HVAC ductwork, $/pound	0.34
Removal of contaminated instrument and sampling tubing, $/linear foot	0.99
Removal of contaminated pipe 0.25 to 2 inches diameter, $/linear foot	23.16
Removal of contaminated pipe >2 to 4 inches diameter, $/linear foot	41.87
Removal of contaminated pipe >4 to 8 inches diameter, $/linear foot	70.12
Removal of contaminated pipe >8 to 14 inches diameter, $/linear foot	137.14
Removal of contaminated pipe >14 to 20 inches diameter, $/linear foot	167.20
Removal of contaminated pipe >20 to 36 inches diameter, $/linear foot	233.76
Removal of contaminated pipe >36 inches diameter, $/linear foot	278.27
Removal of contaminated valves >2 to 4 inches	284.02
Removal of contaminated valves >4 to 8 inches	343.49
Removal of contaminated valves >8 to 14 inches	685.71
Removal of contaminated valves >14 to 20 inches	875.88
Removal of contaminated valves >20 to 36 inches	1,168.80
Removal of contaminated valves >36 inches	1,391.34
Removal of contaminated pipe fittings >2 to 4 inches	150.16
Removal of contaminated pipe fittings > 4 to 8 inches	389.01
Removal of contaminated pipe fittings > 8 to 14 inches	685.71
Removal of contaminated pipe fittings > 14 to 20 inches	875.88
Removal of contaminated pipe fittings >20 to 36 inches	1,168.80
Removal of contaminated pipe hangers for small bore piping	64.79
Removal of contaminated pipe hangers for large bore piping	210.47

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated pumps, <300 pound	597.36
Removal of contaminated pumps, 300-1000 pound	1,388.57
Removal of contaminated pumps, 1000-10,000 pound	4,518.04
Removal of contaminated pumps, >10,000 pound	10,990.73
Removal of contaminated pump motors, 300-1000 pound	587.49
Removal of contaminated pump motors, 1000-10,000 pound	1,831.54
Removal of contaminated pump motors, >10,000 pound	4,119.70
Removal of contaminated turbine-driven pumps < 10,000 pounds	5,503.42
Removal of contaminated turbine-driven pumps < 10,000 pounds	12,563.02
Removal of contaminated heat exchanger <3000 pound	2,715.80
Removal of contaminated heat exchanger >3000 pound	7,863.83
Removal of contaminated tanks, <300 gallons	991.56
Removal of contaminated tanks, >300 gallons, $/square foot	19.90
Removal of contaminated electrical equipment, <300 pound	467.49
Removal of contaminated electrical equipment, 300-1000 pound	1,132.57
Removal of contaminated electrical equipment, 1000-10,000 pound	2,170.66
Removal of contaminated electrical equipment, >10,000 pound	4,277.77
Removal of contaminated electrical cable tray, $/linear foot	22.57
Removal of contaminated electrical conduit, $/linear foot	19.93
Removal of contaminated mechanical equipment, <300 pound	521.10
Removal of contaminated mechanical equipment, 300-1000 pound	1,265.97
Removal of contaminated mechanical equipment, 1000-10,000 pound	2,426.52
Removal of contaminated mechanical equipment, >10,000 pound	4,277.77
Removal of contaminated HVAC equipment, <300 pound	521.10
Removal of contaminated HVAC equipment, 300-1000 pound	1,265.97

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of contaminated HVAC equipment, 1000-10,000 pound	2,426.52
Removal of contaminated HVAC equipment, >10,000 pound	4,277.77
Removal of contaminated HVAC ductwork, $/pound	2.10
Removal/plasma arc cut of contaminated thin metal components, $/linear in.	2.46
Additional decontamination of surface by washing, $/square foot	5.03
Additional decontamination of surfaces by hydrolasing, $/square foot	23.18
Decontamination rig hook up and flush	4,465.86
Chemical flush of components/systems, $/gallon	9.70
Removal of clean standard reinforced concrete, $/cubic yard	53.60
Removal of grade slab concrete, $/cubic yard	143.71
Removal of clean concrete floors, $/cubic yard	236.59
Removal of sections of clean concrete floors, $/cubic yard	708.21
Removal of clean heavily rein concrete w/#9 rebar, $/cubic yard	159.32
Removal of contaminated heavily rein concrete w/#9 rebar, $/cubic yard	1,275.53
Removal of clean heavily rein concrete w/#18 rebar, $/cubic yard	201.52
Removal of contaminated heavily rein concrete w/#18 rebar, $/cubic yard	1,689.21
Removal heavily rein concrete w/#18 rebar & steel embedments, $/cu yd	308.53
Removal of below-grade suspended floors, $/cubic yard	236.59
Removal of clean monolithic concrete structures, $/cubic yard	584.04
Removal of contaminated monolithic concrete structures, $/cubic yard	1,275.25
Removal of clean foundation concrete, $/cubic yard	457.01
Removal of contaminated foundation concrete, $/cubic yard	1,187.53
Explosive demolition of bulk concrete, $/cubic yard	20.98
Removal of clean hollow masonry block wall, $/cubic yard	54.48
Removal of contaminated hollow masonry block wall, $/cubic yard	176.53

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of clean solid masonry block wall, $/cubic yard	54.48
Removal of contaminated solid masonry block wall, $/cubic yard	176.53
Backfill of below-grade voids, $/cubic yard	13.36
Removal of subterranean tunnels/voids, $/linear foot	100.64
Placement of concrete for below-grade voids, $/cubic yard	80.97
Excavation of clean material, $/cubic yard	2.09
Excavation of contaminated material, $/cubic yard	25.25
Excavation of submerged concrete rubble, $/cubic yard	9.82
Removal of clean concrete rubble, $/cubic yard	76.74
Removal of contaminated concrete rubble, $/cubic yard	20.28
Removal of building by volume, $/cubic foot	0.19
Removal of clean building metal siding, $/square foot	0.96
Removal of contaminated building metal siding, $/square foot	3.03
Removal of standard asphalt roofing, $/square foot	1.52
Removal of transite panels, $/square foot	1.64
Scarifying contaminated concrete surfaces (drill & spall)	8.86
Scabbling contaminated concrete floors, $/square foot	5.03
Scabbling contaminated concrete walls, $/square foot	8.20
Scabbling contaminated ceilings, $/square foot	46.54
Scabbling structural steel, $/square foot	4.36
Removal of clean overhead cranes/monorails < 10 ton capacity	449.77
Removal of contaminated overhead cranes/monorails < 10 ton capacity	1,194.77
Removal of clean overhead cranes/monorails >10-50 ton capacity	1,079.47
Removal of contaminated overhead cranes/monorails >10-50 ton capacity	2,876.65
Removal of polar cranes > 50 ton capacity, each	4,508.46

APPENDIX B
(continued)

Unit Cost Factor	Cost/Unit($)
Removal of gantry cranes > 50 ton capacity, each	18,921.34
Removal of structural steel, $/pound	0.25
Removal of clean steel floor grating, $/square foot	2.29
Removal of contaminated steel floor grating, $/square foot	6.62
Removal of clean free-standing steel liner, $/square foot	8.44
Removal of contaminated free-standing steel liner, $/square foot	22.96
Removal of clean concrete-anchored steel liner, $/square foot	4.22
Removal of contaminated concrete-anchored steel liner, $/square foot	26.76
Placement of scaffolding in clean areas, $/square foot	10.50
Placement of scaffolding in contaminated areas, $/square foot	16.06
Removal of chain link fencing, $/linear foot	1.49
Removal of asphalt pavement, $/square foot	0.80
Landscaping with topsoil, $/acre	13,701.42
Cost of CPC B-88 LSA box & preparation for use	940.66
Cost of CPC B-25 LSA box & preparation for use	746.29
Cost of CPC B-12V 12 gauge LSA box & preparation for use	639.09
Cost of CPC B-144 LSA box & preparation for use	3,629.81
Cost of LSA drum & preparation for use	96.36
Cost of cask liner for CNSI 14-195 cask	7,487.37
Cost of cask liner for CNSI 8-120A cask (resins)	5,127.68
Cost of cask liner for CNSI 8-120A cask (filters)	5,127.68
Decontamination of surfaces with vacuuming, $/square foot	0.47

APPENDIX C

DETAILED COST ANALYSIS

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 0a - Pre-Shutdown Early Planning																					
Period 0a Direct Decommissioning Activities																					
Period 0a Additional Costs																					
0a.2.1	ISFSI - Capital Costs *	-	-	-	-	-	-	6,363	-	6,363	-	6,363	-	-	-	-	-	-	-	-	-
0a.2	Subtotal Period 0a Additional Costs	-	-	-	-	-	-	6,363	-	6,363	-	6,363	-	-	-	-	-	-	-	-	-
Period 0a Collateral Costs																					
0a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	2,030	305	2,335	-	2,335	-	-	-	-	-	-	-	-	-
0a.3	Subtotal Period 0a Collateral Costs	-	-	-	-	-	-	2,030	305	2,335	-	2,335	-	-	-	-	-	-	-	-	-
0a.0	TOTAL PERIOD 0a COST	-	-	-	-	-	-	8,393	305	8,698	-	8,698	-	-	-	-	-	-	-	-	-
PERIOD 1a - Shutdown through Transition																					
Period 1a Direct Decommissioning Activities																					
1a.1.1	SAFSTOR site characterization survey	-	-	-	-	-	-	340	102	442	442	-	-	-	-	-	-	-	-	-	-
1a.1.2	Prepare preliminary decommissioning cost	-	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	2,000
1a.1.8	Review plant dwgs & specs.	-	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-	-	-	-	1,300
1a.1.9	Perform detailed rad survey									a											
1a.1.10	Estimate by-product inventory	-	-	-	-	-	-	77	12	88	88	-	-	-	-	-	-	-	-	-	1,000
1a.1.11	End product description	-	-	-	-	-	-	77	12	88	88	-	-	-	-	-	-	-	-	-	1,000
1a.1.12	Detailed by-product inventory	-	-	-	-	-	-	115	17	133	133	-	-	-	-	-	-	-	-	-	1,500
1a.1.13	Define major work sequence	-	-	-	-	-	-	77	12	88	88	-	-	-	-	-	-	-	-	-	1,000
1a.1.14	Perform SER and EA	-	-	-	-	-	-	238	36	274	274	-	-	-	-	-	-	-	-	-	3,100
1a.1.15	Perform Site-Specific Cost Study	-	-	-	-	-	-	385	58	442	442	-	-	-	-	-	-	-	-	-	5,000
Activity Specifications																					
1a.1.16.1	Prepare plant and facilities for SAFSTOR	-	-	-	-	-	-	378	57	435	435	-	-	-	-	-	-	-	-	-	4,920
1a.1.16.2	Plant systems	-	-	-	-	-	-	321	48	369	369	-	-	-	-	-	-	-	-	-	4,167
1a.1.16.3	Plant structures and buildings	-	-	-	-	-	-	240	36	276	276	-	-	-	-	-	-	-	-	-	3,120
1a.1.16.4	Waste management	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	2,000
1a.1.16.5	Facility and site dormancy	-	-	-	-	-	-	154	23	177	177	-	-	-	-	-	-	-	-	-	2,000
1a.1.16	Total	-	-	-	-	-	-	1,247	187	1,434	1,434	-	-	-	-	-	-	-	-	-	16,207
Detailed Work Procedures																					
1a.1.17.1	Plant systems	-	-	-	-	-	-	91	14	105	105	-	-	-	-	-	-	-	-	-	1,183
1a.1.17.2	Facility closeout & dormancy	-	-	-	-	-	-	92	14	106	106	-	-	-	-	-	-	-	-	-	1,200
1a.1.17	Total	-	-	-	-	-	-	183	27	211	211	-	-	-	-	-	-	-	-	-	2,383
1a.1.18	Procure vacuum drying system	-	-	-	-	-	-	8	1	9	9	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	3,101	516	3,617	3,617	-	-	-	-	-	-	-	-	-	35,890

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 1a Additional Costs																					
1a.2.1	Hazardous Material Remediation Program	-	-	-	5	32	-	-	6	43	43	-	-	-	-	-	-	-	-	-	-
1a.2.2	Spent Fuel Pool Isolation	-	-	-	-	-	-	8,354	1,253	9,607	9,607	-	-	-	-	-	-	-	-	-	-
1a.2.3	Site Security Modifications	-	-	-	-	-	-	214	21	235	235	-	-	-	-	-	-	-	-	-	-
1a.2.4	Decon Primary Loop	3,024	-	-	-	-	1,338	-	1,846	6,208	6,208	-	-	-	-	-	-	-	-	-	-
1a.2.5	Fuel Inspection/Failed Fuel Containerization *	-	-	-	-	-	-	702	105	807	807	-	-	-	-	-	-	-	-	-	-
1a.2.6	ISFSI - Fixed Indirect Overhead	-	-	-	-	-	-	187	28	215	-	215	-	-	-	-	-	-	-	-	-
1a.2.7	ISFSI - Operating Costs	-	-	-	-	-	-	60	9	69	-	69	-	-	-	-	-	-	-	-	-
1a.2.8	ISFSI - Utility Operating Staff	-	-	-	-	-	-	1,057	159	1,215	-	1,215	-	-	-	-	-	-	-	-	20,786
1a.2.9	ISFSI - Site Security	-	-	-	-	-	-	243	36	279	-	279	-	-	-	-	-	-	-	-	12,471
1a.2.10	Fixed Indirect Overhead	-	-	-	-	-	-	4,565	685	5,250	5,250	-	-	-	-	-	-	-	-	-	-
1a.2	Subtotal Period 1a Additional Costs	3,024	-	-	5	32	1,338	15,382	4,149	23,930	22,151	1,779	-	-	-	-	-	-	-	-	33,257
Period 1a Period-Dependent Costs																					
1a.4.1	Insurance	-	-	-	-	-	-	1,190	119	1,309	1,309	-	-	-	-	-	-	-	-	-	-
1a.4.2	Property taxes	-	-	-	-	-	-	3,672	367	4,040	4,040	-	-	-	-	-	-	-	-	-	-
1a.4.3	Health physics supplies	-	202	-	-	-	-	-	50	252	252	-	-	-	-	-	-	-	-	-	-
1a.4.4	Heavy equipment rental	-	263	-	-	-	-	-	39	302	302	-	-	-	-	-	-	-	-	-	-
1a.4.5	Disposal of DAW generated	-	-	4	2	-	23	-	6	35	35	-	-	-	404	-	-	-	8,103	99	-
1a.4.6	Plant energy budget	-	-	-	-	-	-	970	145	1,115	1,115	-	-	-	-	-	-	-	-	-	-
1a.4.7	NRC Fees	-	-	-	-	-	-	381	38	419	419	-	-	-	-	-	-	-	-	-	-
1a.4.8	Emergency Planning Fees	-	-	-	-	-	-	101	10	111	-	111	-	-	-	-	-	-	-	-	-
1a.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	976	146	1,123	-	1,123	-	-	-	-	-	-	-	-	-
1a.4.10	Security Staff Cost	-	-	-	-	-	-	900	135	1,035	1,035	-	-	-	-	-	-	-	-	-	58,921
1a.4.11	Utility Staff Cost	-	-	-	-	-	-	24,701	3,705	28,407	28,407	-	-	-	-	-	-	-	-	-	508,914
1a.4	Subtotal Period 1a Period-Dependent Costs	-	464	4	2	-	23	32,892	4,763	38,148	36,914	1,234	-	-	404	-	-	-	8,103	99	567,836
1a.0	TOTAL PERIOD 1a COST	3,024	464	4	6	32	1,361	51,375	9,428	65,695	62,682	3,013	-	-	404	-	-	-	8,103	99	636,983
PERIOD 1b - SAFSTOR Limited DECON Activities																					
Period 1b Direct Decommissioning Activities																					
Decontamination of Site Buildings																					
1b.1.1.1	Reactor	352	-	-	-	-	-	-	176	529	529	-	-	-	-	-	-	-	-	8,868	-
1b.1.1.2	Auxiliary	523	-	-	-	-	-	-	262	785	785	-	-	-	-	-	-	-	-	13,651	-
1b.1.1.3	Condensate Demineralizer	55	-	-	-	-	-	-	27	82	82	-	-	-	-	-	-	-	-	1,490	-
1b.1.1.4	Radwaste Storage East	26	-	-	-	-	-	-	13	39	39	-	-	-	-	-	-	-	-	706	-
1b.1.1.5	Radwaste Storage South	16	-	-	-	-	-	-	8	24	24	-	-	-	-	-	-	-	-	432	-
1b.1.1	Totals	972	-	-	-	-	-	-	486	1,458	1,458	-	-	-	-	-	-	-	-	25,146	-
1b.1	Subtotal Period 1b Activity Costs	972	-	-	-	-	-	-	486	1,458	1,458	-	-	-	-	-	-	-	-	25,146	-
Period 1b Additional Costs																					
1b.2.1	ISFSI - Fixed Indirect Overhead	-	-	-	-	-	-	47	7	54	-	54	-	-	-	-	-	-	-	-	-
1b.2.2	ISFSI - Operating Costs	-	-	-	-	-	-	15	2	17	-	17	-	-	-	-	-	-	-	-	-
1b.2.3	ISFSI - Utility Operating Staff	-	-	-	-	-	-	266	40	306	-	306	-	-	-	-	-	-	-	-	5,239
1b.2.4	ISFSI - Site Security	-	-	-	-	-	-	61	9	70	-	70	-	-	-	-	-	-	-	-	3,143
1b.2.5	Fixed Indirect Overhead	-	-	-	-	-	-	1,151	173	1,323	1,323	-	-	-	-	-	-	-	-	-	-
1b.2	Subtotal Period 1b Additional Costs	-	-	-	-	-	-	1,541	231	1,772	1,323	448	-	-	-	-	-	-	-	-	8,382
Period 1b Collateral Costs																					
1b.3.1	Decon equipment	573	-	-	-	-	-	-	86	659	659	-	-	-	-	-	-	-	-	-	-
1b.3.2	Process liquid waste	77	-	23	76	-	339	-	137	652	652	-	-	-	-	528	-	-	66,539	104	-
1b.3.3	Small tool allowance	-	14	-	-	-	-	-	2	16	16	-	-	-	-	-	-	-	-	-	-
1b.3	Subtotal Period 1b Collateral Costs	650	14	23	76	-	339	-	225	1,327	1,327	-	-	-	-	528	-	-	66,539	104	-

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 1b Period-Dependent Costs																					
1b.4.1	Decon supplies	347	-	-	-	-	-	-	87	434	434	-	-	-	-	-	-	-	-	-	-
1b.4.2	Insurance	-	-	-	-	-	-	300	30	330	330	-	-	-	-	-	-	-	-	-	-
1b.4.3	Property taxes	-	-	-	-	-	-	926	93	1,018	1,018	-	-	-	-	-	-	-	-	-	-
1b.4.4	Health physics supplies	-	121	-	-	-	-	-	30	151	151	-	-	-	-	-	-	-	-	-	-
1b.4.5	Heavy equipment rental	-	66	-	-	-	-	-	10	76	76	-	-	-	-	-	-	-	-	-	-
1b.4.6	Disposal of DAW generated	-	-	4	1	-	19	-	5	29	29	-	-	-	335	-	-	-	6,723	82	-
1b.4.7	Plant energy budget	-	-	-	-	-	-	244	37	281	281	-	-	-	-	-	-	-	-	-	-
1b.4.8	NRC Fees	-	-	-	-	-	-	96	10	106	106	-	-	-	-	-	-	-	-	-	-
1b.4.9	Emergency Planning Fees	-	-	-	-	-	-	25	3	28	-	28	-	-	-	-	-	-	-	-	-
1b.4.10	Spent Fuel Pool O&M	-	-	-	-	-	-	246	37	283	-	283	-	-	-	-	-	-	-	-	-
1b.4.11	Security Staff Cost	-	-	-	-	-	-	227	34	261	261	-	-	-	-	-	-	-	-	-	14,851
1b.4.12	Utility Staff Cost	-	-	-	-	-	-	6,226	934	7,160	7,160	-	-	-	-	-	-	-	-	-	128,274
1b.4	Subtotal Period 1b Period-Dependent Costs	347	187	4	1	-	19	8,291	1,308	10,157	9,845	311	-	-	335	-	-	-	6,723	82	143,126
1b.0	TOTAL PERIOD 1b COST	1,969	200	26	77	-	358	9,831	2,250	14,712	13,953	759	-	-	335	528	-	-	73,262	25,332	151,508
PERIOD 1c - Preparations for SAFSTOR Dormancy																					
Period 1c Direct Decommissioning Activities																					
1c.1.1	Prepare support equipment for storage	-	377	-	-	-	-	-	57	433	433	-	-	-	-	-	-	-	-	3,000	-
1c.1.2	Install containment pressure equal. lines	-	29	-	-	-	-	-	4	33	33	-	-	-	-	-	-	-	-	700	-
1c.1.3	Interim survey prior to dormancy	-	-	-	-	-	-	733	220	953	953	-	-	-	-	-	-	-	-	16,005	-
1c.1.4	Secure building accesses									a											
1c.1.5	Prepare & submit interim report	-	-	-	-	-	-	45	7	52	52	-	-	-	-	-	-	-	-	-	583
1c.1	Subtotal Period 1c Activity Costs	-	406	-	-	-	-	778	287	1,471	1,471	-	-	-	-	-	-	-	-	19,705	583
Period 1c Additional Costs																					
1c.2.1	ISFSI - Fixed Indirect Overhead	-	-	-	-	-	-	47	7	54	-	54	-	-	-	-	-	-	-	-	-
1c.2.2	ISFSI - Operating Costs	-	-	-	-	-	-	15	2	17	-	17	-	-	-	-	-	-	-	-	-
1c.2.3	ISFSI - Utility Operating Staff	-	-	-	-	-	-	266	40	306	-	306	-	-	-	-	-	-	-	-	5,239
1c.2.4	ISFSI - Site Security	-	-	-	-	-	-	61	9	70	-	70	-	-	-	-	-	-	-	-	3,143
1c.2.5	Fixed Indirect Overhead	-	-	-	-	-	-	1,151	173	1,323	1,323	-	-	-	-	-	-	-	-	-	-
1c.2	Subtotal Period 1c Additional Costs	-	-	-	-	-	-	1,541	231	1,772	1,323	448	-	-	-	-	-	-	-	-	8,382
Period 1c Collateral Costs																					
1c.3.1	Process liquid waste	81	-	24	80	-	357	-	144	685	685	-	-	-	-	555	-	-	69,988	109	-
1c.3.2	Small tool allowance	-	2	-	-	-	-	-	0	3	3	-	-	-	-	-	-	-	-	-	-
1c.3.3	Fuel storage site alterations	-	-	-	-	-	-	2,001	300	2,302	-	2,302	-	-	-	-	-	-	-	-	-
1c.3	Subtotal Period 1c Collateral Costs	81	2	24	80	-	357	2,001	444	2,989	688	2,302	-	-	-	555	-	-	69,988	109	-
Period 1c Period-Dependent Costs																					
1c.4.1	Insurance	-	-	-	-	-	-	300	30	330	330	-	-	-	-	-	-	-	-	-	-
1c.4.2	Property taxes	-	-	-	-	-	-	926	93	1,018	1,018	-	-	-	-	-	-	-	-	-	-
1c.4.3	Health physics supplies	-	106	-	-	-	-	-	26	132	132	-	-	-	-	-	-	-	-	-	-
1c.4.4	Heavy equipment rental	-	66	-	-	-	-	-	10	76	76	-	-	-	-	-	-	-	-	-	-
1c.4.5	Disposal of DAW generated	-	-	1	0	-	6	-	2	9	9	-	-	-	102	-	-	-	2,042	25	-
1c.4.6	Plant energy budget	-	-	-	-	-	-	244	37	281	281	-	-	-	-	-	-	-	-	-	-
1c.4.7	NRC Fees	-	-	-	-	-	-	96	10	106	106	-	-	-	-	-	-	-	-	-	-
1c.4.8	Emergency Planning Fees	-	-	-	-	-	-	25	3	28	-	28	-	-	-	-	-	-	-	-	-
1c.4.9	Spent Fuel Pool O&M	-	-	-	-	-	-	246	37	283	-	283	-	-	-	-	-	-	-	-	-
1c.4.10	Security Staff Cost	-	-	-	-	-	-	227	34	261	261	-	-	-	-	-	-	-	-	-	14,851
1c.4.11	Utility Staff Cost	-	-	-	-	-	-	6,226	934	7,160	7,160	-	-	-	-	-	-	-	-	-	128,274
1c.4	Subtotal Period 1c Period-Dependent Costs	-	172	1	0	-	6	8,291	1,214	9,684	9,373	311	-	-	102	-	-	-	2,042	25	143,126

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
1c.0	TOTAL PERIOD 1c COST	81	580	25	80	-	363	12,610	2,177	15,916	12,855	3,061	-	-	102	555	-	-	72,030	19,840	152,091
PERIOD 1 TOTALS		5,073	1,245	56	164	32	2,082	73,817	13,855	96,323	89,490	6,833	-	-	842	1,083	-	-	153,395	45,271	940,581
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	-	-	-	-	-	-	1,133	170	1,303	1,303	-	-	-	-	-	-	-	-	-	-
2a.1.5	Maintenance supplies	-	-	-	-	-	-	838	126	964	964	-	-	-	-	-	-	-	-	-	-
2a.1	Subtotal Period 2a Activity Costs	-	-	-	-	-	-	1,971	296	2,267	2,267	-	-	-	-	-	-	-	-	-	-
Period 2a Additional Costs																					
2a.2.1	Separation Program	-	-	-	-	-	-	7,239	724	7,963	7,963	-	-	-	-	-	-	-	-	-	-
2a.2.2	Site Security Modifications	-	-	-	-	-	-	238	24	261	-	261	-	-	-	-	-	-	-	-	-
2a.2.3	ISFSI - Fixed Indirect Overhead	-	-	-	-	-	-	1,248	187	1,435	-	1,435	-	-	-	-	-	-	-	-	-
2a.2.4	ISFSI - Operating Costs	-	-	-	-	-	-	400	60	460	-	460	-	-	-	-	-	-	-	-	-
2a.2.5	ISFSI - Utility Operating Staff	-	-	-	-	-	-	7,048	1,057	8,106	-	8,106	-	-	-	-	-	-	-	-	131,155
2a.2.6	ISFSI - Site Security	-	-	-	-	-	-	1,618	243	1,861	-	1,861	-	-	-	-	-	-	-	-	83,166
2a.2.7	Fixed Indirect Overhead	-	-	-	-	-	-	8,485	1,273	9,757	1,069	8,689	-	-	-	-	-	-	-	-	-
2a.2.8	ISFSI - Capital Costs *	-	-	-	-	-	-	31,632	-	31,632	-	31,632	-	-	-	-	-	-	-	-	-
2a.2	Subtotal Period 2a Additional Costs	-	-	-	-	-	-	57,907	3,567	61,474	9,031	52,443	-	-	-	-	-	-	-	-	214,321
Period 2a Collateral Costs																					
2a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	21,506	3,226	24,732	-	24,732	-	-	-	-	-	-	-	-	-
2a.3	Subtotal Period 2a Collateral Costs	-	-	-	-	-	-	21,506	3,226	24,732	-	24,732	-	-	-	-	-	-	-	-	-
Period 2a Period-Dependent Costs																					
2a.4.1	Insurance	-	-	-	-	-	-	5,676	568	6,243	2,419	3,824	-	-	-	-	-	-	-	-	-
2a.4.2	Property taxes	-	-	-	-	-	-	16,660	1,666	18,326	16,493	1,833	-	-	-	-	-	-	-	-	-
2a.4.3	Health physics supplies	-	336	-	-	-	-	-	84	420	46	374	-	-	-	-	-	-	-	-	-
2a.4.4	Disposal of DAW generated	-	-	28	10	-	152	-	42	233	26	208	-	-	2,696	-	-	-	54,035	662	-
2a.4.5	Plant energy budget	-	-	-	-	-	-	4,850	727	5,577	744	4,834	-	-	-	-	-	-	-	-	-
2a.4.6	NRC Fees	-	-	-	-	-	-	2,334	233	2,567	2,567	-	-	-	-	-	-	-	-	-	-
2a.4.7	Emergency Planning Fees	-	-	-	-	-	-	673	67	740	-	740	-	-	-	-	-	-	-	-	-
2a.4.8	Spent Fuel Pool O&M	-	-	-	-	-	-	6,512	977	7,488	-	7,488	-	-	-	-	-	-	-	-	-
2a.4.9	Security Staff Cost	-	-	-	-	-	-	2,562	384	2,946	1,396	1,551	-	-	-	-	-	-	-	-	215,583
2a.4.10	Utility Staff Cost	-	-	-	-	-	-	47,195	7,079	54,275	5,945	48,330	-	-	-	-	-	-	-	-	945,783
2a.4	Subtotal Period 2a Period-Dependent Costs	-	336	28	10	-	152	86,461	11,828	98,816	29,635	69,181	-	-	2,696	-	-	-	54,035	662	1,161,366
2a.0	TOTAL PERIOD 2a COST	-	336	28	10	-	152	167,845	18,917	187,289	40,933	146,356	-	-	2,696	-	-	-	54,035	662	1,375,687
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	-	-	-	-	-	-	992	149	1,141	1,141	-	-	-	-	-	-	-	-	-	-
2b.1.5	Maintenance supplies	-	-	-	-	-	-	734	110	844	844	-	-	-	-	-	-	-	-	-	-
2b.1	Subtotal Period 2b Activity Costs	-	-	-	-	-	-	1,726	259	1,985	1,985	-	-	-	-	-	-	-	-	-	-
											-	-									

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 2b Additional Costs																					
2b.2.1	Fixed Indirect Overhead	-	-	-	-	-	-	874	131	1,005	1,005	-	-	-	-	-	-	-	-	-	-
2b.2.2	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	974	-	974	-	974	-	-	-	-	-	-	-	-	-
2b.2.3	ISFSI - Operating Costs *	-	-	-	-	-	-	312	-	312	-	312	-	-	-	-	-	-	-	-	-
2b.2.4	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	5,504	-	5,504	-	5,504	-	-	-	-	-	-	-	-	108,235
2b.2.5	ISFSI - Site Security *	-	-	-	-	-	-	1,264	-	1,264	-	1,264	-	-	-	-	-	-	-	-	64,941
2b.2.6	ISFSI - Fixed Indirect Overhead	-	-	-	-	-	-	118	-	118	-	118	-	-	-	-	-	-	-	-	-
2b.2.7	ISFSI - Operating Costs	-	-	-	-	-	-	38	-	38	-	38	-	-	-	-	-	-	-	-	-
2b.2.8	ISFSI - Utility Operating Staff	-	-	-	-	-	-	669	-	669	-	669	-	-	-	-	-	-	-	-	13,155
2b.2.9	ISFSI - Site Security	-	-	-	-	-	-	154	-	154	-	154	-	-	-	-	-	-	-	-	7,893
2b.2	Subtotal Period 2b Additional Costs	-	-	-	-	-	-	9,907	131	10,038	1,005	9,033	-	-	-	-	-	-	-	-	194,224
Period 2b Collateral Costs																					
2b.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	1,475	221	1,696	-	1,696	-	-	-	-	-	-	-	-	-
2b.3	Subtotal Period 2b Collateral Costs	-	-	-	-	-	-	1,475	221	1,696	-	1,696	-	-	-	-	-	-	-	-	-
Period 2b Period-Dependent Costs																					
2b.4.1	Insurance	-	-	-	-	-	-	1,926	193	2,119	1,059	1,059	-	-	-	-	-	-	-	-	-
2b.4.2	Property taxes	-	-	-	-	-	-	14,593	1,459	16,052	14,447	1,605	-	-	-	-	-	-	-	-	-
2b.4.3	Health physics supplies	-	294	-	-	-	-	-	74	368	368	-	-	-	-	-	-	-	-	-	-
2b.4.4	Disposal of DAW generated	-	-	25	9	-	133	-	37	204	204	-	-	-	2,362	-	-	-	47,330	580	-
2b.4.5	Plant energy budget	-	-	-	-	-	-	566	85	651	651	-	-	-	-	-	-	-	-	-	-
2b.4.6	NRC Fees	-	-	-	-	-	-	2,044	204	2,249	2,249	-	-	-	-	-	-	-	-	-	-
2b.4.7	Emergency Planning Fees	-	-	-	-	-	-	590	59	648	-	648	-	-	-	-	-	-	-	-	-
2b.4.8	Security Staff Cost	-	-	-	-	-	-	1,063	159	1,222	1,222	-	-	-	-	-	-	-	-	-	127,920
2b.4.9	Utility Staff Cost	-	-	-	-	-	-	4,528	679	5,208	5,208	-	-	-	-	-	-	-	-	-	97,463
2b.4	Subtotal Period 2b Period-Dependent Costs	-	294	25	9	-	133	25,311	2,950	28,722	25,408	3,313	-	-	2,362	-	-	-	47,330	580	225,383
2b.0	TOTAL PERIOD 2b COST	-	294	25	9	-	133	38,419	3,561	42,441	28,399	14,042	-	-	2,362	-	-	-	47,330	580	419,607
PERIOD 2 TOTALS		-	630	53	19	-	285	206,263	22,478	229,730	69,332	160,398	-	-	5,058	-	-	-	101,365	1,242	1,795,294
PERIOD 3a - Reactivate Site Following SAFSTOR Dormancy																					
Period 3a Direct Decommissioning Activities																					
3a.1.1	Prepare preliminary decommissioning cost	-	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-	-	-	-	1,300
3a.1.2	Review plant dwgs & specs.	-	-	-	-	-	-	354	53	407	407	-	-	-	-	-	-	-	-	-	4,600
3a.1.3	Perform detailed rad survey									a											
3a.1.4	End product description	-	-	-	-	-	-	77	12	88	88	-	-	-	-	-	-	-	-	-	1,000
3a.1.5	Detailed by-product inventory	-	-	-	-	-	-	100	15	115	115	-	-	-	-	-	-	-	-	-	1,300
3a.1.6	Define major work sequence	-	-	-	-	-	-	577	87	663	663	-	-	-	-	-	-	-	-	-	7,500
3a.1.7	Perform SER and EA	-	-	-	-	-	-	238	36	274	274	-	-	-	-	-	-	-	-	-	3,100
3a.1.8	Perform Site-Specific Cost Study	-	-	-	-	-	-	385	58	442	442	-	-	-	-	-	-	-	-	-	5,000
3a.1.9	Prepare/submit License Termination Plan	-	-	-	-	-	-	315	47	362	362	-	-	-	-	-	-	-	-	-	4,096
3a.1.10	Receive NRC approval of termination plan									a											
Activity Specifications																					
3a.1.11.1	Re-activate plant & temporary facilities	-	-	-	-	-	-	567	85	652	587	-	65	-	-	-	-	-	-	-	7,370
3a.1.11.2	Plant systems	-	-	-	-	-	-	321	48	369	332	-	37	-	-	-	-	-	-	-	4,167
3a.1.11.3	Reactor internals	-	-	-	-	-	-	546	82	628	628	-	-	-	-	-	-	-	-	-	7,100
3a.1.11.4	Reactor vessel	-	-	-	-	-	-	500	75	575	575	-	-	-	-	-	-	-	-	-	6,500
3a.1.11.5	Biological shield	-	-	-	-	-	-	38	6	44	44	-	-	-	-	-	-	-	-	-	500
3a.1.11.6	Steam generators	-	-	-	-	-	-	240	36	276	276	-	-	-	-	-	-	-	-	-	3,120
3a.1.11.7	Reinforced concrete	-	-	-	-	-	-	123	18	142	71	-	71	-	-	-	-	-	-	-	1,600
3a.1.11.8	Turbine & condenser	-	-	-	-	-	-	62	9	71	-	-	71	-	-	-	-	-	-	-	800

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Activity Specifications (continued)																					
3a.1.11.9	Plant structures & buildings	-	-	-	-	-	-	240	36	276	138	-	138	-	-	-	-	-	-	-	3,120
3a.1.11.10	Waste management	-	-	-	-	-	-	354	53	407	407	-	-	-	-	-	-	-	-	-	4,600
3a.1.11.11	Facility & site closeout	-	-	-	-	-	-	69	10	80	40	-	40	-	-	-	-	-	-	-	900
3a.1.11	Total	-	-	-	-	-	-	3,060	459	3,519	3,097	-	421	-	-	-	-	-	-	-	39,777
Planning & Site Preparations																					
3a.1.12	Prepare dismantling sequence	-	-	-	-	-	-	185	28	212	212	-	-	-	-	-	-	-	-	-	2,400
3a.1.13	Plant prep. & temp. svces	-	-	-	-	-	-	2,419	363	2,782	2,782	-	-	-	-	-	-	-	-	-	-
3a.1.14	Design water clean-up system	-	-	-	-	-	-	108	16	124	124	-	-	-	-	-	-	-	-	-	1,400
3a.1.15	Rigging/Cont. Cntrl Envlps/tooling/etc.	-	-	-	-	-	-	2,048	307	2,355	2,355	-	-	-	-	-	-	-	-	-	-
3a.1.16	Procure casks/liners & containers	-	-	-	-	-	-	95	14	109	109	-	-	-	-	-	-	-	-	-	1,230
3a.1	Subtotal Period 3a Activity Costs	-	-	-	-	-	-	10,059	1,509	11,568	11,147	-	421	-	-	-	-	-	-	-	72,703
Period 3a Additional Costs																					
3a.2.1	Site Security Modifications	-	-	-	-	-	-	202	20	222	222	-	-	-	-	-	-	-	-	-	-
3a.2.2	Fixed Indirect Overhead	-	-	-	-	-	-	3,443	516	3,959	3,959	-	-	-	-	-	-	-	-	-	-
3a.2.3	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	187	-	187	-	187	-	-	-	-	-	-	-	-	-
3a.2.4	ISFSI - Operating Costs *	-	-	-	-	-	-	60	-	60	-	60	-	-	-	-	-	-	-	-	-
3a.2.5	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	1,057	-	1,057	-	1,057	-	-	-	-	-	-	-	-	20,786
3a.2.6	ISFSI - Site Security *	-	-	-	-	-	-	243	-	243	-	243	-	-	-	-	-	-	-	-	12,471
3a.2	Subtotal Period 3a Additional Costs	-	-	-	-	-	-	5,191	537	5,728	4,181	1,547	-	-	-	-	-	-	-	-	33,257
Period 3a Collateral Costs																					
3a.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	211	32	242	-	242	-	-	-	-	-	-	-	-	-
3a.3	Subtotal Period 3a Collateral Costs	-	-	-	-	-	-	211	32	242	-	242	-	-	-	-	-	-	-	-	-
Period 3a Period-Dependent Costs																					
3a.4.1	Insurance	-	-	-	-	-	-	585	58	643	643	-	-	-	-	-	-	-	-	-	-
3a.4.2	Property taxes	-	-	-	-	-	-	2,498	250	2,748	2,748	-	-	-	-	-	-	-	-	-	-
3a.4.3	Health physics supplies	-	202	-	-	-	-	-	50	252	252	-	-	-	-	-	-	-	-	-	-
3a.4.4	Heavy equipment rental	-	263	-	-	-	-	-	39	302	302	-	-	-	-	-	-	-	-	-	-
3a.4.5	Disposal of DAW generated	-	-	4	2	-	23	-	6	35	35	-	-	-	404	-	-	-	8,103	99	-
3a.4.6	Plant energy budget	-	-	-	-	-	-	727	109	836	836	-	-	-	-	-	-	-	-	-	-
3a.4.7	NRC Fees	-	-	-	-	-	-	381	38	419	419	-	-	-	-	-	-	-	-	-	-
3a.4.8	Emergency Planning Fees	-	-	-	-	-	-	101	10	111	-	111	-	-	-	-	-	-	-	-	-
3a.4.9	Security Staff Cost	-	-	-	-	-	-	283	42	326	326	-	-	-	-	-	-	-	-	-	27,114
3a.4.10	Utility Staff Cost	-	-	-	-	-	-	24,802	3,720	28,522	28,522	-	-	-	-	-	-	-	-	-	383,771
3a.4	Subtotal Period 3a Period-Dependent Costs	-	464	4	2	-	23	29,377	4,325	34,195	34,084	111	-	-	404	-	-	-	8,103	99	410,886
3a.0	TOTAL PERIOD 3a COST	-	464	4	2	-	23	44,838	6,402	51,733	49,412	1,900	421	-	404	-	-	-	8,103	99	516,845
PERIOD 3b - Decommissioning Preparations																					
Period 3b Direct Decommissioning Activities																					
Detailed Work Procedures																					
3b.1.1.1	Plant systems	-	-	-	-	-	-	364	55	419	377	-	42	-	-	-	-	-	-	-	4,733
3b.1.1.2	Reactor internals	-	-	-	-	-	-	192	29	221	221	-	-	-	-	-	-	-	-	-	2,500
3b.1.1.3	Remaining buildings	-	-	-	-	-	-	104	16	119	30	-	90	-	-	-	-	-	-	-	1,350
3b.1.1.4	CRD cooling assembly	-	-	-	-	-	-	77	12	88	88	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.5	CRD housings & ICI tubes	-	-	-	-	-	-	77	12	88	88	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.6	Incore instrumentation	-	-	-	-	-	-	77	12	88	88	-	-	-	-	-	-	-	-	-	1,000
3b.1.1.7	Reactor vessel	-	-	-	-	-	-	279	42	321	321	-	-	-	-	-	-	-	-	-	3,630
3b.1.1.8	Facility closeout	-	-	-	-	-	-	92	14	106	53	-	53	-	-	-	-	-	-	-	1,200
3b.1.1.9	Missile shields	-	-	-	-	-	-	35	5	40	40	-	-	-	-	-	-	-	-	-	450

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Detailed Work Procedures (continued)																					
3b.1.1.10	Biological shield	-	-	-	-	-	-	92	14	106	106	-	-	-	-	-	-	-	-	-	1,200
3b.1.1.11	Steam generators	-	-	-	-	-	-	354	53	407	407	-	-	-	-	-	-	-	-	-	4,600
3b.1.1.12	Reinforced concrete	-	-	-	-	-	-	77	12	88	44	-	44	-	-	-	-	-	-	-	1,000
3b.1.1.13	Turbine & condensers	-	-	-	-	-	-	240	36	276	-	-	276	-	-	-	-	-	-	-	3,120
3b.1.1.14	Auxiliary building	-	-	-	-	-	-	210	31	241	217	-	24	-	-	-	-	-	-	-	2,730
3b.1.1.15	Reactor building	-	-	-	-	-	-	210	31	241	217	-	24	-	-	-	-	-	-	-	2,730
3b.1.1	Total	-	-	-	-	-	-	2,480	372	2,852	2,299	-	553	-	-	-	-	-	-	-	32,243
3b.1	Subtotal Period 3b Activity Costs	-	-	-	-	-	-	2,480	372	2,852	2,299	-	553	-	-	-	-	-	-	-	32,243
Period 3b Additional Costs																					
3b.2.1	Site Characterization	-	-	-	-	-	-	1,313	394	1,707	1,707	-	-	-	-	-	-	-	-	-	-
3b.2.2	Asbestos Remediation Program	-	7,927	457	80	5,329	-	-	2,839	16,632	16,632	-	-	54,000	-	-	-	-	540,000	232,466	-
3b.2.3	Decommissioning Power System	-	-	-	-	-	-	7,784	1,168	8,951	8,951	-	-	-	-	-	-	-	-	-	-
3b.2.4	Fixed Indirect Overhead	-	-	-	-	-	-	1,754	263	2,018	2,018	-	-	-	-	-	-	-	-	-	-
3b.2.5	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	95	-	95	-	95	-	-	-	-	-	-	-	-	-
3b.2.6	ISFSI - Operating Costs *	-	-	-	-	-	-	31	-	31	-	31	-	-	-	-	-	-	-	-	-
3b.2.7	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	539	-	539	-	539	-	-	-	-	-	-	-	-	10,592
3b.2.8	ISFSI - Site Security *	-	-	-	-	-	-	124	-	124	-	124	-	-	-	-	-	-	-	-	6,355
3b.2	Subtotal Period 3b Additional Costs	-	7,927	457	80	5,329	-	11,639	4,663	30,096	29,308	788	-	54,000	-	-	-	-	540,000	232,466	16,947
Period 3b Collateral Costs																					
3b.3.1	Decon equipment	573	-	-	-	-	-	-	86	659	659	-	-	-	-	-	-	-	-	-	-
3b.3.2	DOC staff relocation expenses	-	-	-	-	-	-	954	143	1,097	1,097	-	-	-	-	-	-	-	-	-	-
3b.3.3	Pipe cutting equipment	-	957	-	-	-	-	-	143	1,100	1,100	-	-	-	-	-	-	-	-	-	-
3b.3.4	Spent Fuel Capital and Transfer	-	-	-	-	-	-	211	32	242	-	242	-	-	-	-	-	-	-	-	-
3b.3	Subtotal Period 3b Collateral Costs	573	957	-	-	-	-	1,165	404	3,099	2,857	242	-	-	-	-	-	-	-	-	-
Period 3b Period-Dependent Costs																					
3b.4.1	Decon supplies	18	-	-	-	-	-	-	4	22	22	-	-	-	-	-	-	-	-	-	-
3b.4.2	Insurance	-	-	-	-	-	-	298	30	328	328	-	-	-	-	-	-	-	-	-	-
3b.4.3	Property taxes	-	-	-	-	-	-	1,273	127	1,400	1,400	-	-	-	-	-	-	-	-	-	-
3b.4.4	Health physics supplies	-	745	-	-	-	-	-	186	931	931	-	-	-	-	-	-	-	-	-	-
3b.4.5	Heavy equipment rental	-	134	-	-	-	-	-	20	154	154	-	-	-	-	-	-	-	-	-	-
3b.4.6	Disposal of DAW generated	-	-	2	1	-	12	-	3	18	18	-	-	-	206	-	-	-	4,129	51	-
3b.4.7	Plant energy budget	-	-	-	-	-	-	371	56	426	426	-	-	-	-	-	-	-	-	-	-
3b.4.8	NRC Fees	-	-	-	-	-	-	194	19	214	214	-	-	-	-	-	-	-	-	-	-
3b.4.9	Emergency Planning Fees	-	-	-	-	-	-	51	5	57	-	57	-	-	-	-	-	-	-	-	-
3b.4.10	Security Staff Cost	-	-	-	-	-	-	144	22	166	166	-	-	-	-	-	-	-	-	-	13,817
3b.4.11	DOC Staff Cost	-	-	-	-	-	-	3,641	546	4,188	4,188	-	-	-	-	-	-	-	-	-	49,954
3b.4.12	Utility Staff Cost	-	-	-	-	-	-	12,639	1,896	14,535	14,535	-	-	-	-	-	-	-	-	-	195,566
3b.4	Subtotal Period 3b Period-Dependent Costs	18	879	2	1	-	12	18,612	2,915	22,437	22,381	57	-	-	206	-	-	-	4,129	51	259,337
3b.0	TOTAL PERIOD 3b COST	591	9,762	459	81	5,329	12	33,896	8,354	58,484	56,844	1,087	553	54,000	206	-	-	-	544,129	232,517	308,527
PERIOD 3 TOTALS		591	10,227	464	82	5,329	34	78,734	14,756	110,217	106,256	2,987	974	54,000	610	-	-	-	552,232	232,616	825,373
PERIOD 4a - Large Component Removal																					
Period 4a Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
4a.1.1.1	Reactor Coolant Piping	20	162	7	4	-	417	-	156	766	766	-	-	-	898	-	-	-	81,691	4,990	-
4a.1.1.2	Pressurizer Quench Tank	3	13	2	1	-	138	-	40	197	197	-	-	-	244	-	-	-	27,068	357	-
4a.1.1.3	Reactor Coolant Pumps & Motors	27	60	32	91	146	3,368	-	910	4,634	4,634	-	-	798	10,290	-	-	-	711,700	2,702	-

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
	Nuclear Steam Supply System Removal (continued)																				
4a.1.1.4	Pressurizer	5	41	464	134	-	1,222	-	385	2,250	2,250	-	-	-	1,506	-	-	-	271,664	2,187	-
4a.1.1.5	Steam Generators	32	4,566	1,978	750	2,841	1,710	-	2,321	14,198	14,198	-	-	17,042	7,496	-	-	-	2,331,204	11,613	-
4a.1.1.6	Retired Steam Generator Units	-	-	1,638	733	2,841	1,710	-	1,127	8,048	8,048	-	-	17,042	7,496	-	-	-	2,203,190	6,760	-
4a.1.1.7	CRDMs/ICIs/Service Structure Removal	20	53	64	6	-	310	-	108	562	562	-	-	-	2,840	-	-	-	60,703	1,874	-
4a.1.1.8	Reactor Vessel Internals	33	1,902	3,673	210	-	1,566	144	3,219	10,748	10,748	-	-	-	1,514	376	115	-	185,100	19,927	929
4a.1.1.9	Reactor Vessel	55	4,185	908	395	-	4,737	144	5,882	16,307	16,307	-	-	-	6,606	2,003	-	-	948,455	19,927	929
4a.1.1	Totals	195	10,984	8,766	2,325	5,828	15,178	288	14,148	57,711	57,711	-	-	34,881	38,890	2,379	115	-	6,820,776	70,337	1,858
	Removal of Major Equipment																				
4a.1.2	Main Turbine/Generator	-	627	64	8	714	-	-	272	1,685	1,685	-	-	2,949	-	-	-	-	250,644	16,476	-
4a.1.3	Main Condensers	-	440	41	8	709	-	-	222	1,420	1,420	-	-	4,976	-	-	-	-	248,819	11,761	-
	Disposal of Plant Systems																				
4a.1.4.1	Auxiliary Feedwater	-	22	-	-	-	-	-	3	25	-	-	25	-	-	-	-	-	-	644	-
4a.1.4.2	Auxiliary Feedwater - RCA	-	69	1	1	76	-	-	29	174	174	-	-	530	-	-	-	-	26,523	1,800	-
4a.1.4.3	Condensate Demineralizer	-	78	-	-	-	-	-	12	89	-	-	89	-	-	-	-	-	-	2,287	-
4a.1.4.4	Condensate Demineralizer Analysis	-	1	-	-	-	-	-	0	1	-	-	1	-	-	-	-	-	-	37	-
4a.1.4.5	Cooling Towers	-	241	-	-	-	-	-	36	277	-	-	277	-	-	-	-	-	-	7,086	-
4a.1.4.6	Extractions/Heater Vents & Drains	-	136	-	-	-	-	-	20	157	-	-	157	-	-	-	-	-	-	4,029	-
4a.1.4.7	Feedwater & Condensate	-	278	-	-	-	-	-	42	320	-	-	320	-	-	-	-	-	-	8,123	-
4a.1.4.8	Feedwater & Condensate - RCA	-	111	2	3	256	-	-	67	439	439	-	-	1,799	-	-	-	-	89,957	3,016	-
4a.1.4.9	HVAC Cooling Tower Pump House	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	180	-
4a.1.4.10	High Pressure Air Operated Valves - RCA	-	21	0	0	43	-	-	12	76	76	-	-	300	-	-	-	-	14,976	552	-
4a.1.4.11	Hydrogen Monitoring - RCA	-	2	-	-	2	-	-	1	6	6	-	-	15	-	-	-	-	758	65	-
4a.1.4.12	Lube Oil/Fuel Oil/Diesel Generator	-	94	-	-	-	-	-	14	109	-	-	109	-	-	-	-	-	-	2,666	-
4a.1.4.13	Main & Auxiliary Steam	-	242	-	-	-	-	-	36	278	-	-	278	-	-	-	-	-	-	7,129	-
4a.1.4.14	Main Steam & Auxiliary Steam - RCA	-	286	5	8	762	-	-	187	1,248	1,248	-	-	5,345	-	-	-	-	267,247	7,792	-
4a.1.4.15	Makeup Demineralizer Analysis	-	0	-	-	-	-	-	-	0	-	-	0	-	-	-	-	-	-	12	-
4a.1.4.16	Makeup Demineralizing	-	58	-	-	-	-	-	9	67	-	-	67	-	-	-	-	-	-	1,712	-
4a.1.4.17	Makeup Domestic Water & Chem Injection	-	153	-	-	-	-	-	23	176	-	-	176	-	-	-	-	-	-	4,352	-
4a.1.4.18	Makeup Water Chemical	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	138	-
4a.1.4.19	Miscellaneous Gas Supply	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	167	-
4a.1.4.20	Non-Critical Service Water	-	42	-	-	-	-	-	6	48	-	-	48	-	-	-	-	-	-	1,257	-
4a.1.4.21	Plant Heating & Fuel Oil	-	54	-	-	-	-	-	8	62	-	-	62	-	-	-	-	-	-	1,600	-
4a.1.4.22	Primary Makeup/Utility Water/Oil Waste	-	63	-	-	-	-	-	9	72	-	-	72	-	-	-	-	-	-	1,783	-
4a.1.4.23	Process Sampling	-	5	-	-	-	-	-	1	5	-	-	5	-	-	-	-	-	-	136	-
4a.1.4.24	Regeneration Chemical Handling	-	28	-	-	-	-	-	4	33	-	-	33	-	-	-	-	-	-	814	-
4a.1.4.25	Service & Instrument Air	-	44	-	-	-	-	-	7	50	-	-	50	-	-	-	-	-	-	1,328	-
4a.1.4.26	Service Water/Screen Struct/Chlorinator	-	132	-	-	-	-	-	20	152	-	-	152	-	-	-	-	-	-	3,881	-
4a.1.4	Totals	-	2,176	8	13	1,138	-	-	549	3,883	1,943	-	1,940	7,989	-	-	-	-	399,461	62,584	-
4a.1.5	Scaffolding in support of decommissioning	-	365	4	1	62	8	-	103	543	543	-	-	439	30	-	-	-	24,648	10,998	-
4a.1	Subtotal Period 4a Activity Costs	195	14,593	8,882	2,354	8,452	15,185	288	15,293	65,243	63,303	-	1,940	51,234	38,920	2,379	115	-	7,744,348	172,156	1,858
	Period 4a Additional Costs																				
4a.2.1	Curie Surcharge	-	-	-	-	-	614	-	154	768	768	-	-	-	-	-	-	-	-	-	-
4a.2.2	Scaffolding	-	-	-	-	-	-	1,057	159	1,216	1,216	-	-	-	-	-	-	-	-	-	-
4a.2.3	Scrap Metal Removal	-	-	-	-	-	-	465	70	535	535	-	-	-	-	-	-	-	-	326	-
4a.2.4	Fixed Indirect Overhead	-	-	-	-	-	-	3,450	517	3,967	3,967	-	-	-	-	-	-	-	-	-	-
4a.2.5	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	221	-	221	-	221	-	-	-	-	-	-	-	-	-
4a.2.6	ISFSI - Operating Costs *	-	-	-	-	-	-	71	-	71	-	71	-	-	-	-	-	-	-	-	-
4a.2.7	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	1,249	-	1,249	-	1,249	-	-	-	-	-	-	-	-	24,566
4a.2.8	ISFSI - Site Security *	-	-	-	-	-	-	287	-	287	-	287	-	-	-	-	-	-	-	-	14,739
4a.2	Subtotal Period 4a Additional Costs	-	-	-	-	-	614	6,800	899	8,314	6,486	1,828	-	-	-	-	-	-	-	326	39,305

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 4a Collateral Costs																					
4a.3.1	Process liquid waste	10	-	4	13	-	59	-	22	109	109	-	-	-	-	92	-	-	11,584	18	-
4a.3.2	Small tool allowance	-	93	-	-	-	-	-	14	107	96	-	11	-	-	-	-	-	-	-	-
4a.3.3	Spent Fuel Capital and Transfer	-	-	-	-	-	-	211	32	242	-	242	-	-	-	-	-	-	-	-	-
4a.3.4	Radwaste Processing Equipment/Services	-	-	-	-	-	-	425	64	489	489	-	-	-	-	-	-	-	-	-	-
4a.3	Subtotal Period 4a Collateral Costs	10	93	4	13	-	59	636	132	947	694	242	11	-	-	92	-	-	11,584	18	-
Period 4a Period-Dependent Costs																					
4a.4.1	Decon supplies	41	-	-	-	-	-	-	10	52	52	-	-	-	-	-	-	-	-	-	-
4a.4.2	Insurance	-	-	-	-	-	-	690	69	759	759	-	-	-	-	-	-	-	-	-	-
4a.4.3	Property taxes	-	-	-	-	-	-	2,950	295	3,245	2,921	-	325	-	-	-	-	-	-	-	-
4a.4.4	Health physics supplies	-	714	-	-	-	-	-	179	893	893	-	-	-	-	-	-	-	-	-	-
4a.4.5	Heavy equipment rental	-	1,679	-	-	-	-	-	252	1,931	1,931	-	-	-	-	-	-	-	-	-	-
4a.4.6	Disposal of DAW generated	-	-	28	10	-	152	-	42	232	232	-	-	-	2,688	-	-	-	53,864	660	-
4a.4.7	Plant energy budget	-	-	-	-	-	-	859	129	988	988	-	-	-	-	-	-	-	-	-	-
4a.4.8	NRC Fees	-	-	-	-	-	-	524	52	576	576	-	-	-	-	-	-	-	-	-	-
4a.4.9	Emergency Planning Fees	-	-	-	-	-	-	119	12	131	-	131	-	-	-	-	-	-	-	-	-
4a.4.10	Security Staff Cost	-	-	-	-	-	-	1,146	172	1,318	1,318	-	-	-	-	-	-	-	-	-	73,886
4a.4.11	DOC Staff Cost	-	-	-	-	-	-	9,181	1,377	10,558	10,558	-	-	-	-	-	-	-	-	-	128,069
4a.4.12	Utility Staff Cost	-	-	-	-	-	-	24,318	3,648	27,966	27,966	-	-	-	-	-	-	-	-	-	384,206
4a.4	Subtotal Period 4a Period-Dependent Costs	41	2,393	28	10	-	152	39,787	6,237	48,649	48,193	131	325	-	2,688	-	-	-	53,864	660	586,160
4a.0	TOTAL PERIOD 4a COST	247	17,079	8,914	2,377	8,452	16,010	47,511	22,561	123,153	118,676	2,201	2,276	51,234	41,608	2,471	115	-	7,809,797	173,160	627,323
PERIOD 4b - Site Decontamination																					
Period 4b Direct Decommissioning Activities																					
4b.1.1	Remove spent fuel racks	188	21	39	5	324	63	-	169	810	810	-	-	2,275	250	-	-	-	136,146	650	-
Disposal of Plant Systems																					
4b.1.2.1	Chemical & Volume Control	-	379	12	6	177	516	-	253	1,344	1,344	-	-	1,244	1,166	-	-	-	163,400	10,241	-
4b.1.2.2	Component Cooling - RCA	-	410	13	21	1,898	-	-	392	2,733	2,733	-	-	13,321	-	-	-	-	666,034	11,050	-
4b.1.2.3	Concentrator Evaporator	-	156	6	3	95	260	-	119	639	639	-	-	663	569	-	-	-	84,156	4,179	-
4b.1.2.4	Condensate & Makeup Demin Building Sumps	-	2	-	-	-	-	-	0	2	-	-	2	-	-	-	-	-	-	47	-
4b.1.2.5	Dirty & Gaseous Waste	-	132	3	2	121	87	-	73	418	418	-	-	852	195	-	-	-	59,629	3,525	-
4b.1.2.6	Electrical	-	1,933	-	-	-	-	-	290	2,223	-	-	2,223	-	-	-	-	-	-	55,181	-
4b.1.2.7	Electrical - Contaminated	-	840	5	7	560	58	-	310	1,779	1,779	-	-	3,930	126	-	-	-	207,850	22,428	-
4b.1.2.8	Electrical - RCA	-	5,659	37	60	5,451	-	-	2,245	13,453	13,453	-	-	38,252	-	-	-	-	1,912,622	149,848	-
4b.1.2.9	Fire Protection	-	89	-	-	-	-	-	13	102	-	-	102	-	-	-	-	-	-	2,623	-
4b.1.2.10	Fire Protection - RCA	-	330	4	7	614	-	-	176	1,131	1,131	-	-	4,308	-	-	-	-	215,376	8,776	-
4b.1.2.11	Gas Analyzing	-	9	0	0	12	4	-	5	31	31	-	-	88	8	-	-	-	5,098	240	-
4b.1.2.12	Gaseous Effluent Monitoring	-	7	0	0	8	5	-	4	25	25	-	-	59	10	-	-	-	3,837	198	-
4b.1.2.13	HVAC Auxiliary Building Offices	-	12	-	-	-	-	-	2	14	-	-	14	-	-	-	-	-	-	358	-
4b.1.2.14	HVAC Condensate & Makeup Demin Bldg	-	35	-	-	-	-	-	5	40	-	-	40	-	-	-	-	-	-	1,098	-
4b.1.2.15	HVAC Containment	-	734	8	12	1,018	111	-	367	2,250	2,250	-	-	7,142	242	-	-	-	378,838	17,391	-
4b.1.2.16	HVAC Control Room	-	14	-	-	-	-	-	2	16	-	-	16	-	-	-	-	-	-	410	-
4b.1.2.17	HVAC Radwaste	-	116	1	2	157	17	-	57	350	350	-	-	1,104	36	-	-	-	58,437	2,774	-
4b.1.2.18	HVAC Radwaste & Miscellaneous Areas	-	97	1	1	125	13	-	46	283	283	-	-	874	29	-	-	-	46,286	2,263	-
4b.1.2.19	HVAC Switchgear & Cable Spreading Rooms	-	9	-	-	-	-	-	1	10	-	-	10	-	-	-	-	-	-	271	-
4b.1.2.20	HVAC Turbine & Miscellaneous Building	-	115	-	-	-	-	-	17	132	-	-	132	-	-	-	-	-	-	3,664	-
4b.1.2.21	HVAC VRS & Miscellaneous Areas	-	118	1	2	167	18	-	59	365	365	-	-	1,171	38	-	-	-	61,996	2,833	-
4b.1.2.22	Heating Steam For Volume Reduction - RCA	-	17	0	1	49	-	-	12	78	78	-	-	345	-	-	-	-	17,252	442	-
4b.1.2.23	Primary Coolant	-	19	0	0	7	3	-	7	36	36	-	-	47	8	-	-	-	3,043	519	-
4b.1.2.24	Primary\Makeup\Utility\Oil Waste - RCA	-	23	0	0	19	-	-	9	50	50	-	-	130	-	-	-	-	6,500	598	-
4b.1.2.25	Purge Air Treatment	-	6	-	-	-	-	-	1	7	-	-	7	-	-	-	-	-	-	168	-
4b.1.2.26	Radiation Monitoring	-	1	-	-	0	0	-	0	1	1	-	-	2	0	-	-	-	130	14	-

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Disposal of Plant Systems (continued)																					
4b.1.2.27	Radiation Monitoring & Sampling	-	60	1	1	56	44	-	35	197	197	-	-	395	96	-	-	-	28,376	1,587	-
4b.1.2.28	Radwaste Auxiliary	-	349	8	6	283	316	-	210	1,172	1,172	-	-	1,987	690	-	-	-	161,258	9,366	-
4b.1.2.29	Radwaste Evaporator (Clean)	-	207	6	3	83	209	-	117	624	624	-	-	579	489	-	-	-	69,874	5,624	-
4b.1.2.30	Radwaste Evaporator (Miscellaneous)	-	485	14	7	228	507	-	285	1,525	1,525	-	-	1,601	1,199	-	-	-	179,438	13,168	-
4b.1.2.31	Radwaste Solidification	-	165	5	3	105	206	-	109	594	594	-	-	733	474	-	-	-	77,138	4,463	-
4b.1.2.32	Radwaste Treatment (Clean)	-	931	29	16	636	1,056	-	597	3,266	3,266	-	-	4,466	2,587	-	-	-	430,303	25,130	-
4b.1.2.33	Raw & Filtered Water	-	70	-	-	-	-	-	11	81	-	-	81	-	-	-	-	-	-	2,092	-
4b.1.2.34	Resin Filter Media Addition	-	23	-	-	-	-	-	3	27	-	-	27	-	-	-	-	-	-	666	-
4b.1.2.35	Resin Handling	-	157	7	4	200	246	-	132	747	747	-	-	1,404	615	-	-	-	118,517	4,242	-
4b.1.2.36	Safety Inj/Cntnmnt Spray/Shtdn Coolng	-	1,195	36	33	2,067	1,184	-	913	5,428	5,428	-	-	14,504	2,643	-	-	-	957,423	32,353	-
4b.1.2.37	Service & Instrument Air - RCA	-	72	0	1	48	-	-	25	146	146	-	-	338	-	-	-	-	16,892	1,925	-
4b.1.2.38	Service Wtr/Screen Struct/Chlor - RCA	-	524	9	15	1,331	-	-	334	2,213	2,213	-	-	9,343	-	-	-	-	467,133	14,241	-
4b.1.2.39	Shield Cooling	-	119	3	1	46	97	-	61	327	327	-	-	325	213	-	-	-	35,251	3,197	-
4b.1.2.40	Spent Fuel Cooling	-	281	8	6	268	298	-	187	1,047	1,047	-	-	1,882	656	-	-	-	152,566	7,513	-
4b.1.2.41	Spent Resin & Radwaste Packaging	-	109	4	2	58	140	-	72	385	385	-	-	410	319	-	-	-	48,005	2,934	-
4b.1.2.42	Steam Generator Blowdown Modification	-	159	3	2	110	122	-	88	485	485	-	-	774	270	-	-	-	62,727	4,274	-
4b.1.2	Totals	-	16,168	225	224	15,999	5,517	-	7,646	45,778	43,124	-	2,654	112,272	12,676	-	-	-	6,695,384	433,915	-
4b.1.3	Scaffolding in support of decommissioning	-	548	6	1	94	12	-	155	815	815	-	-	658	45	-	-	-	36,972	16,497	-
Decontamination of Site Buildings																					
4b.1.4.1	Reactor	341	612	78	81	231	1,287	-	700	3,331	3,331	-	-	1,624	9,448	-	-	-	983,703	23,182	-
4b.1.4.2	Auxiliary	503	417	32	35	150	192	-	435	1,765	1,765	-	-	1,051	3,714	-	-	-	422,950	22,847	-
4b.1.4.3	Condensate Demineralizer	54	33	5	6	2	31	-	45	176	176	-	-	15	617	-	-	-	62,366	2,119	-
4b.1.4.4	Radwaste Storage East	25	7	1	1	5	3	-	16	56	56	-	-	32	61	-	-	-	7,561	820	-
4b.1.4.5	Radwaste Storage South	15	12	2	2	5	12	-	15	62	62	-	-	32	227	-	-	-	24,181	655	-
4b.1.4	Totals	937	1,082	118	124	392	1,525	-	1,210	5,389	5,389	-	-	2,754	14,066	-	-	-	1,500,763	49,623	-
4b.1	Subtotal Period 4b Activity Costs	1,126	17,819	386	355	16,809	7,117	-	9,179	52,792	50,138	-	2,654	117,959	27,038	-	-	-	8,369,264	500,685	-
Period 4b Additional Costs																					
4b.2.1	PCB Allowance	-	-	-	-	-	-	2,129	319	2,448	2,448	-	-	-	-	-	-	-	-	-	-
4b.2.2	Scrap Metal Removal	-	-	-	-	-	-	180	27	207	207	-	-	-	-	-	-	-	-	126	-
4b.2.3	Reactor Building Containment Decon	-	1,398	-	651	6,401	6,896	-	3,131	18,476	18,476	-	-	102,643	71,266	-	-	-	25,902,000	24,881	-
4b.2.4	Fixed Indirect Overhead	-	-	-	-	-	-	5,515	827	6,342	6,342	-	-	-	-	-	-	-	-	-	-
4b.2.5	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	405	-	405	-	405	-	-	-	-	-	-	-	-	-
4b.2.6	ISFSI - Operating Costs *	-	-	-	-	-	-	130	-	130	-	130	-	-	-	-	-	-	-	-	-
4b.2.7	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	2,291	-	2,291	-	2,291	-	-	-	-	-	-	-	-	45,045
4b.2.8	ISFSI - Site Security *	-	-	-	-	-	-	526	-	526	-	526	-	-	-	-	-	-	-	-	27,027
4b.2	Subtotal Period 4b Additional Costs	-	1,398	-	651	6,401	6,896	11,175	4,305	30,825	27,473	3,352	-	102,643	71,266	-	-	-	25,902,000	25,007	72,072
Period 4b Collateral Costs																					
4b.3.1	Process liquid waste	23	-	9	31	-	137	-	51	251	251	-	-	-	-	213	-	-	26,864	42	-
4b.3.2	Small tool allowance	-	264	-	-	-	-	-	40	304	304	-	-	-	-	-	-	-	-	-	-
4b.3.3	Spent Fuel Capital and Transfer	-	-	-	-	-	-	632	95	727	-	727	-	-	-	-	-	-	-	-	-
4b.3.4	Radwaste Processing Equipment/Services	-	-	-	-	-	-	780	117	897	897	-	-	-	-	-	-	-	-	-	-
4b.3	Subtotal Period 4b Collateral Costs	23	264	9	31	-	137	1,412	302	2,178	1,451	727	-	-	-	213	-	-	26,864	42	-
Period 4b Period-Dependent Costs																					
4b.4.1	Decon supplies	414	-	-	-	-	-	-	104	518	518	-	-	-	-	-	-	-	-	-	-
4b.4.2	Insurance	-	-	-	-	-	-	1,267	127	1,394	1,394	-	-	-	-	-	-	-	-	-	-
4b.4.3	Property taxes	-	-	-	-	-	-	5,414	541	5,956	5,956	-	-	-	-	-	-	-	-	-	-
4b.4.4	Health physics supplies	-	1,888	-	-	-	-	-	472	2,360	2,360	-	-	-	-	-	-	-	-	-	-
4b.4.5	Heavy equipment rental	-	3,100	-	-	-	-	-	465	3,565	3,565	-	-	-	-	-	-	-	-	-	-
4b.4.6	Disposal of DAW generated	-	-	81	29	-	431	-	120	661	661	-	-	-	7,647	-	-	-	153,244	1,878	-

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Period 4b Period-Dependent Costs (continued)																					
4b.4.7	Plant energy budget	-	-	-	-	-	-	1,177	177	1,353	1,353	-	-	-	-	-	-	-	-	-	-
4b.4.8	NRC Fees	-	-	-	-	-	-	961	96	1,057	1,057	-	-	-	-	-	-	-	-	-	-
4b.4.9	Emergency Planning Fees	-	-	-	-	-	-	219	22	241	-	241	-	-	-	-	-	-	-	-	-
4b.4.10	Security Staff Cost	-	-	-	-	-	-	2,103	316	2,419	2,419	-	-	-	-	-	-	-	-	-	135,600
4b.4.11	DOC Staff Cost	-	-	-	-	-	-	16,503	2,475	18,978	18,978	-	-	-	-	-	-	-	-	-	230,520
4b.4.12	Utility Staff Cost	-	-	-	-	-	-	38,409	5,761	44,170	44,170	-	-	-	-	-	-	-	-	-	614,720
4b.4	Subtotal Period 4b Period-Dependent Costs	414	4,988	81	29	-	431	66,052	10,676	82,672	82,431	241	-	-	7,647	-	-	-	153,244	1,878	980,840
4b.0	TOTAL PERIOD 4b COST	1,563	24,469	476	1,065	23,210	14,581	78,639	24,462	168,466	161,492	4,319	2,654	220,602	105,951	213	-	-	34,451,370	527,612	1,052,912
PERIOD 4e - License Termination																					
Period 4e Direct Decommissioning Activities																					
4e.1.1	ORISE confirmatory survey	-	-	-	-	-	-	120	36	156	156	-	-	-	-	-	-	-	-	-	-
4e.1.2	Terminate license									a											
4e.1	Subtotal Period 4e Activity Costs	-	-	-	-	-	-	120	36	156	156	-	-	-	-	-	-	-	-	-	-
Period 4e Additional Costs																					
4e.2.1	License Termination Survey	-	-	-	-	-	-	4,141	1,242	5,384	5,384	-	-	-	-	-	-	-	-	95,943	-
4e.2.2	Fixed Indirect Overhead	-	-	-	-	-	-	471	71	541	541	-	-	-	-	-	-	-	-	-	-
4e.2.3	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	138	-	138	-	138	-	-	-	-	-	-	-	-	-
4e.2.4	ISFSI - Operating Costs *	-	-	-	-	-	-	44	-	44	-	44	-	-	-	-	-	-	-	-	-
4e.2.5	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	782	-	782	-	782	-	-	-	-	-	-	-	-	15,376
4e.2.6	ISFSI - Site Security *	-	-	-	-	-	-	179	-	179	-	179	-	-	-	-	-	-	-	-	9,225
4e.2	Subtotal Period 4e Additional Costs	-	-	-	-	-	-	5,756	1,313	7,069	5,925	1,144	-	-	-	-	-	-	-	95,943	24,601
Period 4e Collateral Costs																					
4e.3.1	DOC staff relocation expenses	-	-	-	-	-	-	954	143	1,097	1,097	-	-	-	-	-	-	-	-	-	-
4e.3.2	Spent Fuel Capital and Transfer	-	-	-	-	-	-	421	63	485	-	485	-	-	-	-	-	-	-	-	-
4e.3	Subtotal Period 4e Collateral Costs	-	-	-	-	-	-	1,376	206	1,582	1,097	485	-	-	-	-	-	-	-	-	-
Period 4e Period-Dependent Costs																					
4e.4.1	Insurance	-	-	-	-	-	-	432	43	476	476	-	-	-	-	-	-	-	-	-	-
4e.4.2	Property taxes	-	-	-	-	-	-	1,848	185	2,033	2,033	-	-	-	-	-	-	-	-	-	-
4e.4.3	Health physics supplies	-	414	-	-	-	-	-	103	517	517	-	-	-	-	-	-	-	-	-	-
4e.4.4	Disposal of DAW generated	-	-	3	1	-	17	-	5	26	26	-	-	-	299	-	-	-	5,994	73	-
4e.4.5	Plant energy budget	-	-	-	-	-	-	143	22	165	165	-	-	-	-	-	-	-	-	-	-
4e.4.6	NRC Fees	-	-	-	-	-	-	328	33	361	361	-	-	-	-	-	-	-	-	-	-
4e.4.7	Emergency Planning Fees	-	-	-	-	-	-	75	7	82	-	82	-	-	-	-	-	-	-	-	-
4e.4.8	Security Staff Cost	-	-	-	-	-	-	90	13	103	103	-	-	-	-	-	-	-	-	-	13,886
4e.4.9	DOC Staff Cost	-	-	-	-	-	-	4,101	615	4,716	4,716	-	-	-	-	-	-	-	-	-	57,086
4e.4.10	Utility Staff Cost	-	-	-	-	-	-	3,508	526	4,034	4,034	-	-	-	-	-	-	-	-	-	52,457
4e.4	Subtotal Period 4e Period-Dependent Costs	-	414	3	1	-	17	10,525	1,553	12,513	12,431	82	-	-	299	-	-	-	5,994	73	123,429
4e.0	TOTAL PERIOD 4e COST	-	414	3	1	-	17	17,777	3,108	21,320	19,609	1,711	-	-	299	-	-	-	5,994	96,016	148,030
PERIOD 4 TOTALS		1,810	41,962	9,394	3,443	31,662	30,609	143,928	50,131	312,938	299,777	8,232	4,929	271,836	147,858	2,684	115	-	42,267,160	796,788	1,828,265
PERIOD 5b - Site Restoration																					
Period 5b Direct Decommissioning Activities																					
Demolition of Remaining Site Buildings																					
5b.1.1.1	Reactor	-	6,456	-	-	-	-	-	968	7,424	1,114	-	6,310	-	-	-	-	-	-	124,330	-
5b.1.1.2	Auxiliary	-	2,033	-	-	-	-	-	305	2,338	234	-	2,105	-	-	-	-	-	-	37,077	-

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Class B Cu. Feet	Class C Cu. Feet	GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
Demolition of Remaining Site Buildings (continued)																					
5b.1.1.3	Condensate Demineralizer	-	334	-	-	-	-	-	50	384	-	-	384	-	-	-	-	-	-	7,175	-
5b.1.1.4	Cooling Tower Pumphouse	-	345	-	-	-	-	-	52	396	-	-	396	-	-	-	-	-	-	5,679	-
5b.1.1.5	Cooling Towers (1 & 2)	-	1,639	-	-	-	-	-	246	1,885	-	-	1,885	-	-	-	-	-	-	33,346	-
5b.1.1.6	Discharge Structures & Basins	-	145	-	-	-	-	-	22	166	-	-	166	-	-	-	-	-	-	2,774	-
5b.1.1.7	Intake	-	721	-	-	-	-	-	108	829	-	-	829	-	-	-	-	-	-	5,935	-
5b.1.1.8	Miscellaneous Site Foundations	-	155	-	-	-	-	-	23	178	-	-	178	-	-	-	-	-	-	2,966	-
5b.1.1.9	Miscellaneous Site Structures	-	671	-	-	-	-	-	101	772	-	-	772	-	-	-	-	-	-	16,085	-
5b.1.1.10	Paving,Rail & Fencing	-	362	-	-	-	-	-	54	417	-	-	417	-	-	-	-	-	-	5,370	-
5b.1.1.11	Radwaste Storage East	-	94	-	-	-	-	-	14	108	-	-	108	-	-	-	-	-	-	2,153	-
5b.1.1.12	Radwaste Storage South	-	87	-	-	-	-	-	13	100	-	-	100	-	-	-	-	-	-	1,993	-
5b.1.1.13	Service Building and Addition	-	519	-	-	-	-	-	78	597	-	-	597	-	-	-	-	-	-	11,606	-
5b.1.1.14	Steam Generator Mausoleum	-	88	-	-	-	-	-	13	101	-	-	101	-	-	-	-	-	-	1,975	-
5b.1.1.15	Support	-	166	-	-	-	-	-	25	191	-	-	191	-	-	-	-	-	-	3,754	-
5b.1.1.16	Turbine	-	2,341	-	-	-	-	-	351	2,692	-	-	2,692	-	-	-	-	-	-	55,511	-
5b.1.1.17	Turbine Pedestal	-	2,688	-	-	-	-	-	403	3,091	-	-	3,091	-	-	-	-	-	-	52,613	-
5b.1.1.18	Water Treatment	-	13	-	-	-	-	-	2	15	-	-	15	-	-	-	-	-	-	261	-
5b.1.1.19	Yard Piping	-	163	-	-	-	-	-	24	187	-	-	187	-	-	-	-	-	-	3,867	-
5b.1.1	Totals	-	19,020	-	-	-	-	-	2,853	21,873	1,347	-	20,526	-	-	-	-	-	-	374,469	-
Site Closeout Activities																					
5b.1.2	Grade & landscape site	-	63	-	-	-	-	-	9	72	-	-	72	-	-	-	-	-	-	353	-
5b.1.3	Final report to NRC	-	-	-	-	-	-	120	18	138	138	-	-	-	-	-	-	-	-	-	1,560
5b.1	Subtotal Period 5b Activity Costs	-	19,083	-	-	-	-	120	2,880	22,083	1,485	-	20,597	-	-	-	-	-	-	374,822	1,560
Period 5b Additional Costs																					
5b.2.1	Separation Program	-	-	-	-	-	-	1,071	107	1,178	-	-	1,178	-	-	-	-	-	-	-	-
5b.2.2	Scrap Metal Removal	-	-	-	-	-	-	1,802	270	2,072	-	-	2,072	-	-	-	-	-	-	1,261	-
5b.2.3	Clean Concrete Disposal/Backfill	-	977	-	-	-	-	15,941	2,538	19,456	-	-	19,456	-	-	-	-	-	-	20,065	-
5b.2.4	Fixed Indirect Overhead	-	-	-	-	-	-	1,037	156	1,193	1,193	-	-	-	-	-	-	-	-	-	-
5b.2.5	ISFSI - Licensing Fees *	-	-	-	-	-	-	520	-	520	-	520	-	-	-	-	-	-	-	-	-
5b.2.6	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	305	-	305	-	305	-	-	-	-	-	-	-	-	-
5b.2.7	ISFSI - Operating Costs *	-	-	-	-	-	-	98	-	98	-	98	-	-	-	-	-	-	-	-	-
5b.2.8	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	1,723	-	1,723	-	1,723	-	-	-	-	-	-	-	-	33,884
5b.2.9	ISFSI - Site Security *	-	-	-	-	-	-	396	-	396	-	396	-	-	-	-	-	-	-	-	20,330
5b.2	Subtotal Period 5b Additional Costs	-	977	-	-	-	-	22,892	3,071	26,940	1,193	3,041	22,706	-	-	-	-	-	-	21,326	54,214
Period 5b Collateral Costs																					
5b.3.1	Small tool allowance	-	194	-	-	-	-	-	29	223	-	-	223	-	-	-	-	-	-	-	-
5b.3.2	Spent Fuel Capital and Transfer	-	-	-	-	-	-	421	63	485	-	485	-	-	-	-	-	-	-	-	-
5b.3	Subtotal Period 5b Collateral Costs	-	194	-	-	-	-	421	92	708	-	485	223	-	-	-	-	-	-	-	-
Period 5b Period-Dependent Costs																					
5b.4.1	Insurance	-	-	-	-	-	-	953	95	1,048	-	-	1,048	-	-	-	-	-	-	-	-
5b.4.2	Property taxes	-	-	-	-	-	-	4,073	407	4,480	-	-	4,480	-	-	-	-	-	-	-	-
5b.4.3	Heavy equipment rental	-	3,185	-	-	-	-	-	478	3,663	-	-	3,663	-	-	-	-	-	-	-	-
5b.4.4	Plant energy budget	-	-	-	-	-	-	158	24	182	-	-	182	-	-	-	-	-	-	-	-
5b.4.5	Emergency Planning Fees	-	-	-	-	-	-	165	16	181	-	181	-	-	-	-	-	-	-	-	-
5b.4.6	Security Staff Cost	-	-	-	-	-	-	198	30	227	-	-	227	-	-	-	-	-	-	-	30,600
5b.4.7	DOC Staff Cost	-	-	-	-	-	-	9,037	1,356	10,392	-	-	10,392	-	-	-	-	-	-	-	125,800
5b.4.8	Utility Staff Cost	-	-	-	-	-	-	7,730	1,160	8,890	-	-	8,890	-	-	-	-	-	-	-	115,600
5b.4	Subtotal Period 5b Period-Dependent Costs	-	3,185	-	-	-	-	22,313	3,565	29,063	-	181	28,882	-	-	-	-	-	-	-	272,000
5b.0	TOTAL PERIOD 5b COST	-	23,439	-	-	-	-	45,747	9,609	78,794	2,678	3,707	72,409	-	-	-	-	-	-	396,148	327,774

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 5c - Fuel Storage Operations/Shipping																					
Period 5c Direct Decommissioning Activities																					
Period 5c Additional Costs																					
5c.2.1	Other Cost Reserve	-	-	-	-	-	-	-	46,000	46,000	-	46,000	-	-	-	-	-	-	-	-	-
5c.2.2	ISFSI - Licensing Fees *	-	-	-	-	-	-	5,275	-	5,275	-	5,275	-	-	-	-	-	-	-	-	-
5c.2.3	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	3,096	-	3,096	-	3,096	-	-	-	-	-	-	-	-	-
5c.2.4	ISFSI - Operating Costs *	-	-	-	-	-	-	992	-	992	-	992	-	-	-	-	-	-	-	-	-
5c.2.5	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	17,490	-	17,490	-	17,490	-	-	-	-	-	-	-	-	343,962
5c.2.6	ISFSI - Site Security *	-	-	-	-	-	-	6,023	-	6,023	-	6,023	-	-	-	-	-	-	-	-	309,566
5c.2	Subtotal Period 5c Additional Costs	-	-	-	-	-	-	32,877	46,000	78,877	-	78,877	-	-	-	-	-	-	-	-	653,528
Period 5c Collateral Costs																					
5c.3.1	Spent Fuel Capital and Transfer	-	-	-	-	-	-	6,532	980	7,512	-	7,512	-	-	-	-	-	-	-	-	-
5c.3	Subtotal Period 5c Collateral Costs	-	-	-	-	-	-	6,532	980	7,512	-	7,512	-	-	-	-	-	-	-	-	-
Period 5c Period-Dependent Costs																					
5c.4.1	Insurance	-	-	-	-	-	-	5,457	546	6,003	-	6,003	-	-	-	-	-	-	-	-	-
5c.4.2	Property taxes	-	-	-	-	-	-	4,134	413	4,548	-	4,548	-	-	-	-	-	-	-	-	-
5c.4.3	Plant energy budget	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5c.4.4	Emergency Planning Fees	-	-	-	-	-	-	1,670	167	1,837	-	1,837	-	-	-	-	-	-	-	-	-
5c.4.5	Utility Staff Cost	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5c.4	Subtotal Period 5c Period-Dependent Costs	-	-	-	-	-	-	11,261	1,126	12,388	-	12,388	-	-	-	-	-	-	-	-	-
5c.0	TOTAL PERIOD 5c COST	-	-	-	-	-	-	50,671	48,106	98,777	-	98,777	-	-	-	-	-	-	-	-	653,528
PERIOD 5d - GTCC shipping																					
Period 5d Direct Decommissioning Activities																					
Nuclear Steam Supply System Removal																					
5d.1.1.1	Vessel & Internals GTCC Disposal	-	-	637	-	-	13,766	-	2,129	16,531	16,531	-	-	-	-	-	-	495	85,300	-	-
5d.1.1	Totals	-	-	637	-	-	13,766	-	2,129	16,531	16,531	-	-	-	-	-	-	495	85,300	-	-
5d.1	Subtotal Period 5d Activity Costs	-	-	637	-	-	13,766	-	2,129	16,531	16,531	-	-	-	-	-	-	495	85,300	-	-
Period 5d Additional Costs																					
5d.2.1	ISFSI - Licensing Fees *	-	-	-	-	-	-	12	-	12	-	12	-	-	-	-	-	-	-	-	-
5d.2.2	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	7	-	7	-	7	-	-	-	-	-	-	-	-	-
5d.2.3	ISFSI - Operating Costs *	-	-	-	-	-	-	2	-	2	-	2	-	-	-	-	-	-	-	-	-
5d.2.4	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	41	-	41	-	41	-	-	-	-	-	-	-	-	797
5d.2.5	ISFSI - Site Security *	-	-	-	-	-	-	14	-	14	-	14	-	-	-	-	-	-	-	-	718
5d.2	Subtotal Period 5d Additional Costs	-	-	-	-	-	-	76	-	76	-	76	-	-	-	-	-	-	-	-	1,515
Period 5d Period-Dependent Costs																					
5d.4.1	Insurance	-	-	-	-	-	-	13	1	14	-	14	-	-	-	-	-	-	-	-	-
5d.4.2	Property taxes	-	-	-	-	-	-	10	1	11	-	11	-	-	-	-	-	-	-	-	-
5d.4.3	Plant energy budget	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5d.4.4	Emergency Planning Fees	-	-	-	-	-	-	4	0	4	-	4	-	-	-	-	-	-	-	-	-
5d.4.5	Utility Staff Cost	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5d.4	Subtotal Period 5d Period-Dependent Costs	-	-	-	-	-	-	26	3	29	-	29	-	-	-	-	-	-	-	-	-
5d.0	TOTAL PERIOD 5d COST	-	-	637	-	-	13,766	102	2,131	16,636	16,531	105	-	-	-	-	-	495	85,300	-	1,515

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

Activity Index	Activity Description	Decon Cost	Removal Cost	Packaging Costs	Transport Costs	Off-Site Processing Costs	LLRW Disposal Costs	Other Costs	Total Contingency	Total Costs	NRC Lic. Term. Costs	Spent Fuel Management Costs	Site Restoration Costs	Processed Volume Cu. Feet	Burial Volumes Class A Cu. Feet	Burial Volumes Class B Cu. Feet	Burial Volumes Class C Cu. Feet	Burial Volumes GTCC Cu. Feet	Burial / Processed Wt., Lbs.	Craft Manhours	Utility and Contractor Manhours
PERIOD 5e - ISFSI Decontamination																					
Period 5e Direct Decommissioning Activities																					
Period 5e Additional Costs																					
5e.2.1	ISFSI License Termination	-	424	24	86	-	2,090	1,274	835	4,732	-	4,732	-	-	10,401	-	-	-	992,786	8,135	2,560
5e.2.2	ISFSI - Licensing Fees *	-	-	-	-	-	-	106	-	106	-	106	-	-	-	-	-	-	-	-	-
5e.2.3	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	62	-	62	-	62	-	-	-	-	-	-	-	-	-
5e.2.4	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	350	-	350	-	350	-	-	-	-	-	-	-	-	6,891
5e.2.5	ISFSI - Site Security *	-	-	-	-	-	-	121	-	121	-	121	-	-	-	-	-	-	-	-	6,202
5e.2.6	Fixed Indirect Overhead	-	-	-	-	-	-	118	18	136	-	136	-	-	-	-	-	-	-	-	-
5e.2	Subtotal Period 5e Additional Costs	-	424	24	86	-	2,090	2,031	852	5,507	-	5,507	-	-	10,401	-	-	-	992,786	8,135	15,653
Period 5e Collateral Costs																					
5e.3.1	Small tool allowance	-	3	-	-	-	-	-	0	4	-	4	-	-	-	-	-	-	-	-	-
5e.3	Subtotal Period 5e Collateral Costs	-	3	-	-	-	-	-	0	4	-	4	-	-	-	-	-	-	-	-	-
Period 5e Period-Dependent Costs																					
5e.4.1	Insurance	-	-	-	-	-	-	130	13	143	-	143	-	-	-	-	-	-	-	-	-
5e.4.2	Property taxes	-	-	-	-	-	-	83	8	91	-	91	-	-	-	-	-	-	-	-	-
5e.4.3	Heavy equipment rental	-	190	-	-	-	-	-	29	219	-	219	-	-	-	-	-	-	-	-	-
5e.4.4	Plant energy budget	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5e.4.5	Utility Staff Cost	-	-	-	-	-	-	824	124	947	-	947	-	-	-	-	-	-	-	-	13,137
5e.4	Subtotal Period 5e Period-Dependent Costs	-	190	-	-	-	-	1,037	173	1,400	-	1,400	-	-	-	-	-	-	-	-	13,137
5e.0	TOTAL PERIOD 5e COST	-	618	24	86	-	2,090	3,067	1,026	6,911	-	6,911	-	-	10,401	-	-	-	992,786	8,135	28,790
PERIOD 5f - ISFSI Site Restoration																					
Period 5f Direct Decommissioning Activities																					
Period 5f Additional Costs																					
5f.2.1	ISFSI Demolition & Site Restoration	-	486	-	-	-	-	36	78	600	-	600	-	-	-	-	-	-	-	2,762	160
5f.2.2	ISFSI - Fixed Indirect Overhead *	-	-	-	-	-	-	31	-	31	-	31	-	-	-	-	-	-	-	-	-
5f.2.3	ISFSI - Utility Operating Staff *	-	-	-	-	-	-	177	-	177	-	177	-	-	-	-	-	-	-	-	3,474
5f.2.4	ISFSI - Site Security *	-	-	-	-	-	-	61	-	61	-	61	-	-	-	-	-	-	-	-	3,126
5f.2.5	Fixed Indirect Overhead	-	-	-	-	-	-	29	4	33	-	33	-	-	-	-	-	-	-	-	-
5f.2	Subtotal Period 5f Additional Costs	-	486	-	-	-	-	334	83	902	-	902	-	-	-	-	-	-	-	2,762	6,760
Period 5f Collateral Costs																					
5f.3.1	Small tool allowance	-	1	-	-	-	-	-	0	2	-	2	-	-	-	-	-	-	-	-	-
5f.3	Subtotal Period 5f Collateral Costs	-	1	-	-	-	-	-	0	2	-	2	-	-	-	-	-	-	-	-	-
Period 5f Period-Dependent Costs																					
5f.4.1	Insurance	-	-	-	-	-	-	66	7	72	-	72	-	-	-	-	-	-	-	-	-
5f.4.2	Property taxes	-	-	-	-	-	-	42	4	46	-	46	-	-	-	-	-	-	-	-	-
5f.4.3	Heavy equipment rental	-	64	-	-	-	-	-	10	73	-	73	-	-	-	-	-	-	-	-	-
5f.4.4	Plant energy budget	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5f.4.5	Utility Staff Cost	-	-	-	-	-	-	179	27	206	-	206	-	-	-	-	-	-	-	-	3,224
5f.4	Subtotal Period 5f Period-Dependent Costs	-	64	-	-	-	-	287	47	398	-	398	-	-	-	-	-	-	-	-	3,224
5f.0	TOTAL PERIOD 5f COST	-	551	-	-	-	-	620	130	1,302	-	1,302	-	-	-	-	-	-	-	2,762	9,984
PERIOD 5 TOTALS		-	24,607	661	86	-	15,855	100,207	61,002	202,419	19,209	110,801	72,409	-	10,401	-	-	495	1,078,086	407,045	1,021,591
TOTAL COST TO DECOMMISSION		7,474	78,671	10,627	3,795	37,023	48,866	611,342	162,527	960,325	584,064	297,948	78,313	325,836	164,769	3,767	115	495	44,152,240	1,482,962	6,411,104

Table C
Palisades Nuclear Plant
SAFSTOR Decommissioning Cost Estimate
(Thousands of 2003 Dollars)

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

TOTAL COST TO DECOMMISSION WITH 20.37% CONTINGENCY:	960,325	thousands of 2003 dollars
TOTAL NRC LICENSE TERMINATION COST IS 60.82% OR	584,064	thousands of 2003 dollars
SPENT FUEL MANAGEMENT COST IS 31.03% OR:	297,948	thousands of 2003 dollars
NON-NUCLEAR DEMOLITION COST IS 8.15% OR:	78,313	thousands of 2003 dollars
TOTAL PRIMARY SITE RADWASTE VOLUME BURIED:	55,448	cubic feet
TOTAL SECONDARY SITE RADWASTE VOLUME BURIED:	113,203	cubic feet
TOTAL GREATER THAN CLASS C RADWASTE VOLUME GENERATED	495	cubic feet
TOTAL SCRAP METAL REMOVED:	34,249	tons
TOTAL CRAFT LABOR REQUIREMENTS:	1,482,962	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
* indicates Preliminary Incremental SNF Cost at a total cost of $92,311 (thousands)